RiHEI



Responsible and Impactful Universities as Sustainable Growth and Enterprise Catalysts in Georgia

Innovation commercialization and regional impact via RRI and young citizen science

Toolkit 2

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Introduction

The toolkit is a comprehensive guide supporting commercialization processes in higher education institutions (HEIs). Commercializing scientific research is presented as a process that may lead to Responsible Research and Innovation (RRI) and Impact Investing and engage young scientists. The booklet consists of five main chapters enabling a deeper understanding of commercialization processes in HEIs.

The toolkit aims to provide knowledge, strategies and guidance to HEIs to trigger university-industry collaboration in key areas such as:

- Innovation process characteristics;
- The complexity of commercialization processes in HEIs;
- University commercialization strategies;
- Academic entrepreneurship and start-up foundation;
- Legal aspects of commercialization in HEIs;
- Funding of innovation with special attention to impact investing;
- RRI concept, its complexity and potential for regional growth;
- Young scientists' engagement.

The first unit defines innovation and it types. It aims at understanding the scope of innovation and its difference from typical business processes. As it is introductory unit, it gives a glance at commercialization processes in HEIs, presenting the idea of securing Intellectual Protection (IP) rights. In this chapter one can be familiarized with the model of commercialization process , a step-by-step procedure of setting up collaborative innovation projects and last but not least – commercialization strategies in HEIs.

The second unit focuses on academic entrepreneurship. At first, it defines entrepreneurship and then presents various ways academic entrepreneurship can be executed. The institutional anvironment as well as factors and mechanisms accompanying academic entrepreneurship are discussed. Academic spin-offs with examples are explored. The unit presents the measures which can be taken into consideration when trying to evaluate university in this field.

The third unit addresses legal aspects of knowledge commercialization. The importance of the matter of intellectual property created within HEIs is presented here. This unit discusses all main aspects of this important field – patenting, licensing, non-disclosure agreements as well as trade secrets.

The fourth unit concentrates on funding commercialization processes. At first, the stages of the innovative project are presented with corresponding features and fundind demand. This unit presents dept and equity funding, business angels and Venture Capital funds.

The importance of finding a proper investor is discussed here. Finally, impact investing is presented as an important aspect of generating a publicly valuable impact on the environment by HEIs.

The last unit presents the concept of Responsible Research and Innovation (RRI) and young citizen science. RRi is presented in terms of its policy keys and actors, principles and process requirements and also outcomes. The approaches to RRI key performance indicators are discussed. This unit presents also how to embed RRI in HEI strategies and how HEIs can self-evaluate in this field. This unit provides also some insight into the idea of engaging youth into research processes.

By attending the course, participants will:

- learn about the fundamentals of innovation and innovation processes in higher educational institutions;
- gain the ability to find the proper strategy for commercializing a research project;
- understand the idea and scope of academic entrepreneurship;
- learn about the characteristics of start-ups and spin-offs in the university environment;
- acquire competence in designing a dedicated intellectual property protection for a project;
- gain competence in finding an investor;
- understand the idea of impact investing;
- acquire knowledge in the field of Responsible Research and Innovation (RRI);
- gain competence in how to implement the RRI concept in a university.

Unit 1. Introduction to innovation management and commercialization in HEI

1.1. Innovation– definition(s)

The notion of innovation was introduced to economic sciences by J.A. Schumpeter[1] at the beginning of the previous century. According to this author, one should understand innovation as:Innovation is: [Schumpeter, 1994]

- The introduction of a new good - that is one with which consumers have yet to become familiar- or of a new quality of a good.
- The introduction of a new method of production.
- The opening of a new market, that is a market into which the particular branch of manufacture of the country in question has yet to enter, whether or not this market has existed before.
- The conquest of a new source of raw materials or half-manufactured goods.
- The carrying out of the new organization of any industry.

A broad understanding of innovation is also presented in the Oslo Manual. It is a document published by the Organisation for Economic Co-operation and Development (OECD) that describes guidelines for collecting, reporting and using data on innovation and is considered as an internationally recognised standard of innovation activities definition and classification.

According to Olso Manual „An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)."

Oslo Manual defines also innovation activities, and it specifies that they „include all developmental, financial and commercial activities undertaken by a firm that are intended to result in an innovation for the firm".

1.2. Types of innovation

Oslo Manual presents also types of innovation. According to the Manual, innovations by object are:

[1] Joseph Schumpeter was one of the most influential economists of the 20th century. Schumpeter identified innovation as the critical dimension of economic change

- product innovation is a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market.
- business innovation – a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm.

For a better understanding what business innovation can be, it is worthy to know what a business process is.

FIGURE 1 TYPES OF BUSINESS PROCESSESS

	Type	Details
1	Production of goods or services	Activities that transform inputs into goods or services, including engineering and related technical testing, analysis and certification activities to support production.
2	Distribution and logistics	This function includes: a) transportation and service delivery b) warehousing c) order processing.
3	Marketing and sales	This function includes. a) marketing methods including advertising (product promotion and placement, packaging of products), direct marketing (telemarketing), exhibitions and fairs, market research and other activities to develop new markets b) pricing strategies and methods c) sales and after-sales activities, including help desks other customer support and customer relationship activities.
4	Information and communication systems	The maintenance and provision of information and communication systems, including: a) hardware and software b) data processing and database c) maintenance and repair d) web-hosting and other computer-related information activities. These functions can be provided in a separate division or in divisions responsible for other functions.
5	Administration and management	a) strategic and general business management (cross-functional decision-making), including organising work responsibilities b) corporate governance (legal, planning and public relations) c) accounting, bookkeeping, auditing, payments and other financial or insurance activities

		d) human resources management (training and education, staff recruitment, workplace organisation, provision of temporary personnel, payroll management, health and medical support) e) procurement 6. Product and business process development f) managing external relationships with suppliers, alliances, etc.
6	Product and business development	Activities to scope, identify, develop, or adapt products or a firm's business processes. This function can be undertaken in a systematic fashion or on an ad hoc basis, and be conducted within the firm or obtained from external sources Responsibility for these activities can lie within a separate division or in divisions responsible for other functions, e.g. production of goods or services.

SOURCE: OECD/EUROSTAT (2018), OSLO MANUAL 2018: GUIDELINES FOR COLLECTING, REPORTING AND USING DATA ON INNOVATION, 4TH EDITION, THE MEASUREMENT OF SCIENTIFIC, TECHNOLOGICAL AND INNOVATION ACTIVITIES, OECD PUBLISHING, PARIS, HTTPS://DOI.ORG/10.1787/9789264304604-EN.

There are many classifications of innovation. One of them incorporates the criterion of novelty or scale in which the changes are implemented. This classification includes:

- Breakthrough innovations (radical);
- Substantial innovations (semi-radical);
- Incremental innovations (small improvements).

Breakthrough innovations, also defined as radical or pioneer, are those that do not have a prototype. For example, the construction of the car or invention of electricity were breakthrough innovations. At present, a breakthrough innovation could be the implementation of a product based on new technologies; however, it could also be related to changes in processes or management methods. An example of a radical organisational innovation could be the concept of just-in-time as a solution for stock reduction or the use of reengineering as a concept of processes improvement.

Substantial innovations, also called semi-radical, are those which lead to considerable improvements but are not the result of essentially new technologies or approaches.

Incremental innovations, also defined as small improvements can be understood as having small effects, but being the result of continuous improvement. Progress in this case consists of significant improvements of products, shortening customer service time or cost reduction (the introduction of a new colour of an article or the simplification of a product delivery process are examples of incremental innovations). This kind of innovation is very close to the idea of continuous improvement originating from quality management standards – continuous, small improvements of products and the management system contribute to achieving a long-term benefits (e.g. competitive advantage).

While it is comparatively easy to decide what a breakthrough or incremental innovation is, the category of substantial innovations is quite difficult to define. This classification criterion

will often be subjective and dependent on the range of implemented changes from the individual point of view. An improvement in customer service processes that could be insignificant for a large firm operating in the global market may be at the same time a substantial or even a breakthrough innovation for a small company operating in the local market.

Disruptive technology is a technological innovation, product, or service that eventually overturns the existing dominant technology or product in the market. Disruptive innovations introduce a new value proposition and can be divided into:

- Low-end disruption: initially attracts low-end customers, moves into more upscale markets over time as the technology improves;
    - Example: 3D-Printed Real Estate
- New-market disruption: occur when existing products limit the number of potential consumers.
    - Examples: personal computers, smartphones

FIGURE 2 INNOVATION – LEVEL OF NOVELTY



SOURCE: OWN DEVELOPMENT

Changes that are not innovations:

- Routine changes or updates,
- Simple capital replacement or extension,
- Minor aesthetic changes,
- Custom production,
- Advertised concept, prototype or model of a product that does not yet exist,
- Outputs of creative and professional service firms,

- Extension of the range of products handled or offered to customers,
- Mergers or the acquisition of other firms,
- Ceasing to use a business process, ceasing to outsource a business process, or withdrawing a product from the market,
- A change due to externally determined factor prices,
- A formulation of a new corporate or managerial strategy.

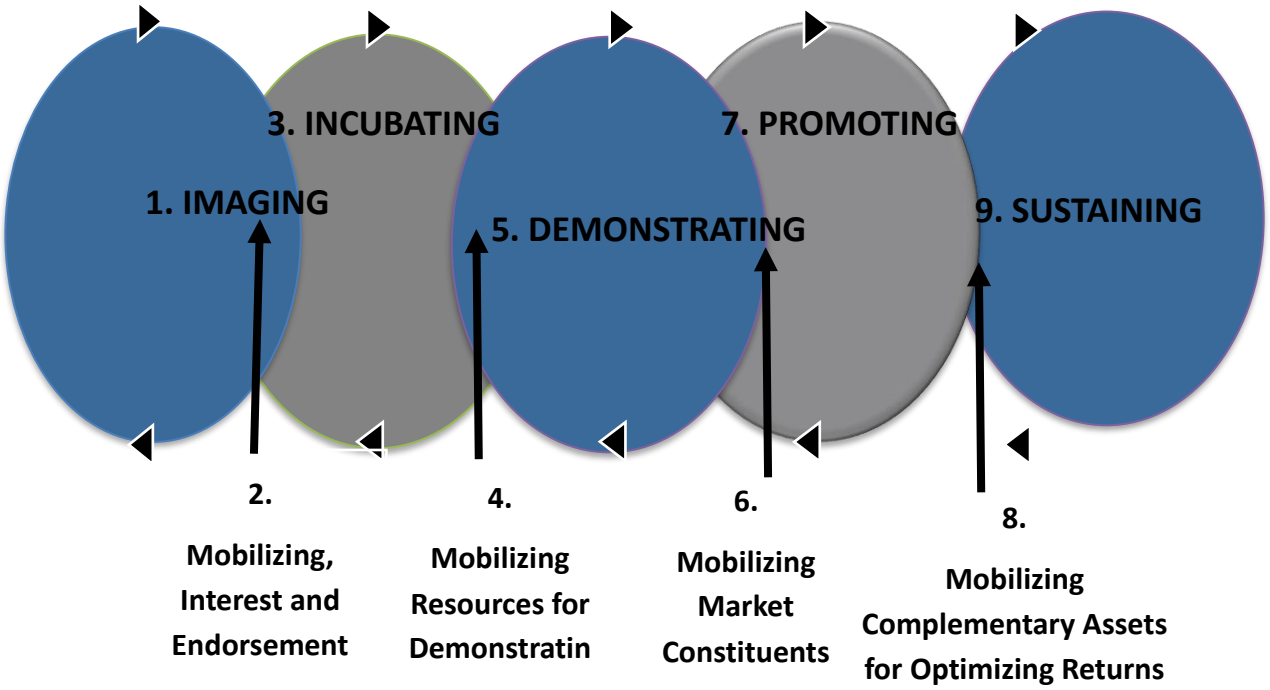
1.3. Commercialization of knowledge on HEIs

IP commercialization is the process of creating economic value by converting knowledge, discoveries and inventions into new or significantly improved products and services. The intellectual property commercialization approach may vary across universities or research institutions, yet typically follows these steps: [WIPO.int]

1. Presenting the invention or discovery to Technology Transfer Offices (TTOs), often through invention disclosure forms.
2. Conducting an evaluation to determine the technical merit, IP status, and market potential of the invention – serving as the basis for deciding on its protection and commercialization viability.
3. Securing protection through intellectual property rights or other suitable means.
4. Developing a business case and commercial plan.
5. Implementing IP marketing strategies.
6. Engaging in licensing agreements, commonly the primary method for technology transfer.
7. Creating a product development roadmap.
8. Facilitating market outreach and commercialization efforts.

Source: WIPO.inc

FIGURE 3 JOLLY MODEL OF COMMERCIALIZATION PROCESS



SOURCE: JOLLY MODEL FOR COMMERCIALIZING TECHNOLOGY [JOLLY 1997]

As per Jolly, venturing new technological innovations into the commercial market can be complex due to various challenges. There are specific steps that can often face setbacks in this process, such as connecting a technological breakthrough with a viable market opportunity, securing early endorsement for the technology, adequately nurturing the technology to uncover its full capabilities, allocating resources for testing and verification, showcasing the technology in the intended environment, rallying market stakeholders to achieve market acceptance, marketing the end products effectively, selecting the right business model, and ensuring ongoing commercial success to extract value from the technology through effective life cycle management.

By following a structured approach, universities and regional industries can establish robust collaborations that foster innovation, drive economic development, and create sustainable partnerships. These projects can ultimately lead to significant advancements in research, technology transfer, and workforce development in the local economy. A proposed step-by-step guide for setting up collaborative innovation projects between universities and regional industry:

Step 1: Identify Objectives

- Define Goals: Establish what you want to achieve through the collaboration (e.g., research commercialization, workforce development, technology transfer).
- Engage Stakeholders: Involve all relevant stakeholders early in the process, including university faculty, industry partners, and community representatives.

Step 2: Conduct a Needs Assessment

- Survey Industry Needs: Gather information on the technological and research needs of local industries through surveys, interviews, and focus groups.
- Assess Academic Strengths: Identify the university's research capabilities, resources, and areas of expertise that align with industry needs.

Step 3: Establish a Partnership Framework

- Define Roles and Responsibilities: Clearly delineate the roles of university staff and industry partners.
- Create Governance Structures: Develop a partnership agreement or memorandum of understanding (MOU) that outlines the governance of the collaboration, including decision-making processes.

Step 4: Secure Funding and Resources

- Explore Funding Opportunities: Identify potential funding sources such as grants, public funds, and industry contributions to support the collaborative projects.
- Allocate Resources: Determine and allocate the necessary resources, including laboratory space, equipment, and personnel.

Step 5: Develop Project Proposals

- Outline Collaborative Projects: Develop detailed project proposals outlining objectives, deliverables, timelines, and metrics for success.
- Incorporate Feedback: Engage stakeholders in refining these proposals to ensure alignment with the goals of both the university and industry partners.

Step 6: Establish Communication Channels

- Create Communication Plans: Develop a communication strategy that outlines how information will be shared between partners.
- Regular Meetings: Schedule regular meetings to foster open communication and monitor project progress. Utilize technology for remote collaboration if necessary.

Step 7: Pilot Collaborative Projects

- Start Small: Begin with pilot projects that allow both parties to test the collaboration framework on a smaller scale.

- Monitor and Evaluate: Regularly assess the performance of pilot projects against established metrics and gather feedback from all partners.

Step 8: Foster Knowledge Sharing and Capacity Building

- Host Workshops and Seminars: Organize events that facilitate knowledge sharing and training for both industry staff and university researchers.
- Encourage Joint Research and Development: Promote joint R&D initiatives that leverage the strengths of both partners.

Step 9: Assess Impact and Iterate

- Evaluate Outcomes: Conduct thorough evaluations of collaborative projects, examining both quantitative and qualitative impacts.
- Solicit Feedback: Gather feedback from all stakeholders to identify successes, challenges, and areas for improvement.
- Iterate on Projects: Use the feedback to refine processes, technologies, and approaches for future collaborations.

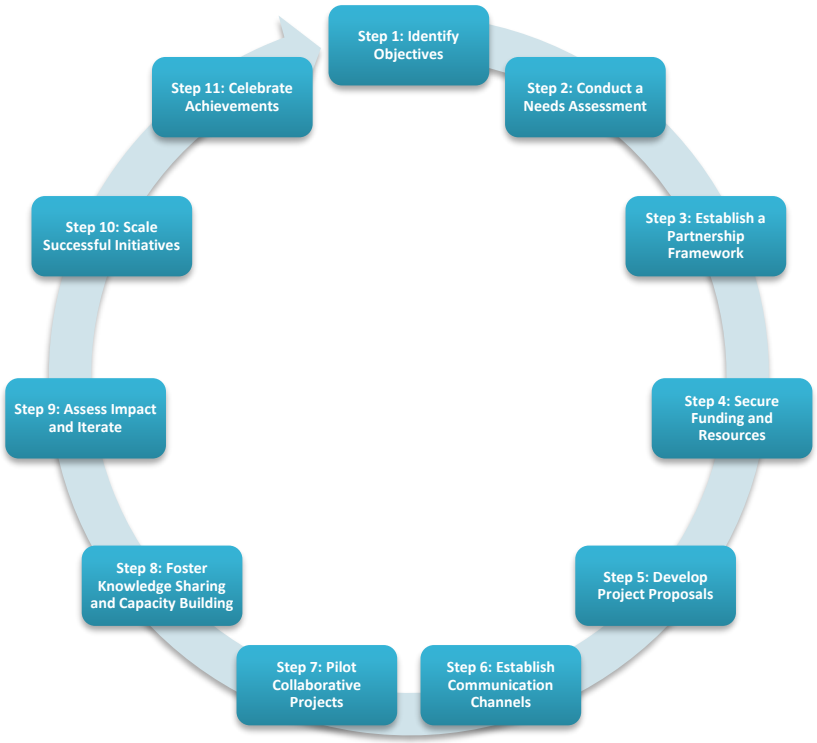
Step 10: Scale Successful Initiatives

- Identify Successful Models: Determine which collaborative projects or models demonstrate significant success and can be replicated or scaled.
- Expand Collaborations: Explore opportunities for broader partnerships with other universities and industries based on initial successes.

Step 11: Celebrate Achievements

- Recognize Contributions: Acknowledge and celebrate the contributions of partners, researchers, and teams involved in the collaborative projects.
- Share Success Stories: Publicize successful outcomes and case studies through presentations, reports, and media to inspire future partnerships.

FIGURE 4 STEP-BY-STEP GUIDE FOR SETTING UP COLLABORATIVE INNOVATION PROJECTS



SOURCE: OWN DEVELOPMENT

1.3. Commercialization strategies

FIGURE 5 THE COMMERCIALIZATION STRATEGIES IN UNIVERSITY CONTEXT



SOURCE: OWN DEVELOPMENT

One of the key steps in the commercialization process is to choose proper strategy of commercialization. One can choose from:

1. **Start-up creation**

The focus of the start up must on outside to help of an investor to gain a foothold in the market .

Without customers, there is no revenue and the business will fail.

The venture requires financial foresight - especially planning for the cash flow and capital needs as the venture grows.

The most important issue is not the revenue growth but the cash flow management to support the growth.

2. **Licensing**

Technology licensing is an arrangement in which the licensor's know-how, patents, trademarks, services, copyrights, trade secrets, or other intellectual property may be sold or made available to a licensee for royalties, lump sum royalty, royalty that is based on volume of production or income, or a combination of compensation methods.

3. **Organization development**

The organization development focuses on four main elements:

1. How to develop a viable commercialization plan
2. A business model for technology commercialization from the perspective of business managers, customers and future investors.
3. Sources of financing for the organization.
4. Technology sales and distribution channels. How the technology enablers can identify and sell technology.

5. **Science and business cooperation**

By establishing collaboration strategy, market players tend to develop market tools to withstand competition on others having the access to better partners, resources or intellectual property.

The organization collaboration brings an additional element of challenging task. It includes theoretical concerns and methodological practice focused on:

- institutional support for collaboration,
- perception of tasks,
- methods of working together,

- information technology,
- communication and research procedures.

6. **Strategic alliances**

One of the goals of strategic alliances is to cut down the risk involved in market operations.

Business models for developing technology are very risky. By discussing a variety of forms of business alliances and cooperation that fit the expected market activities, it is possible to create a competitive advantage for new a project.

Alliances endeavor to improve the commercialization and technology implementation process.

Balancing knowledge commercialization and technology transfer with academic freedom and the financing of potentially non-commercial research requires careful consideration. Here are several strategies that can facilitate this balance:

Strategies for Knowledge Commercialization and Technology Transfer

1. Flexible Funding Models
   - Strategy: Establish flexible grant programs that support both high-risk, non-commercial research and applied projects.
   - Implementation: Institutions could create a dual-funding mechanism that allocates a percentage of research funds specifically for exploratory projects that may not have immediate commercial applications but could yield future insights or innovations.
2. Innovation Incubators with a Broad Mission
   - Strategy: Develop incubators that focus not just on commercial viability, but also on social impact and long-term research outcomes.
   - Implementation: Programs like the Carnegie Mellon University Swartz Center for Entrepreneurship can serve as models. They could include hurdles for startups and emerging technologies that focus on societal challenges rather than immediate profit.
3. Promoting Open Science and Collaborative Research
   - Strategy: Encourage open-access publications and collaborative research projects across institutions, enhancing knowledge sharing.
   - Implementation: Establish platforms where researchers can share data, methodologies, and findings openly. This could foster future commercialization opportunities through shared insights.
4. Inclusive Stakeholder Engagement
   - Strategy: Involve a wider range of stakeholders, including industry partners, government agencies, and community organizations, in setting research priorities.

- Implementation: Institutions can hold forums or workshops that gather input on potential research directions and areas of interest, enabling researchers pursuing non-commercial work to connect with sectors interested in their findings.

5. Long-Term Impact Assessments

- Strategy: Develop frameworks for assessing the long-term potential impact of research initiatives regardless of current commercial viability.
- Implementation: Institutions could conduct regular reviews of research outcomes that evaluate not only immediate economic impacts but longer-term social, environmental, and technological contributions.

6. Academic Freedom Policies

- Strategy: Reaffirm and protect policies that support academic freedom to pursue research directions that may not align with immediate market needs.
- Implementation: Universities can establish clear policies that explicitly state the protection of academic freedom, allowing researchers the space to explore “blue-sky” projects without financial constraints.

7. Seed and Bridge Funding Initiatives

- Strategy: Implement seed funding programs that allow researchers to explore early-stage ideas and bridge funding initiatives that help transition from basic research to applied outcomes.
- Implementation: Establish grants specifically for projects that show promise but require further validation to attract larger commercial funding later—similar to the approach utilized by entities like the National Science Foundation (NSF) in the U.S.

8. Mentorship and Training Programs

- Strategy: Provide mentorship programs that pair researchers with experienced entrepreneurs and industry professionals to explore potential commercialization pathways.
- Implementation: Institutions can create mentorship networks that guide researchers in identifying market opportunities for their findings, irrespective of immediate commercial success.

9. Highlighting Case Studies of Past Success

- Strategy: Showcase examples where seemingly non-commercial research led to future successful innovations.
- Implementation: Institutions can publish case studies or hold seminars that illustrate how research in niche areas has eventually contributed to significant advancements or technologies.

10. Cultural Change within Research Institutions

- Strategy: Foster a culture that values both academic research and practical applications, recognizing varied outputs of research.
- Implementation: Change metrics of success to include not just publications and patents, but also societal impact, community engagement, and long-term innovation trajectories.

By adopting these strategies, research institutions can promote an environment where researchers feel encouraged to pursue fundamental research while also considering the potential for future commercialization. This creates a more robust ecosystem for knowledge transfer and innovation that benefits both academic and commercial stakeholders.

Georgian context

It is very important to consider the local environment and use already established practices. Here are some localized strategies and adjustments that can enhance the adoption and relevance of technology transfer and commercialization processes in Georgia, along with examples of successful implementations in the region:

Localized Strategies for Technology Transfer and Commercialization in Georgia

1. Strengthening University-Industry Partnerships
    - Strategy: Establish stronger collaborations between universities and local industries to facilitate knowledge exchange.
    - Example: The Ilia State University has initiated partnerships with various tech companies to provide internships and collaborative research projects, bridging the gap between theoretical knowledge and practical application.
2. Enhancing Innovation Ecosystems
    - Strategy: Create innovation hubs or clusters that connect startups, entrepreneurs, and research institutions to encourage collaboration and resource sharing.
    - Example: The Innovation and Technology Agency of Georgia (GITA) has supported the establishment of tech parks in Tbilisi and Kutaisi, providing infrastructure and resources for startups, which has led to successful local tech innovations.
3. Promoting Access to Funding and Investment
    - Strategy: Develop grant programs and funding initiatives specifically aimed at supporting technology transfer and commercialization.
    - Example: The Enterprise Georgia agency has launched various funding programs aimed at startups and small businesses, such as grants and co-funding for innovative projects, successfully enabling numerous tech startups to launch their products.
4. Customizing Technology Transfer Models
    - Strategy: Adapt technology transfer models to fit local cultural and economic contexts, ensuring alignment with industry needs.

- Example: The Tbilisi State Medical University has successfully implemented a model where graduates participate in clinical trials and medical technology innovation, thus transferring knowledge from academia to industry in a manner relevant to local healthcare needs.

5. Fostering a Skilled Workforce

- Strategy: Invest in training and educational programs focused on key technological skills to ensure that the local workforce meets industry demands.
- Example: The Georgia Technical University offers specialized training programs and workshops in high-demand tech skills, helping local professionals adapt to evolving technological landscapes.

6. Utilizing Digital Platforms for Awareness and Training

- Strategy: Create online platforms for training and awareness about technology commercialization processes.
- Example: The establishment of the Startup Georia online resources, which provides entrepreneurs with guides, webinars, and tools for successful technology commercialization.

7. Support for Intellectual Property Rights (IPR) Awareness

- Strategy: Develop programs to educate innovators about intellectual property rights, ensuring they can protect their inventions.
- Example: The National Intellectual Property Center of Georgia conducts regular workshops and seminars on IPR, helping innovators understand the importance of IP in commercialization.

8. Local Pilot Projects and Examples

- Strategy: Implement pilot projects that showcase successful technology transfer and encourage replication.
- Example: The Rural Development Agency has run projects demonstrating modern agricultural technologies, which have led to increased productivity and have been replicated across various rural communities in Georgia.

By leveraging these localized strategies, it is possible to enhance the relevance and adoption of technology transfer and commercialization processes in Georgia. The successful implementations of innovation strategies, combined with ongoing efforts to build partnerships and support local talent, can significantly contribute to creating a robust ecosystem for innovation and entrepreneurship in the country.

1.4. Intellectual property valuation and evaluation

Knowledge created within HEI needs an assessment. **Evaluation of IP** is a process of estimating the value of the technology based on its technical advantages (how well and innovatively it solves the problem), market applicability (whether there is a market need), and the level of "freedom of operation" for industry partners (whether there are similar protected inventions and potential danger of IP infringement).

Valuation of IP is a projection of the potential value that the technology may generate in the specific market and context, taking into consideration the risk and changing value of the money over time.

Economic value assessment criteria:

- ✓ Market potential
- ✓ Competitive organization and technologies
- ✓ Human resources and laboratories infrastructure
- ✓ IP protection possibilities
- ✓ The stage of development
- ✓ Commercialization scenarios
- ✓ Financial resources available
- ✓ Market interest
- ✓ Entrance barier
- ✓ Market development

Commercialization Quicklook Report

There are various approaches to evaluating the potential commercial success of research projects. One option is to engage a consulting firm to analyze the likelihood of technology success and market opportunities, despite the costly nature of this consultation. The IC2 Institute at the University of Texas at Austin describes Quicklook as a method for conducting technology market assessments that offer early insights into potential commercial interest in new technologies originating from universities or research labs.

Quicklook involves conducting around 40 to 60 hours of research to assess the commercial readiness and viability of a technology. Developed in the 1980s at NASA's Mid-Continent Technology Center, Quicklook was designed to evaluate the commercial potential of U.S. space technologies post the conclusion of the U.S. space program.

The benefit of using the Quicklook methodology is the ability for an organization or researcher to swiftly gauge the commercial prospects of a technology.

However, a drawback of the Quicklook approach is that due to its rapid nature, it may lead to a higher possibility of making errors in judgment.

The Quicklook process consists of four steps:

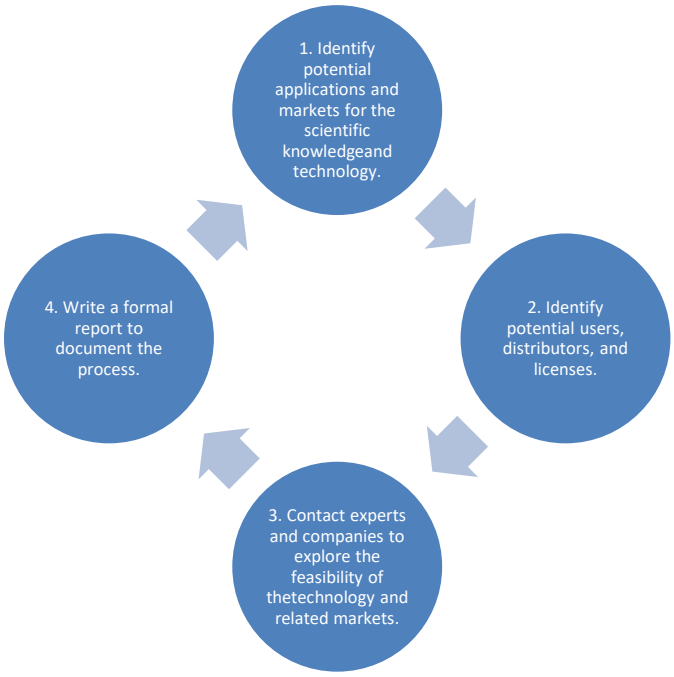
1. Identifying potential applications and markets for the scientific knowledge and technology.

2. Identifying potential users, distributors, and licensees.

3. Contacting specialists and companies to investigate the feasibility of the technology and related markets.

4. Writing a formal report documenting the process.

FIGURE 6 QUICKLOOK METHODOLOGY FOR TECHNOLOGY ASSESSMENT



SOURCE: ZEHNER II, W. B. „BRAD", & PLETCHER, G. (2017). SUCCESSFUL TECHNOLOGY COMMERCIALIZATION – YES OR NO? IMPROVING THE ODDS. THE QUICK LOOK METHODOLOGY AND PROCESS. MARKETING INSTYTUCJI NAUKOWYCH I BADAWCZYCH, 3(25), 81–102.

Unit 2. Academic entrepreneurship and scientific projects marketization

2.1. Concept of academic entrepreneurship

Academic entrepreneurship is a very broad concept. It basically refers to the different types of entrepreneurial behaviour that take place in an academic environment. The starting point is to see entrepreneurship as a process of seeking new opportunities and turning them into practice. Entrepreneurship understood in this way is, to a large extent, is a daily feature of university work. Academics:

- look for opportunities for new research, new publications, study trips, etc.
- seek opportunities for research grants, guest lectures, new courses, etc.

From a business perspective, the case is somewhat different - entrepreneurship with a business dimension is not a matter of course in academic work - looking for an opportunity and seizing the opportunity to create a business is not obvious to the academic sphere.

However, the importance of academic entrepreneurship in the economic field is highlighted. Seeking opportunities to apply scientific knowledge outside the university - in particular by implementing knowledge into innovations - new/improved services or new/improved processes - promotes the economic and social development of modern societies.

Academic entrepreneurship can be seen at different levels:

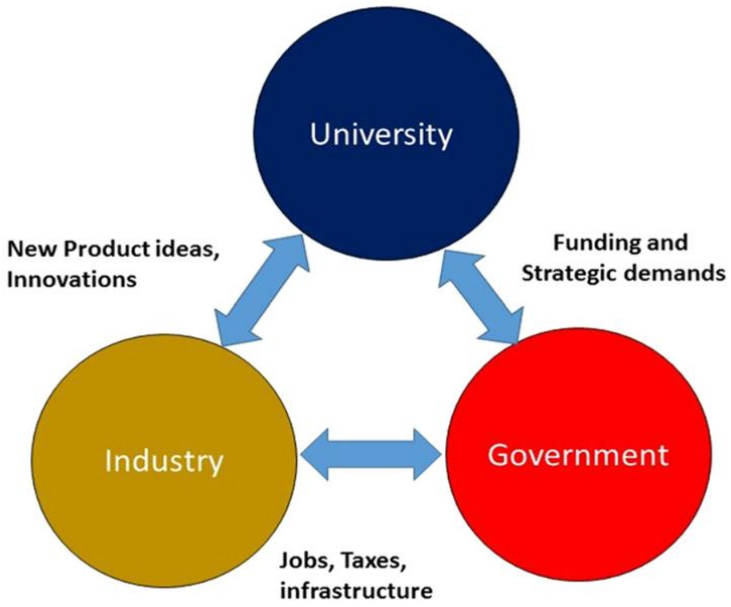
1. Academic entrepreneurship at the organisation level:
   Entrepreneurial university - a university that has the capacity to innovate, recognize and create opportunities, as well as working as a team, taking risks and responding to challenges (Buruck Klein, Pereira, 2020).

2. Academic entrepreneurship at the employees level:
   Entrepreneurial university staff - individuals employed by universities, who seek new opportunities and possibilities to put research results and scientific knowledge into practice. They use identifying market opportunities, assessing technological feasibility, securing funding, overcoming regulatory hurdles and are directed to successfully bring innovations to market.

3. Academic entrepreneurship at the students level:
   Entrepreneurial students - individuals who engage in entrepreneurial activities while still pursuing their education, aiming to create businesses and opportunities rather than solely seeking employment (Smith, 2023).

The entrepreneurial university plays a key role as a catalyst for innovation, supporting the development of local and global economies through collaboration with industry and public institutions. Through the transfer of technology and knowledge, universities contribute to the creation of new jobs and the competitiveness of businesses. At the same time, they support social development by engaging in sustainability, education and public health projects. Such cooperation helps to build stronger links between science and society, promoting sustainable economic and social development. A model that reflects the role of the entrepreneurial university is triple helix concept. It reflects the role of entrepreneurial university is a valuable partner in cooperation with the environment (see Figure below).

FIGURE 7 TRIPLE HELIX CONCEPT



SOURCE: HTTPS://ACADEMIC-ACCELERATOR.COM/ENCYCLOPEDIA/TRIPLE-HELIX-MODEL-OF-INNOVATION

The Triple Helix concept refers to the collaborative interaction between universities, industry, and government, aimed at fostering innovation and driving economic and social development. The model emphasizes the importance of synergy among these three sectors to create an environment conducive to knowledge exchange, entrepreneurship, and technological advancement. The Triple Helix model is also sometimes enriched with a fourth element - civil society. In this view it is referred to as the quadruple helix - it expands the perception of the university's links with civil society and its institutions.

FIGURE 8 TRIPLE HELIX CONCEPT



SOURCE: HTTPS://SEA2LANDPROJECT.EU/INVENTORY-OF-STAKEHOLDERS/

2.2. Institutional environment of academic entrepreneurship at university

Universities, as large and complex organisations, create a number of units within their frameworks directed at supporting various forms of academic entrepreneurship. These are most often:

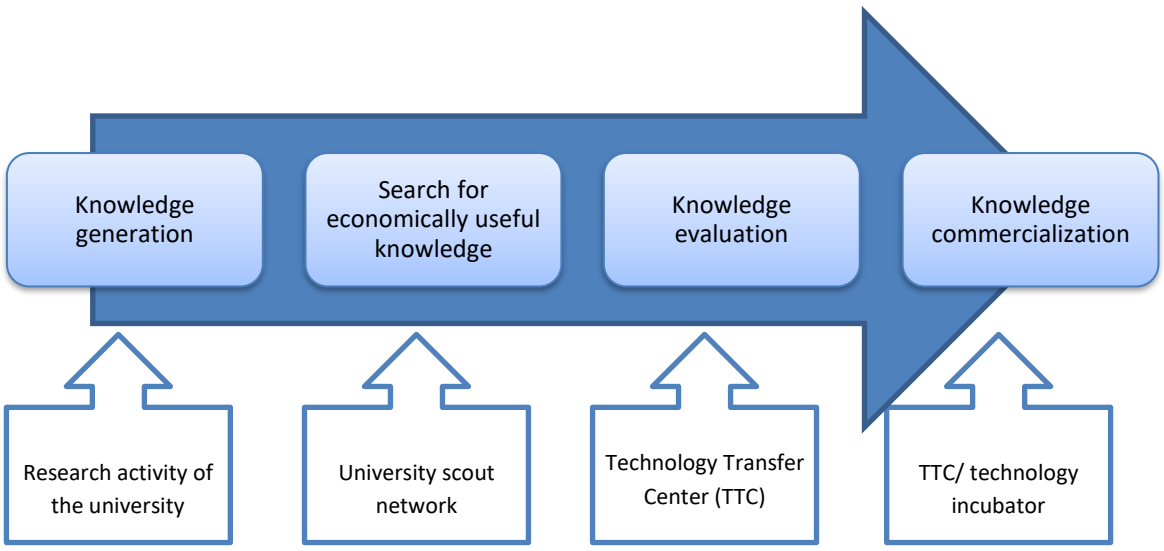
- Technology transfer office (TTO) - is a department within a university responsible for managing and facilitating the commercialization of innovations and intellectual property (IP) developed by researchers. The TTO helps identify promising technologies, protect them through patents or other legal means, and collaborate with industry partners or startups to license or develop these innovations for real-world applications, contributing to economic growth and societal benefit.
- Technology scouting network – is an unit within a university dedicated to identifying and evaluating emerging technologies, innovations, and research outcomes with high potential for commercialization or industry collaboration. Technology scouts proactively seeks out discoveries across various departments, assesses their market viability. It can be alsko a part of TTO.
- Academic technology incubator (ATI) - is a facility or program within a university that supports the early-stage development of technology-based startups, often founded by students or faculty/researchers. The incubator provides resources such as office space, mentoring, funding, networking opportunities, and access to university research infrastructure to help entrepreneurs refine their business models, develop prototypes, and bring innovations to market. ATIs aim to foster innovation, promote entrepreneurship, and bridge the gap between academic research and commercial success.

The main departments mentioned above are often supported by other specialized departments:

- University IP office
- Refctors/Deans represantatives for relations with industry/business
- Knowledge shops – focusing to facilitate students entrepreneurial activity
- others

The activities carried out by university units supporting academic entrepreneurship should be seen as a process of interrelated elements that create the entire innovation process. The idea is presented in the Figure below.

FIGURE 9LINKING THE INNOVATION PROCESS TO THE UNIVERSITY INSTITUTIONS



SOURCE: WIŚNIEWSKA, GŁODEK AND TRZMIELAK (2015)

2.3. Enabling academic entrepreneurship - factors

Academic entrepreneurship is not a single event, but rather a continues process comprised of a series of events. It is rather a bundle of various experiences and events like (D'este, Mahdi, Neely, 2010):

1. Experience in collaborative research with industry
2. Range of ties to external academic research networks
3. Integration of multiple fields of research
4. Quality of academic research

Each of these points will be developed in the following pages.

FIGURE 10 CONCEPT OF ACADEMIC ENTREPRENEURSHIP ENVIRONMENT



SOURCE: OWN DEVELOPMENT

The first of these elements – 'Experience in collaborative research with industry' - consists of the following factors:

- Transferring information from previous experience to a current entrepreneurship
- Existing of academic-industry linkages: mutual teams of researchers, committees, etc.
- Established tradition in collaborative research with companies
- Existing information links between universities and business
- High level of interactions e.g. scientific conferences with participations from business, business-scientific forum, mutual committees
- Mutual awareness to exploit commercial potential of scientific research
- Entrepreneurial skills among academic researchers e.g. previous business experience

The secont of the academic entrepreneurship enabling elements – 'Range of ties to external academic research networks' - consists of the following factors:

- Access to complementary expertise
- Access to extra infrastructure, equipment
- Boosting the opportunity to recognise anilities of academic researchers
- Enhance of entrepreneurial capabilities
- Increase among academics propensity to be an entrepreneur
- Mobilisation of social resources required to obtain objective perspective
- Enhance cross-fertilisation among disciplines

- Enrichment the research perspectives and methodology of research to identify new technological breakthroughs

The third of academic entrepreneurship elements – 'Integration of multiple fields of research' - consists of the following factors:

- Wide range of varied skills (technical and social)
- Boundary spanning approach
- Multiplace academic teams with varied methodological perspectives
- Platform of knowledge exchange
- Mutual interdisciplinary projects triggers innovative approach and commercial value

The fourth of academic entrepreneurship elements – 'Quality of academic research' - consists of the following factors:

- The best scientists enjoy access to high value knowledge
- The best research leads to a stronger capacity to identify high value entrepreneurial solutions
- Activity in research generally connects with patenting and potential entrepreneurial products

Academic entrepreneurship - in search of economic value

The entrepreneurial process in business starts with the search for market opportunities that have economic value. The university is not an obvious place to look for such value. The results of scientific research include research findings, scientific discoveries, new ideas and even inventions - they are usually published in research reports, scientific articles, monographs.

They have scientific value but how can they be understood through the lens of market value? The challenge is to apply the research results in economic practice within e.g.:

- a new/improved product,
- a new/improved service, or,
- new/improved business process…

this is only possible for some inventions!

A scientific invention has no significant economic value to the economy if it cannot beused in economic practice. If so, the invention itself has no economic value, hovewer it can bye found in the entrepreneurial process.

The economic value of an invention (and scientific knowledge more broadly) is built by, among other things:

- Identifying opportunities for its use in practice,

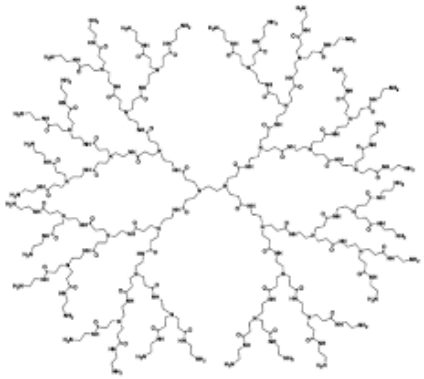
- Building conditions conducive to its use,
- Identifying the benefits, and the beneficiaries of those benefits.

Indication of the possibility and manner of using the invention in solving a problem relevant to individuals, companies, institutions, etc. Academic entrepreneurship is about search for creation economic (and others) value out of scientific research.

Case of dendrimers – economic value of scientific developments is not stable

Dendrimers are nanoparticles whose structure resembles a tree with an exuberant branching crown the name dendrimer, derived from the Greek dendron-tree, meros-part. The first dendrimers were synthesised in 1978.

Figure 11Illustrative drawing of a dendrimer



Source: https://miesiecznikchemik.pl/wp-content/uploads/2015/01/chemik_2014_02-10.pdf

Between 2011 and 2015, one type of dendrimer was found to have apoptosis-inducing properties in leukaemic cells - an important practical application was identified. A number of tests and studies were carried out and then a new company was created to pursue commercialization of this invention. Unfortunately, after further thorough testing of this solution, significant limitations were found in the application of this technology, so that its economic value was greatly reduced. The company is now in liquidation and activities in this direction have been abandoned.

2.4. Spin-off as a form of academic entrepreneurship

Academic spin-offs are new/young companies that transform scientific inventions developed from university research into market offer. They are developed with researchers as entrepreneurs and often with the support/participation of universities. Some academic spin-offs have become famous as symbols of the successful transformation of science into business. Examples include Google Inc., Genetech Inc., Lycos Inc. and others.

It is companies like these that have helped to create great expectations of academic spin-offs for economic development and revenue for universities. American and European publications

discussing examples from top universities helped to popularise the idea, which at one point became almost a big-business legend. These publications included:

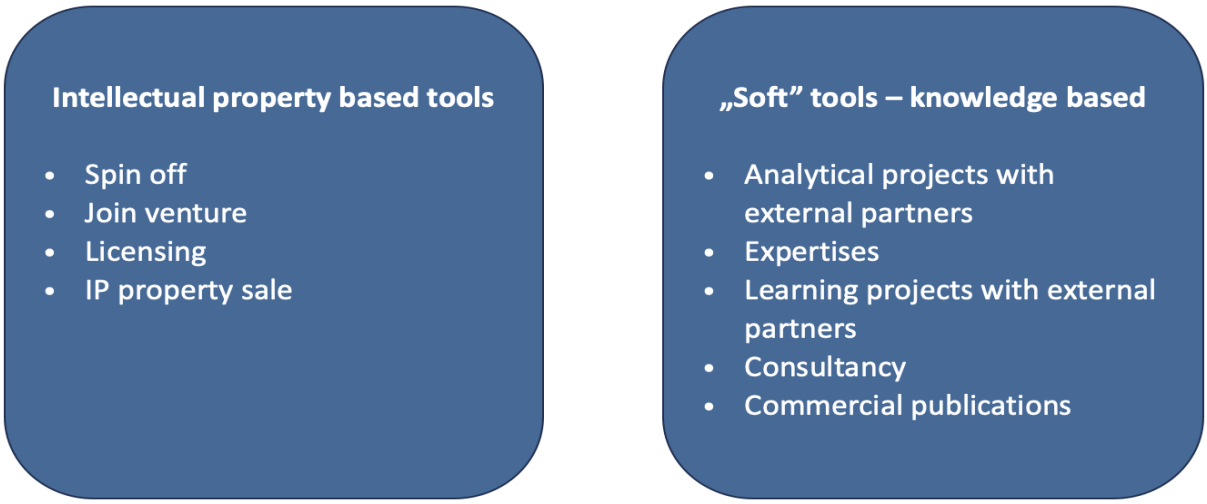
- American Authors:
    - 1991 - E.B. Roberts, Entrepreneurs in high technology: Lessons from MIT and beyond, Oxford University Press, New York.
    - 2004 - S. Shane, Academic Entrepreneurship. University Spinoffs and Wealth Creation, Edward Elgar, Cheltenham–Northampton
- European Authors:
    - 2005 - N. Carayol, M. Matt, Does research organization influence academic production? Laboratory level evidence from a large European university, „Research Policy" 2004, no. 33, s. 1081–1102.
    - 2005 - K. Debackere, R. Veugelers, The role of academic technology transfer organisations in improving industry science links, „Research Policy", 2005, no. 34, s. 321–342.

Spin off is currently considered as a form of commercialisation of only a small part of scientific knowledge. It mainly applies when we are dealing with breakthrough technologies that form the basis for completely new products and services and create new market sectors. The creation of such scientific solutions is not common outside the main research centres. Thus, a number of studies have now emerged that analyse the potential of academic spin-offs in the context of 'normal' universities much more realistically. These publications included:

- M. Wright, B. Clarysse, P. Mostar, A. Lockett, Academic Entrepreneurship in Europe, Edward Elgar, Cheltenham–Northampton 2007.
- P. Migliorini, Ch. Serarols, A. Bikfalvi, Overcoming Critical Junctures in Spin-off Companies from Non-elite Universities: Evidence from Catalonia, [w:] D. Smallbone, J. Leitão, M. Raposo, F. Welter (red.), The Theory and Practice of Entrepreneurship. Frontiers in European Entrepreneurship Research, Edward Elgar Publishing, Cheltenham 2010.

Creation of spin offs as a form of commercialisation for a small part of academic knowledge – see figure below.

FIGURE 12 DIVERSE FORMS OF COMMERCIALISATION OF SCIENTIFIC KNOWLEDGE



SOURCE: OWN DEVELOPMENT

2.5. Case studies of digital technology used as leverage for academic spin off incubation and technology commercialization

Case 1: Stanford University and the Stanford Technology Ventures Program (STVP)

The Stanford Technology Ventures Program (STVP) is an educational initiative at Stanford University focused on entrepreneurship and innovation. It utilizes digital technology to facilitate the transfer of knowledge and support startup incubation.

Digital Technology Utilization:

- **Online Learning Platforms:** STVP offers courses and workshops that leverage digital platforms, enabling access to a wider audience. Utilizing platforms like Coursera, the program reaches entrepreneurs worldwide.
- **Virtual Mentorship:** The program employs digital communication tools (e.g., Zoom, Slack) for real-time interaction between students and industry mentors, fostering collaboration despite geographical boundaries.
- **Startup Databases:** STVP maintains an online repository of startup resources, including access to successful case studies, market research, and funding opportunities.

Impact - the program has significantly increased entrepreneurship awareness among students, leading to numerous startups, job creation, and substantial contributions to the Silicon Valley ecosystem.

Case 2: MIT Media Lab

The MIT Media Lab fosters innovation at the intersection of technology, media, art, and design. It uses digital technology to facilitate collaboration between researchers, startups, and industry.

Digital Technology Utilization

- **Collaborative Online Platforms:** The Media Lab provides tools for project management and collaboration among researchers and industry partners, promoting interdisciplinary research and innovation.
- **Open Source Resources:** The Lab encourages sharing of innovations through open-source platforms, enabling faster adoption and adaptation by startups and developers around the globe.
- **Virtual Hackathons:** The Media Lab organizes online hackathons to bring together students, entrepreneurs, and experts to collaborate and solve real-world problems.

Impact – the MIT Media Lab has led to numerous entrepreneurial ventures and commercialized technologies, significantly influencing sectors like education, healthcare, and artificial intelligence.

Major success metrics for the commercialization of knowledge from universities that can be measured at the institutional level:

1. **Number of Patents:** The number of patents (1) applied for and (2) granted to university researchers.
2. **Derived Revenue:** Income generated from patents, licenses, and technologies commercialized from the university.
3. **Number of Spin-offs and Start-ups:** The number of businesses created based on university research.
4. **Technology Licensing:** The number of licensing agreements for technologies developed by the university and the revenue generated from them.
5. **Collaboration with Industry:** The number of research projects conducted in partnership with companies and the number of agreements related to joint research.
6. **Graduate Employment:** The percentage of graduates employed in the industrial sector, especially in fields related to their studies.
7. **Participation in Business Incubators:** The number of projects or individuals utilizing incubators at the university.
8. **Research Activity:** External funding secured for applied research and development of innovative technologies.

Collecting and analysing this data is important for HEIs to enable assessment of the effectiveness of their knowledge commercialisation activities and their impact on the economy. In addition, it is valuable to survey students and alumni to gain additional insight into perceptions of universities' support for innovation and entrepreneurship.

Unit 3. Legal aspects of knowledge commercialization

3.1. Intellectual property

In the broad view of **Intellectual property** it is perceived as **the legal rights that result from intellectual activity in the industrial, scientific, literary and artistic fields.**

Main reasons for the protection of intellectual property:

- to give statutory expression to the moral and economic rights of creators in their creations and the rights of the public in access to those creations,
- to promote, creativity and the dissemination and application of its results and to encourage fair trading which would contribute to economic and social development.

Intellectual property rights encourage creativity and innovation by providing incentives for creators and inventors, and by facilitating the sharing of knowledge. The provision of robust legal frameworks and effective enforcement mechanisms is therefore crucial to safeguard IP and foster innovation. Strengthening IP protection in response to technological advances while considering international best practices is key to making this possible.

What is protected by IP rights?

- literary, artistic and scientific works;
- performances of performing artists, phonograms and broadcasts;
- inventions in all fields of human endeavor;
- scientific discoveries;
- industrial designs;
- trademarks, service marks, and commercial names and designations;
- protection against unfair competition; and
- “all other rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields”.

FIGURE 13 INDUSTRIAL PROPERTY RIGHTS VS COPYRIGHTS



SOURCE: OWN DEVELOPMENT

"Industrial property shall be understood in the broadest sense and shall apply not only to industry and commerce proper, but likewise to agricultural and extractive industries and to all manufactured or natural products, for example, wines, grain, tobacco leaf, fruit, cattle, minerals, mineral waters, beer, flowers, and flour."

Paris Convention – Article 1(3)

3.2. Patent

A patent is a legal title that can be granted for any invention with a technical character provided that it is new, involves an 'inventive step', and is susceptible to industrial application.

Patenting is used to protect the intellectual property, being the result of research and development (R&D). In most cases, patenting refers to inventions as the results of the R&D process.

A patent is a document, issued, upon application, by a government office (or a regional office acting for several countries), which describes an invention and creates a legal situation in which the patented invention can typically only be exploited (manufactured, used, sold, imported) with the authorisation of the owner of the patent.

A patent can cover how things work, what they do, what they are made of and how they are made. Anybody can apply for a patent. It gives the owner the right to prevent others from making, using or selling the invention without permission. Inventions can be protected in Europe either by national patents, granted by the competent national IP authorities (patent offices) in EU countries or by European patents granted centrally by the European Patent Office (EPO). Applicants seeking worldwide patent protection may use either the services of the national IP authorities or the EPO, under the Patent Cooperation Treaty (PCT). In general terms, an international patent application has the effect of a national patent application (and certain regional patent applications) in or for all PCT Contracting States.

The regulations regarding patenting may differ in various parts of the world. The best solution, in this case, is to refer to the patenting office operating in your country for more details. If you plan to patent your inventions in other countries or regions, you should refer to the respective patenting office covering them.

In a number of countries, inventions are also protectable through registration under the name of "utility model" or "short-term patent." The requirements are somewhat less strict than for patents, in particular in respect of inventive step, and in comparison with patents the fees are lower, and the duration of protection is shorter, but otherwise, the rights under the utility model or short-term patent are similar.**Conditions of patentability :**

1. Patentable subject matter. The invention must fall within the scope of patentable subject matter as defined by national law. This varies from one country to another. Many countries exclude from patentability such subject matter as scientific theories, mathematical methods, plant or animal varieties, discoveries of natural substances, methods for medical treatment (as opposed to medical products), and any invention where prevention of commercial exploitation is necessary to protect public order, morality or public health.
2. Industrial applicability (utility). The invention must be of practical use, or capable of some kind of industrial application.
3. Novelty. The invention must show some new characteristic that is not known in the body of existing knowledge (referred to as prior art) in its technical field.
4. Inventive step (non-obviousness). The invention must show an inventive step that could not be deduced by a person with average knowledge of the technical field.
5. Disclosure of the invention. The invention must be disclosed in a clear and complete manner in the patent application to be carried out by a person skilled in the art (a person conversant in the field of technology concerned).

3.3. Licensing

Intellectual property can be bought, sold or licensed. A license is an agreement between you as the IP right owner (licensor) and another party (licensee). It grants them permission to do something that would be an infringement of the rights without the license. A royalty is a payment made by the licensee to IP right owner, the licensor. IP can be “licensed-out” or “licensed-in”. You can “license-out” to another company in return for a fee. You can “license-in” if you want to use another company’s IP to develop your own business and products.

FIGURE 14 LICENSING



SOURCE: OWN DEVELOPMENT

Licencing - Royalty Agreements

- The seller gets a payment that is typically a percentage of sales
- Royalties is the most common form of deal
- Seller shares the risk of market development but also shares in potential upsides
- Income is dependent on the company not just the technology
- The terms are negotiable

BASIC TYPES OF LICENSES

Exclusive license

The broadest scope of license that can be granted is an exclusive license. An exclusive license excludes the use of the property right licensed to everyone but the licensee. After granting an exclusive license, the licensor is also often (but not always) excluded from continuing to use the licensed products within the territory of exclusivity. The licensor retains ownership but licenses away everything else.

Sole license

A sole license, once granted, prevents the licensor from licensing the rights to anyone else. The licensor retains the right to use the licensed products.

Non-exclusive license

A non-exclusive license can be granted as often by the licensor to as many licensees as desired. Most commercial software licensed today is licensed on a non-exclusive basis.

Territorial limitations

It is common to restrict the territory that a license agreement covers, particularly in the area of intellectual property licenses where different distribution partners may be granted exclusivity for their regions.

When not to grant or take a license?

If you can commercialize your own IP, you might be better off doing it yourself;

You should be wary of licensing your IP to companies who might lessen the value of the IP;

The IP to be licensed may be too weak – if a competitor could work round it and take away market share, it may not be worth investing in a license

The prospective licensor may want to charge royalties that are too high and may restrict the growth of the business;

A royalty is a payment to an owner for the use of patents. A royalty payment is made to the legal owner of the patent by those who wish to make use of it to generate revenue. Royalties are designed to compensate the owner for the asset's use, and they are legally binding

3.4. Non-Disclosure Agreements (NDA) in IP

Non-Disclosure Agreements (NDA) in IP are the most important agreements in the case of IP protection rights are Non-Disclosure Agreements (NDA). An NDA, also known as a confidentiality agreement (CA), confidential disclosure agreement (CDA), proprietary information agreement (PIA), or secrecy agreement (SA), is a legal contract between at least two parties that outlines confidential material, knowledge, or information that the parties wish to share with one another for certain purposes, but wish to restrict access to or by third parties. Use NDAs to keep your invention a secret when talking to others.

3.5. Trade Secret

Trade secrets are intellectual property (IP) rights on confidential information which may be sold or licensed

The unauthorized use of such information by persons other than the holder is regarded as an unfair practice and a violation of the trade secret.

How are Trade Secrets Protected?

In contrast to patents, trade secrets are protected without registration, that is, trade secret acts are protected without any procedural formalities.

Consequently, a trade secret can be protected for an unlimited period of time. For these reasons, the protection of trade secrets is particularly attractive for SMEs.

General standards of trade secrets: [wipo.int.]

- The information must be known only to a limited group of persons
- It must have commercial value because it is a secret.
- It must have been subject to reasonable steps by the rightful holder of the information to keep it secret (e.g., through confidentiality agreements).

The Case of Coca Cola The formula for Coca-Cola is one of the go-to examples of a trade secret. And it is due to the ease of its reverse engineering.

If one of the principles of your "formula" could be replaced with another, but due to processing it is complicated to decompose it into prime factors, reconsider patenting because you must reveal the secrets during this procedure.

The Case of Kentucky Fried Chicken

Famous KFC's "Secret Recipe of 11 Herbs and Spices" is nearly as renowned as their former ad slogan "finger lickin' good."

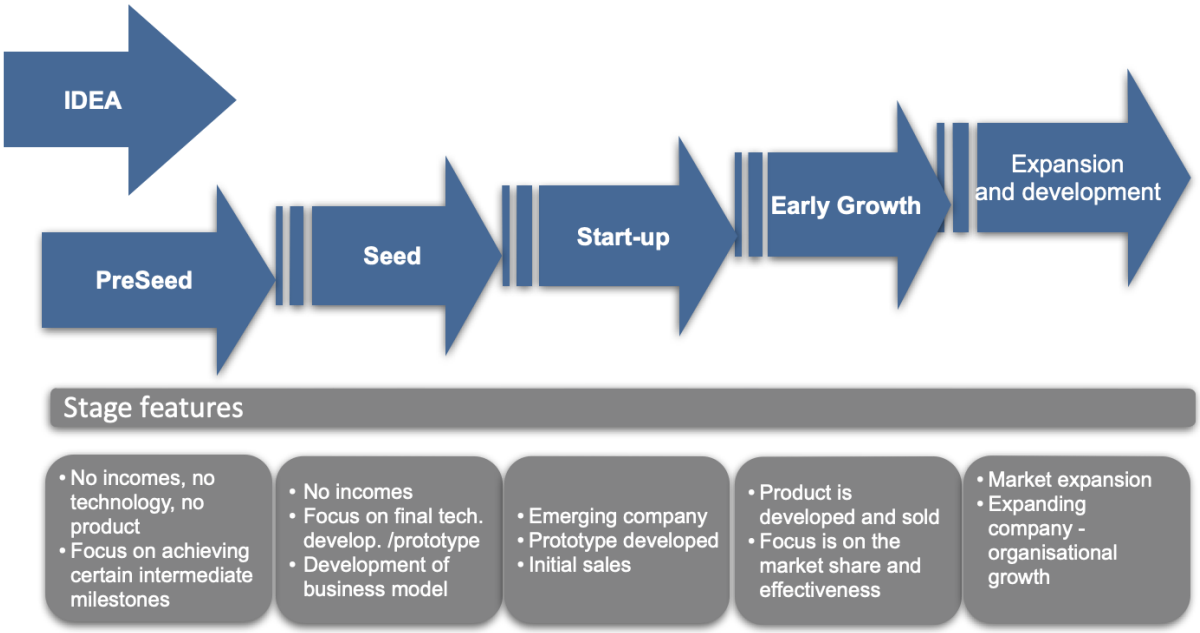
It's kept under lock and key in a Louisville, Ky., safe. One company blends part of the spice recipe, and another company mixes the rest so that neither party has the entire recipe.

Unit 4. Funding with impact investing perspective

4.1. Funding needs

The funding needs for innovative projects are directly related to the stages of innovative project development.

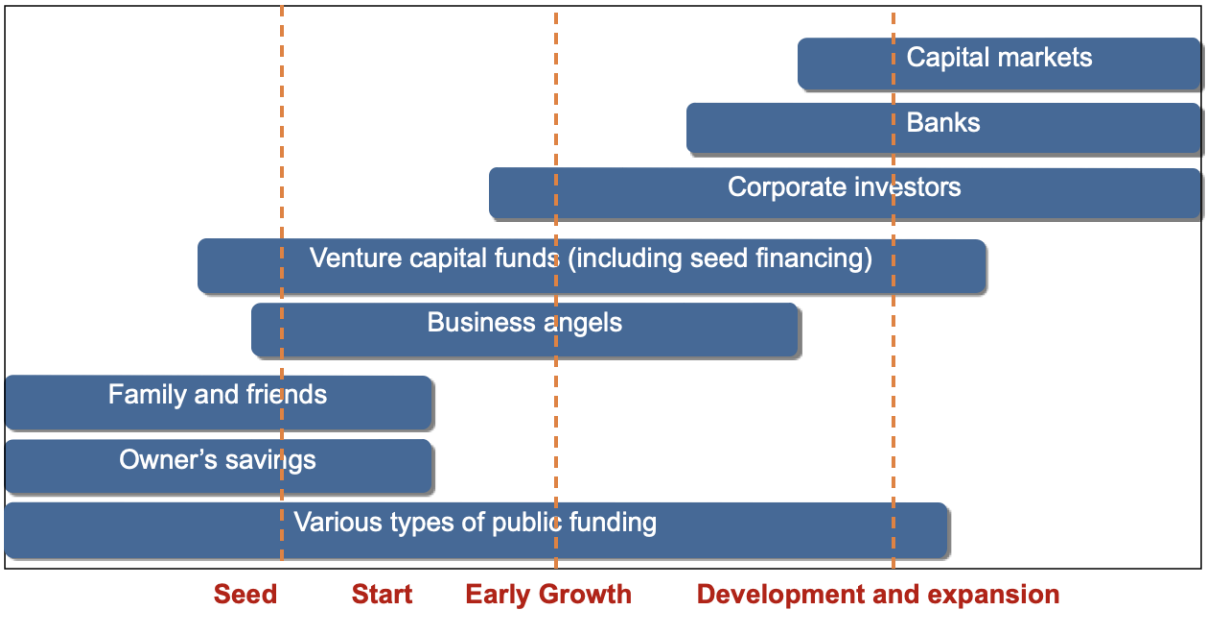
FIGURE 15 THE STAGES OF INNOVATIVE PROJECT DEVELOPMENT



SOURCE: OWN DEVELOPMENT

Depending on the development stage, there can be different sources of funding.

FIGURE 16 PROJECT STAGES AND SOURCES OF FUNDING



SOURCE: OWN DEVELOPMENT

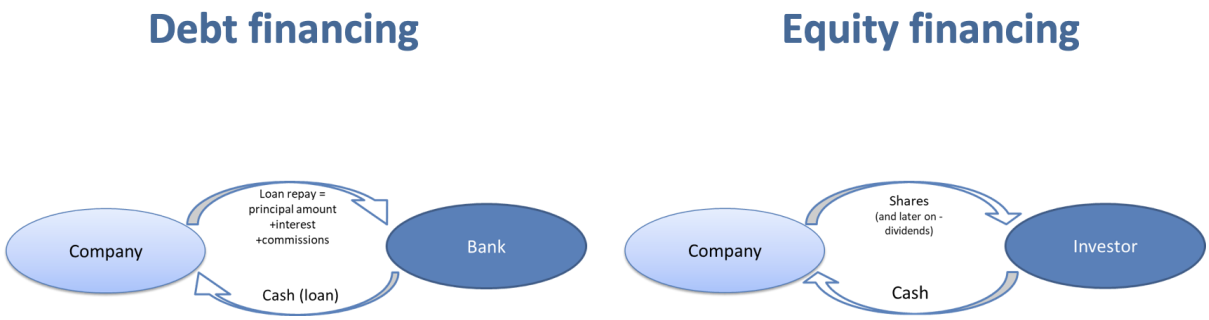
The key question related to funding sources for your innovative project is: How much money does it need to develop? The answer to the initial question relates to how do you want to develop your project. If you want to set-up a firm, you should decide: will it grow fast (then it will need more money) or will it grow slow? The financing needs are also dependent on the industry sector that the project falls into (local niche – smaller funding needs or global entry – much higher funding needs).

4.2. Dept and equity financing

It is worth to be acquainted with selected forms and methods of financing of innovative projects, for example debt and equity financing.

In many cases, the financing options vary between debt and equity financing. Before we proceed with details, look at the general comparison of debt and equity financing.

FIGURE 17 DEPT VS EQUITY FINANCING



SOURCE: OWN DEVELOPMENT

Debt financing refers to cash borrowed from a lender (e.g. bank) at an agreed rate of interest and with a predetermined maturity date. In return for lending the money, the bank becomes a creditor and receives a promise that the principal and interest on the debt will be repaid (and sometimes other commissions). The principal must be paid back in full by the maturity date, but it is common to introduce periodic repayments of the principal as part of the loan arrangement. Banks are one of the most important sources of debt financing for innovative projects and companies that originated from them. Loans (or other types of debt financing) may, however, be difficult to obtain for innovative start-up companies, as they:

- Need to provide formal documentation to the bank – credit-worthiness analysis;
- Need to provide collateral.

Equity financing refers to cash paid into the project by investors. The business (based on the innovative project) founder is usually one of these investors, but not necessarily the only one. Investors receive a share of the company, in effect, a percentage of it proportional to the total investment paid in. Investors may provide investment at a different stage of business development (start-up vs already active business; a new joint venture with existing business; etc.). Investors may deliver cash to a company as an investment opportunity, however, they

do not receive their money back in the same form. The investment return may be related with:

- Shares/stock appreciation, or;
- Other profits, such as the yield of dividends which the business may (but need not) pay to the investor.

For some early-stage company owners, the most challenging feature of equity financing is the need to share ownership.

FIGURE 18 DEPT AND EQUITY FINANCING FEATURES

Debt financing	Equity financing
Needs to be repaid to the lender	Does not need to be repaid – stays with the company
The cost of the debt is mainly related to interest	Different types of investors available – more flexibility
Banks as the main source of debt	Part of the ownership of the company is transferred to an external investor

SOURCE: P. GLODEK. P. PIETRAS (2011) ŹRÓDŁA FINANSOWANIA DLA KOMERCJALIZACJI TECHNOLOGII I WIEDZY. BIOS, WARSZAWA.

A range of potential equity investors may be considered by innovative project managers e.g.:

- Business angels;
- Venture capital funds.

4.3. Business angels

Business angels (BA) are private, informal investors who invest part of their financial resources in new, promising, innovative projects. They invest private funds (usually the amount of 200,000 € to approx. 2 million). Investments are usually targeted at the early stages of business life. They often do not intend to publicly disclose their investment activities. In many BAs cases are people with professional experience related to business - entrepreneurs (various industries), managers, lawyers, etc. They have the potential to advise on building a business and are oriented to the success of the venture. One of the easiest ways to contact a BA is through business angel networks. At the European level, information about local/regional BAs networks is provided by EBAN (European Business Angel Network, http://www.eban.org/). Have a look at the website to get more details on business angels.

4.4. Venture capital (VC) funds

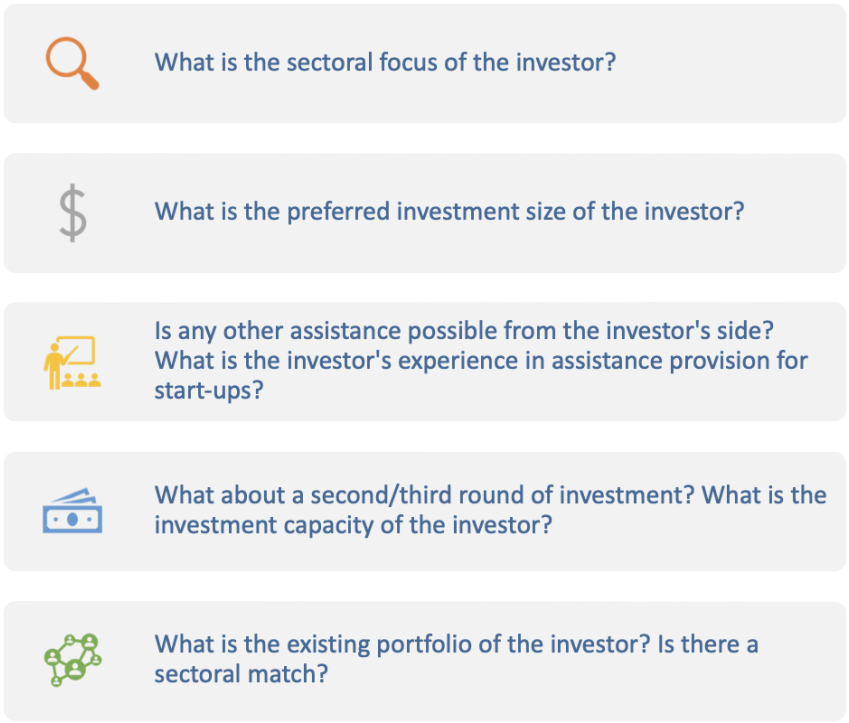
Venture capital (VC) funds are private equity investment vehicles that seek to invest in firms with high-risk/high-return profiles, based on a company's size, assets, and stage of product development. Venture capital funds differ from other investment funds in that they focus on a specific type of early-stage investment. All firms receiving venture capital investments with high-growth potential are risky and have a long investment horizon. Venture capital funds take a more active role in their investments by providing guidance and often holding a board seat. Venture capital funds have portfolio returns that resemble a barbell approach to investing. Many VC funds make small investments in a wide variety of young companies, assuming that at least part of them will achieve high growth and reward the fund with a comparatively large payout at the end. An effective way to get information on VC is to contact local innovation support organizations (e.g. technology transfer centers). At the European level, information about national/regional VC funds is provided by Invest Europe (http://www.investeurope.eu). Have a look at the website to get more details on venture capital.

4.5. Investor – a perfect match

When looking for an equity investor, there are some important questions to be answered to check if the innovative project is aligned with the potential investor characteristics, such as:

- What is the sectoral focus of the investor?
- What is the preferred investment size of the investor?
- Is any other assistance possible from the investor's side? What is the investor's experience in assistance provision for start-ups?
- What about a possible second/third round of investment? What is the investment capacity of the investor?
- What is the existing portfolio of the investor? Is there a sectoral match?

FIGURE 19 MATCHING WITH INVESTOR



SOURCE: OWN DEVELOPMENT.

Equity investors expect a high return on investment and may accept high investment risk. They usually expect high growth of the company; profits are a little less important at the beginning. The usual return expectations (of the invested capital) depending on the type of investor are as follows:

- Business angels: 60-100%;
- Seed Fund (very early stage VC): 30-80%;
- Venture Capital Fund: 30-50%;
- Stock market: 12-20%;
- Bank loan: depending on actual rates.

At an early stage of innovative business development, different financing providers have other preferences regarding their investments. They are marked with colours (similarly to traffic lights) to indicate which options are better than the others for an early stage of innovative business development.

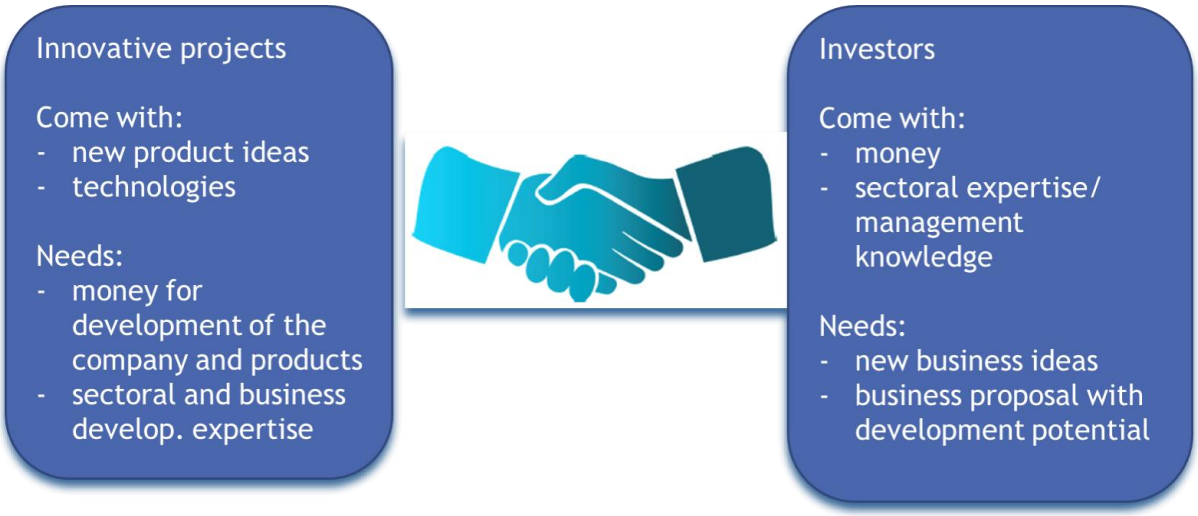
FIGURE 20 POTENTIAL INVESTORS AND THEIR PREFERENCES

Type of investor	Characteristics and investor's preferences
Bank	• Institutional investor; • Invest external capital; • Aim for a low rate of return and low risk; • Collateral is required.
Family, friends and founders	• Individual investor; • Invest own capital; • Low profit requirements; • They invest in their friend's idea – personal relationships at stake; • Passive investors – one investment usually.
Business Angels	• Individual investor; • Invest own capital; • Business and (sometimes) sectoral experience; • Active investors – usually a broad portfolio of investments; • Invest in a specific entrepreneur (personal choice).
Venture capital funds and seed funds	• Institutional investor; • Invest external capital; • Active investors – a broad portfolio of investments; • Invests in specific businesses (aligned with funds' strategy).
Capital markets	• Start-up companies are too small and too risky to enter regular capital markets
"Parallel" capital markets	• e.g.: First North (Nasdaq), NewConnect (Warsaw Stock Exchange), AIM (London Stock Exchange), Alternext (Euronext); • An alternative route for small- and mid-sized companies; • Fewer formal obligations and much lower capital requirements; • Provide capital but they also greatly increase the credibility and the visibility of the business.

SOURCE: P. GLODEK

Interacting with investors

FIGURE 21 PRINCIPLES OF INTERACTING WITH INVESTORS.



SOURCE: OWN DEVELOPMENT

Investors, apart from the return rate from the investment, are looking for:

- Business projects with high growth perspective (new product or technology is just a way to achieve business growth, it is not the essence of the project);
- Interesting people (good, dynamic, motivated teams).

In order to attract investors to your innovative project, the key is to show the preparation of the business assumptions, which builds credibility as a future manager of the growing business. Some of the basic documents for potential investors upon which they assess the innovative project are business plans, executive summaries, presentations. So they should be well prepared (see module "Commercialization of innovative projects" for guidance on business plan development).

Having developed a business plan, it can be a foundation for the executive summary or innovative project presentation. The executive summary is a short version of a business plan; however, both documents must be consistent. Some investors prefer to receive an executive summary first. It is because of investor's time-saving preference.

For that reason, the executive summary must be interesting enough to encourage the investor to invest more time to read longer documents. It can be said that the executive summary is the first step towards a potential meeting or presentation etc.

The executive summary should cover a brief description of the project, which is required at the starting phase of a cooperation with a potential investor, to build up investor interest. It should focus on the most important aspects of the innovative project (because of its short form – not longer than 2 pages). The executive summary is sometimes referred as the

"elevator speech/pitch", so a short description of the innovative project that explains its concept in a way such that any listener can understand it in a short period of time.

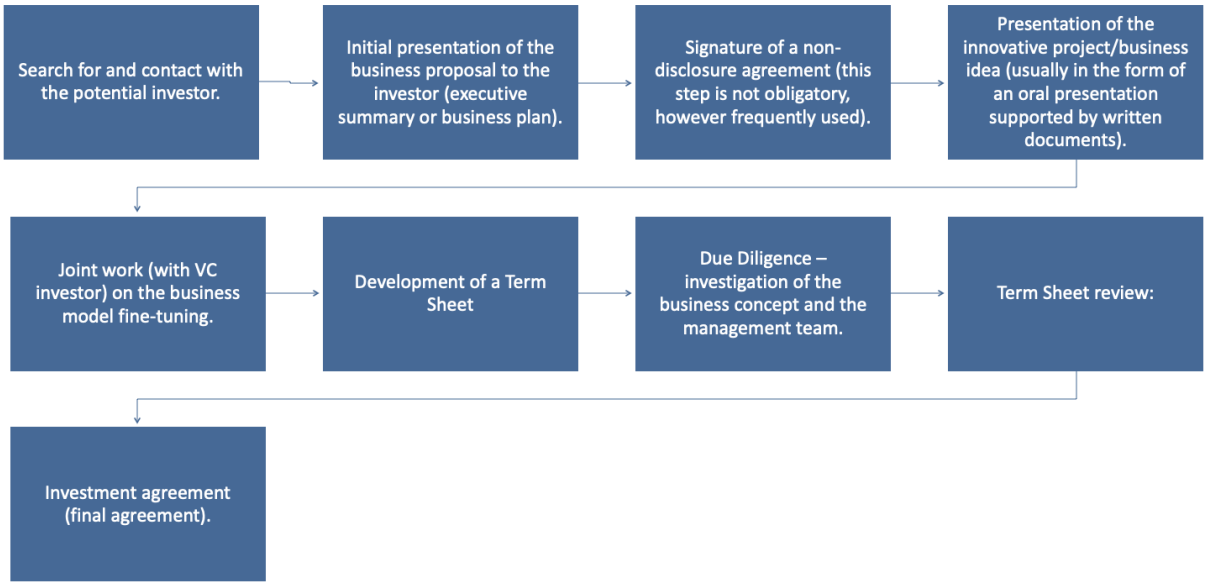
Common mistakes

- Excessive optimism, but also, conversely, lack of confidence;
- Lack of a clear commercialization strategy;
- Lack of a clear business model;
- Insufficient market potential:
    - Niche projects, located in markets with low value and limited growth potential;
- The underestimation of costs and/or overestimation of expected revenue;
- Lack of reliable documentation supporting the project;
- Concealment of information about the state of the project/company;
- Failure to indicate essential risks associated with the project;
- Unreasonable valuation of the business resulting in significant differences in valuation between the inventor and the potential investor;
- The inventor's lack of conviction to "give" part of the ownership to the investor.

4.6. Venture capital investment as a process

The venture capital investment can be seen as a process. We will now use, an example of such a process to summarise the presented content.

FIGURE 22 VENTURE CAPITAL INVESTMENT AS A PROCESS



SOURCE: OWN DEVELOPMENT

1. Search for and contacts with the potential investor.
2. Initial presentation of the business proposal to the investor (executive summary or business plan).
2. Signature of a non-disclosure agreement (this step is not obligatory, however frequently used).
3. Presentation of the innovative project/business idea (usually in the form of an oral presentation supported by written documents).
4. Joint work (with VC investor) on the business model fine-tuning.
5. Development of a Term Sheet, including:
    - List of key terms of the investment;
    - Business concept valuation;
    - Identification and risk evaluation.
6. Due Diligence – investigation of the business concept and the management team:
    - Checking the technical, economic and legal conditions for the implementation of the project;
    - Often done by external experts;
    - Take approximately 2-3 months;
    - Focus on the weak points of the company, entrepreneurial team or business concept;
    - In VC Investor tries to evaluate different risk levels, connected with project/technology/product; market; competitors; legal aspects; management, etc.
7. Term Sheet review:
    - The review may be the consequence of the findings of Due Diligence.
8. Investment agreement (final agreement), covering:
    - Distribution of shares in the company;
    - Milestones of the investment project;
    - Investment size and timing – investment rounds;
    - Strategies of the investor exit;
    - Obligations of the investor.

4.7. Impact investors

Understanding impact investors

As there is a spectrum of enterprises, there is a spectrum of impact investors.

The European Venture Philanthropy Association (EVPA) distinguishes:

a) investing FOR impact which means investing with a primary focus on the impact of the underlying asset from

b) investing WITH impact where the investor is also looking at the financial returns (not only the impact).

FIGURE 23 INVESTING FOR AND WITH IMPACT



SOURCE: GIANONCELLI, A., GAGGIOTTI, G., BOIARDI, P., AND PICON MARTINEZ A., (2019). 15 YEARS OF IMPACT – TAKING STOCK AND LOOKING AHEAD. EVPA. RETRIEVED FROM HTTPS://EVPA.EU.COM/KNOWLEDGE-CENTRE/PUBLICATIONS/15-YEARS-OF-IMPACT.

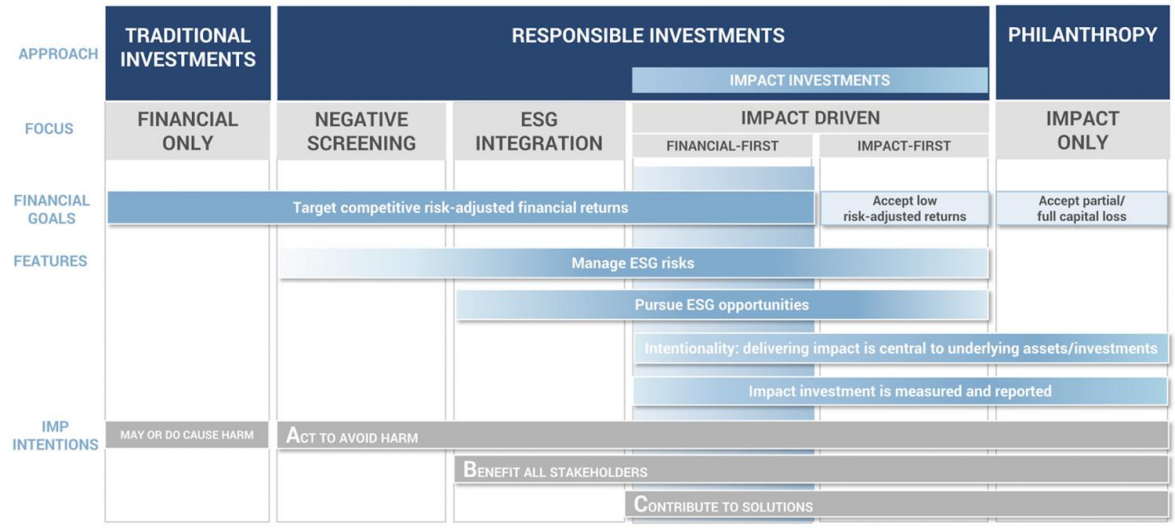
Venture philanthropy (VP) is a high-engagement and long-term approach whereby an investor for impact supports a social purpose organization (SPO) to help it maximize its social impact. VP not only invests in social entrepreneurs but also in charities and NGOs. They are not motivated by financial returns.

For a broader overview of the spectrum of capital, take a look at the next slide.

When starting to fundraise, it is important to understand what type of impact investors you are looking at. Do your own due diligence so you know if the investor you are talking to puts an emphasis on impact, profits, or both equally. This will help you shape your message.

Impact investors could also have a special appetite for e.g. climate solutions, tech for good, women entrepreneurs…Try to find out in advance if the impact investor you want to talk to has its own preferences.

FIGURE 24 SPECTRUM OF CAPITAL (PHENIX CAPITAL)



SOURCE: HTTPS://PHENIXCAPITALGROUP.COM/IMPACT-INVESTING-CONSULTING, BRIDGES FUND MANAGEMENT (2014), PRI (2013), RIAA (2019), UK NAB (2017), IMPACT MANAGEMENT PROJECT (IMP) (2018)

Finding impact investors

Several networks exist where you can look for impact investors. First you need to understand where you sit in the investment readiness spectrum.

As an early stage start-up you might want to look at impact business angels or incubation/acceleration programs with an investing arm or early-stage impact funds.

If you have a hybrid business model with for profit activities and not for profit you can also look at foundations and venture philanthropists.

You can start by asking your local/national business angel network and look for impact business angels.

Toniic is the global community of impact investors: find out if there is one or several in your region. You can also refer to the EVPA directory.

If you are a woman entrepreneur, you can look at gender-smart investors (investors embedding gender factor in their investment process for better economic, environmental and social outcomes). Project SAGE 4.0 which tracks Venture Capital, Private Equity and Private Debt with a gender-lens.

Database of dealroom.co shows more than 70 European VC funds – identified as impact investors.

Their portfolio exceeds 1500 companies.

Unit 5. RRI and young citizen science

5.1. RRI concept

The concept of Responsible Research and Innovation (RRI) was developed in response to the growing need to conduct research and innovation in an ethical, sustainable and socially responsible manner. It is rooted in the idea that science and technology have a huge impact on society, so research processes should include broad public consultation, transparency and sensitivity to the needs of different stakeholder groups. RRI has gained particular prominence in the European Union, where it has become a key element of Horizon 2020, promoting innovation in line with ethical principles, inclusivity, gender equality, open science and sustainable development. The concept has evolved based on collaboration between researchers, policy makers and society, with an emphasis on integrating societal values throughout the innovation cycle.

Responsible Research and Innovation (RRI) is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view on:

1. the (ethical) acceptability,
2. sustainability, and,
3. societal desirability

of the innovation process and its marketable products.

This is to to allow a proper embedding of scientific and technological advances in our society. RRI seeks to bring issues related to research and innovation into the open, anticipate their consequences, and involve society in discussing how science and technology can help create the kind of world and society we desire for generations to come.

Principles of Responsible Research and Innovation

The European Commission has provided more concrete normative orientations in the form of six policy keys that RRI should foster:

1. **Ethics:** focuses on one hand, on research integrity and on the other hand, on science and society
2. **Gender Equality**: is about promoting gender-balanced teams, ensuring gender balance in decision-making bodies, and always considering the gender dimension in Research and Innovation (R&I)
3. **Governance**: arrangements that lead to acceptable and desirable futures have to be robust and adaptable to the unpredictable development of R&I; be familiar enough to align with existing practices in R&I; share responsibility and accountability among all

actors; and provide governance instruments actually to foster this shared responsibility.

4. **Open access**: addresses issues of accessibility to and ownership of scientific information. Free and early access to scientific work might improve the quality of scientific research and facilitate fast innovation, constructive collaborations among peers, and productive dialogue with civil society.
5. **Public engagement**: fosters R&I processes that are collaborative and multi-actor: all societal actors work together during the whole process to align its outcomes to society's values, needs, and expectations.
6. **Science Education**: focuses on enhancing the current education process to better equip citizens with the necessary knowledge and skills so they can participate in R&I debates; and in-creasing the number of researchers.

Actors aiming at Responsible Research and Innovation commit themselves to the following principles:

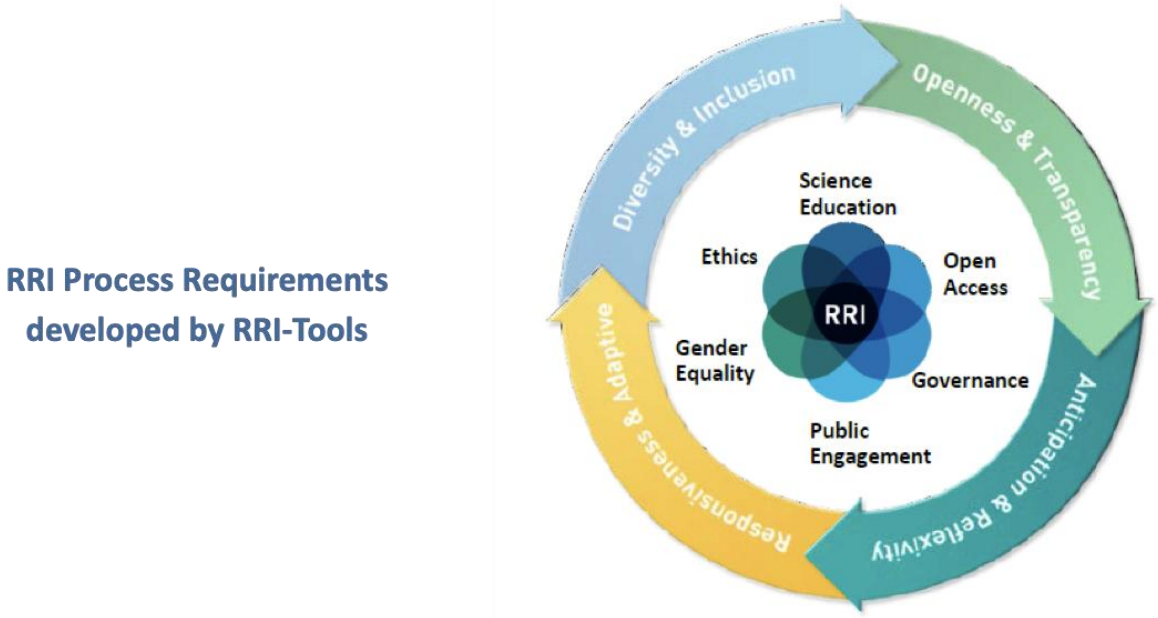
- **Transparency**: by engaging in open innovation, reflecting on and openly disclosing the purposes and potential implications of innovations, as well as the associated uncertainties.
- **Participation & Inclusion**: by involving people of a broad diversity and different backgrounds on eye-level (inclusive innovation processes) and considering their needs.
- **Governance**: by capacity building for Responsible Innovation, fostering the links between innovation and Sustainability Management and implementing gender equality.
- **Anticipation**: by assessing risks and wider impacts (risk management and due diligence), considering ethical limitations, welcoming early warnings of negative impacts and mitigating harms.
- **Sustainability**: by orientating innovation towards Planet, People and Profit (triple bottom line) and increasing shared value (for the company and for society).

Responsible Research and Innovation aims to create a society where R&I practices strive towards sustainable, ethically acceptable, and socially desirable outcomes. RRI does so in such a way that the responsibility for our future is shared by all people and institutions affected by and involved in R&I.

Responsible Research and Innovation Process Requirements

RRI-Tools (https://rri-tools.eu/), developed a framework to support in a dynamic, iterative manner, the RRI outcomes to find solutions for the societal challenges formulated by the European Commission (see figure below).

FIGURE 25 RESPONSIBLE RESEARCH AND INNOVATION PROCESS IDEA



SOURCE: HTTPS://BLOG.RRI-TOOLS.EU/-/RRI-TOOLS-SO-FAR-SO-GO-1

The Four Responsible Research and Innovation Process Requirements developed by RRI-Tools

1. Diversity and inclusion

   Diverse and inclusive RRI processes should call for the involvement of a wide range of stakeholders in the early development of science and technology, both for normative democratic reasons and to broaden and diversify the sources of expertise, disciplines and perspectives. In this respect, inclusive practices should lead to diverse practices. In reverse, diverse practices are more likely to be inclusive.

2. Openness and transparency

   Openness and transparency are conditions for accountability, liability and thus the responsibility. This is an important aspect for publics to establish trust in science and politics. However, more openness does not automatically lead to more trust: information has to be tailored to stakeholders' needs to make sense to them.

3. Anticipation and reflexivity

   Anticipation both concerns understanding how the present dynamics of research and innovation practices shape the future, and envisioning the future. Thus, one enables oneself to act on future challenges. In order to act adequately and be open to changes in direction, also reflexivity is required. This reflexivity implies learning about the definitions

of the problem(s) at issue, commitments, practices, and individual and institutional values, assumptions and routines.

4. Responsiveness and adaptive change

Responsiveness means responding to emerging knowledge, perspectives, views and norms. Responsiveness is a condition for adaptive change. RRI requires a capacity to change or shape existing routines of thought and behavior and the overarching organizational structures and systems in response to changing circumstances, new insights and stakeholder and public values.

Responsible Research and Innovation outcomes and relevant Key Performance Indicators (KPIs)

Adopting Responsible Research and Innovation is meant to aim the outcomes in three areas: learning outcomes, R&I outcomes and solutions to societal challenges. Areal of relevant KPIs are visible in the figure below.

FIGURE 26 RRI OUTCOMES AND RELEVANT KPIS

1. Learning outcomes	2. R&I outcomes	3. Solutions to societal challenges
1a Engaged publics	2a Ethically acceptable	3a Health, demographic change, and wellbeing;
1b Responsible actors	2b Sustainable	3b Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bio-economy;
1c Responsible institutions	2c Socially desirable	3c Secure, clean, and efficient energy;
		3d Smart, green, and integrated transport;
		3e Climate action, environment, resource efficiency, and raw materials;
		3f Europe in a changing world - inclusive, innovative, and reflective societies;
		3g Secure societies - protecting freedom and security of Europe and its citizens.

SOURCE: KUPPER ET AL. 2015

There are various approaches to RRI Key Performance Indicators. Two examples will be mentioned in this section: PRISMA-Project tool and ORBIT Self-Assessment Tool

(1) The PRISMA-Project RRI KPIs - a practical guideline for RRI created under Horizon 2020

Key Performance Indicators for Monitoring RRI could help align RRI activities with key business drivers and processes, stimulate the continuous improvement of RRI "performances", and allow consideration of RRI aspects in regular sustainability reporting at the organization level.

FIGURE 27 MEASURING RRI

	Item	RRI KPIs	Examples of quantitative parameters to measure KPIs
Anticipation & Reflection	1	Awareness of moral values	- Nr. of training sessions/meetings per year to learn and reflect on moral values connected to innovation strategy and core business
	2	Awareness of ethical issues of innovations	- Nr. of training sessions/meetings per year aiming to reflect on integration of social and ethical values into specific R&I/R&D projects
	3	Does the company embed moral values in its innovations?	- RRI principles formally integrated into the company's mission and vision (e.g. ethical code of conduct)
			- Nr. of R&I/R&D projects per year where moral values are actively and included into innovation strategies and technological design
	4	Does the company (actively) anticipate social effects of its innovations?	- Nr. of R&I/R&D projects per year where internal/external stakeholders were involved from the early stages in product development
			- Nr. of consultancy initiatives with other innovators and external advisors to discuss and identify social impacts of R&I/R&D projects
			- Nr. of stakeholder engagement initiatives organized per year by the company
Inclusiveness	5	Stakeholder engagement	- Nr. of R&I/R&D projects per year where active stakeholder engagement is foreseen into R&I/R&D plans
			- Nr. of R&I/R&D projects per year where engagement with end-users has been performed
	6	Gender Diversity	- Percentage of men and women involved in R&I/R&D function/teams in the company

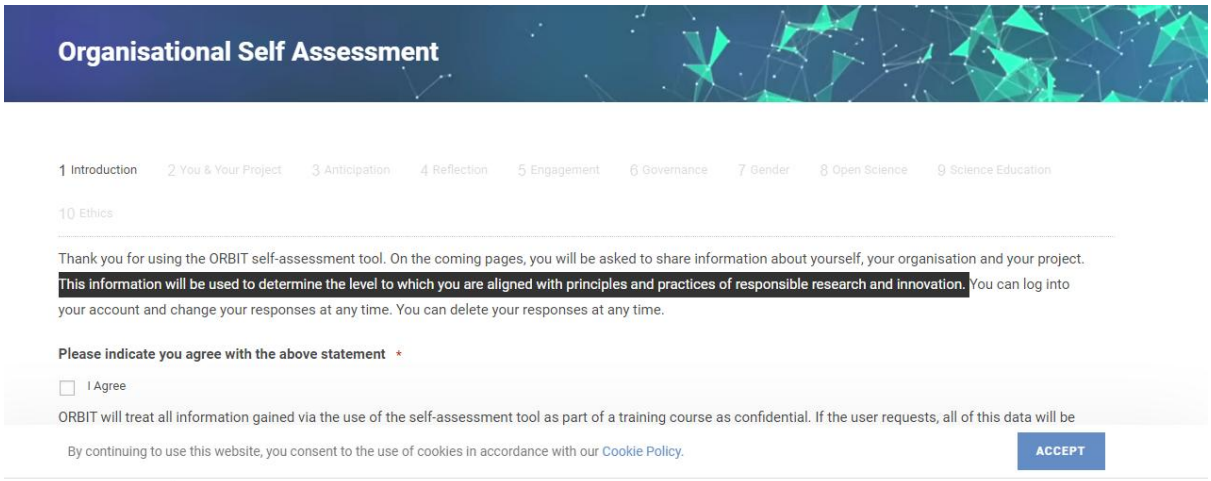
Responsiveness	7	Transparency and accountability about RRI-relevant choices	- Formal communication strategy established at company level to ensure most relevant RRI choices are explained in key company documents and/or the website
			- Nr. of patents per year aiming to integrate non-financial values
			- Nr. of open access publications
			- Nr. of events or webpages or channels in social media (or similar) disseminating project results to the general public
	8	Learning mechanisms to address public and social values in product development	- Nr. of user-centered approaches per year formally integrated into the company innovation model (e.g. user-centered design, co-creation)
			- Nr. of user experience tools per year carried-out to respond (new) societal demands and developments
	9	Capacity to align to societal goals	- Nr. of R&I/R&D projects per year addressing socially/ethically-oriented products/services
	10	Active monitoring of RRI impacts	- Percentage of R&I/R&D projects per year that apply impact analysis strategies (e.g. risk management, ethical/social impact analysis, etc.)
			- Formal external auditing procedures (at least yearly basis) in place to monitor non-financial values of the company

SOURCE: HTTPS://WWW.RRI-PRISMA.EU/ROAD-MAP-RRI-FOR-COMPANIES/

(2) ORBIT Self-Assessment Tool

The ORBIT self-assessment tool is implemented in the form of an online survey, consisting of 10 main sections: introduction, your project, anticipation, reflection, engagement, governance, gender, open science, science education and ethics (https://www.orbit-rri.org/tools/sat/#gf_81). The suggested tool is used to determine the level to which you are aligned with principles and practices of responsible research and innovation.

FIGURE 28 RRI SELF-ASSESSMENT



SOURCE: https://www.orbit-rri.org/tools/self-assessment-tool-free/

Why do universities should to start with raising awareness on RRI for all stakeholders?

All stakeholders involved in the research and innovation practice become mutually responsive and share responsibility regarding the outcomes and process requirement.

How do we support raising awareness?

- Delivering informative and interactive training in a multi-stakeholder setting through
- Lecture-style trainings
- Interactive workshops
- Teamwork
- Mentoring

What is more, multi-stakeholder approach is not a good option. Stakeholder-specific training can facilitate reaching the common ground when the language or knowledge of different stakeholders is wildly divergent.

How to embed Responsible Research and Innovation in HEIs strategies?

Embedding RRI principles in the innovation strategy of HEIs enables different opportunities but can also present some challenges, especially in the implementation phase. The processes should be coordinated delicately to deliver desirable RRI outcomes. Key points are:

1. Raising Awareness on RRI Principles for All Stakeholders
2. A Step-by-step plan for the set-up of a living lab under RRI principles
3. Useful Tools and Methods for RRI-proof living labs

Practical hints

1. **Know your audience:** identifying the expectations, learning styles and learning outcomes of each stakeholder can support the proces.
2. **Learning from errors:** experimental investigations indicate that errorful learning followed by corrective feedback is beneficial to learning.
3. **Promoting reflective learning among the stakeholders:** Reflective learning involves actively monitoring and assessing your knowledge, abilities, and performance during the learning process to improve the process and its associated outcomes.

Self-evaluation tool for HEI – the need

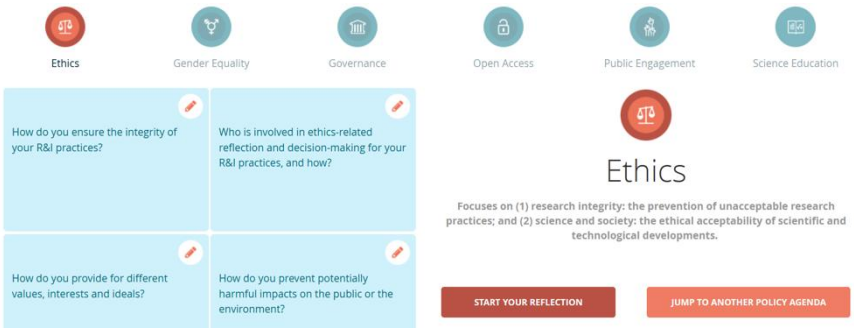
- There is a necessity of developing a self-evaluation tool to evaluate the level of embeddedness of RRI in the HEIs.
- The process must be mastered, and the planning must be made from a self-critical perspective that will support entrepreneurship.

The core factors that make up the RRI vision can be summarized as:

- factors related to cooperation and power,
- factors that ensure the social and moral wellbeing of people and, in doing so, can incorporate future sustainability plans into the process,
- factors based on process improvement, which are compatible with the principle of cooperation for individuals and institutions.

Examples of existing RRI related self-evaluation tools

FIGURE 29 RRI SELF REFLECTION TOOL



SOURCE: HTTPS://RRI-TOOLS.EU/EN/SELF-REFLECTION-TOOL

FIGURE 30 ORBIT SELF ASSESSMENT TOOL



SOURCE: HTTPS://ORBIT-RRI.ORG/TOOLS/SELF-ASSESSMENT-TOOL/

FIGURE 31 RESPONSIBLE INNOVATION SELF-CHECK TOOL

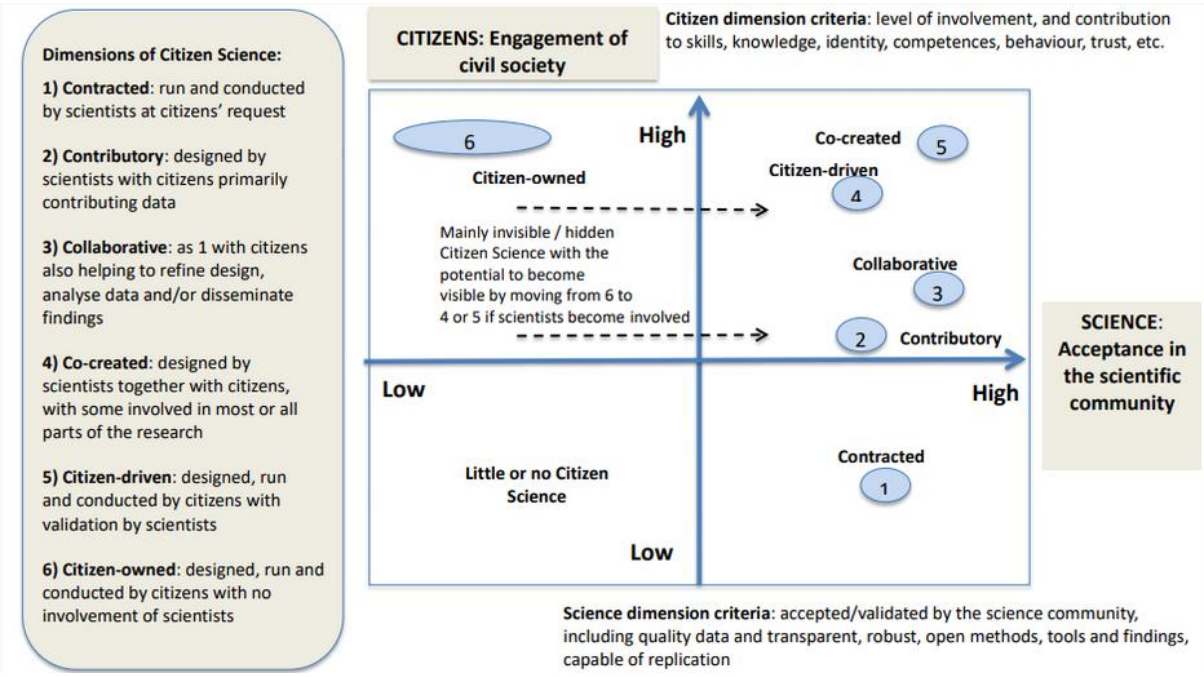


SOURCE: HTTPS://INNOVATION-COMPASS.EU/SELF-CHECK/

5.2. Citizens Science - concept

Citizen science is research conducted with the general public or amateur/non-professional researchers or participants in science, social science and many other disciplines. There are variations in the exact definition of citizen science, and different individuals and organisations have their own interpretations of what citizen science encompasses (Vohland ed., 2021). Figure below shows Citizens Science analytic dimensions.

FIGURE 32 CITIZENS SCIENCE ANALYTIC DIMENSIONS



SOURCE: MANZONI ET AL. (2021)

Citizen science includes academics and young researchers creating local living labs, conducting interviews, developing dialogue forums, organising local and national workshops and using an app specifically designed to collect and share everyday experiences of inclusion and exclusion. It also includes a collective evaluation of our impact and how the co-created citizen social science worked in the different cases, and in each case.

Citizen Social Science is defined as involving equal collaboration between citizen groups (co-researchers) that are sharing a social concern and academic researchers. Youth Citizen Social Science involves equal collaboration between young citizen scientists and academic researchers. However, involving young citizen scientists in research processes on an equal basis with academic researchers poses a whole new set of challenges that need to be looked into carefully

(see: https://www.youcountproject.eu/about-the-project/what-is-youth-citizen-science).

Examples of real-world applications for RRI in the context of involving young citizens in the innovation process.

Example 1: Youth Innovation Labs

Establishment of innovation labs where young citizens can work collaboratively on real-world problems. Implementation steps are:

- **Identify Local Issues:** Organize idea generation sessions where youth can identify and prioritize issues in their communities (e.g., environmental concerns, health challenges).
- **Workshops and Training:** Provide workshops focusing on design thinking, project management, and prototyping.
- **Prototype Development:** Allow participants to develop prototypes or digital solutions addressing the identified problems using available tools and technologies.
- **Showcase Events:** Organize events where teams present their solutions to a panel of community leaders, educators, and entrepreneurs for feedback.

Expected outcomes - this fosters a sense of ownership and responsibility in young citizens, encouraging them to be active participants in problem-solving.

Example 2: Hackathons for Social Good

Organizsation of hackathons focused on societal (ecological) challenges, where young citizens develop technology-based solutions. Implementation steps are:

- **Define Themes:** Select themes that resonate with young people, such as climate change, mental health, or food waste.
- **Collaboration with Experts:** Partner with local businesses, universities, and NGOs to provide mentorship and resources.
- **Team Formation:** Encourage diverse teams that bring together different skills (e.g., coding, design, marketing).
- **Pitch Sessions:** Have participants present their projects to a panel and the wider community for feedback and potential funding.

Expected outcomes - participants learn about teamwork, project development, and innovation, while also working on issues they care about.

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