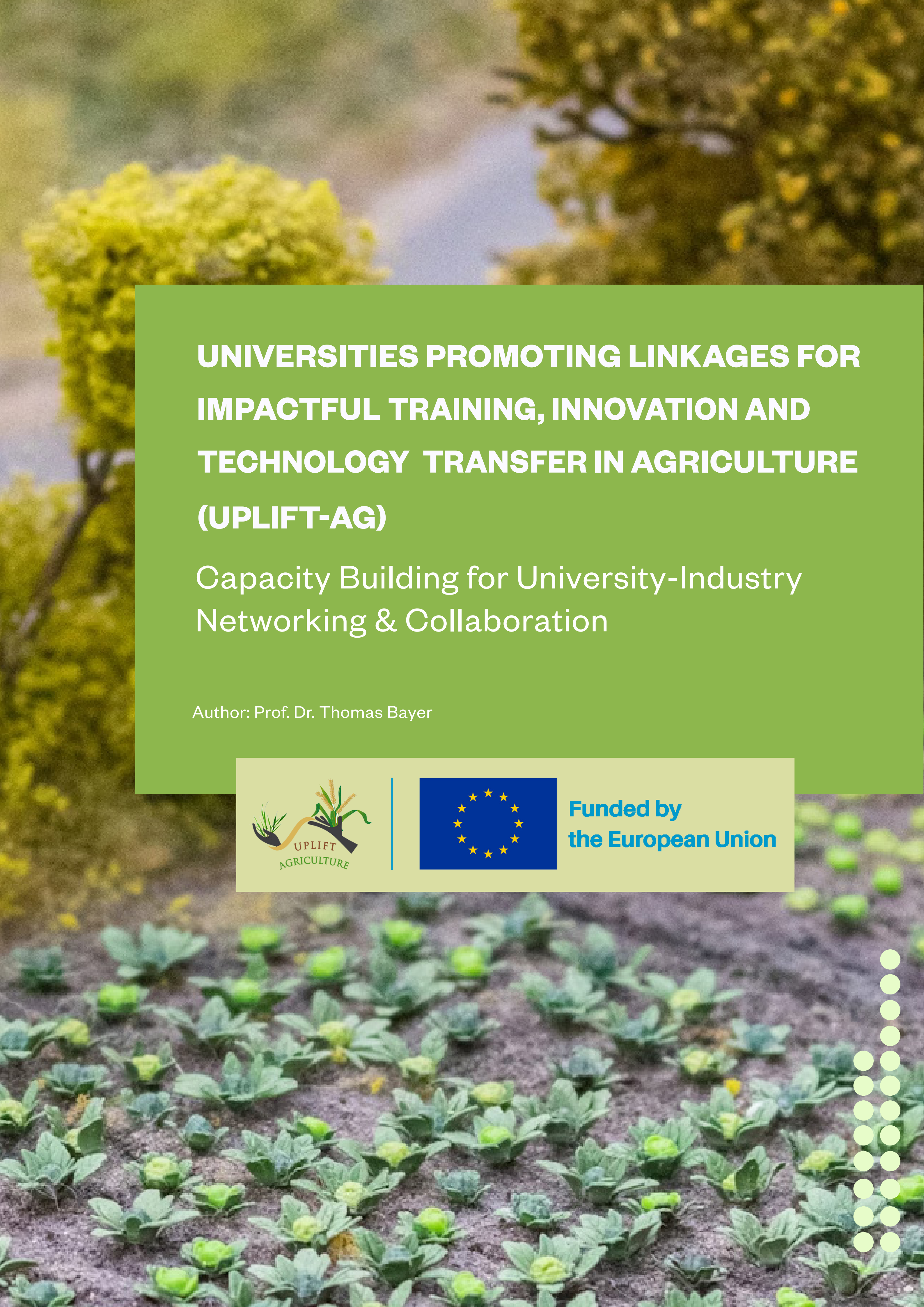

UNIVERSITIES PROMOTING LINKAGES FOR IMPACTFUL TRAINING, INNOVATION AND TECHNOLOGY TRANSFER IN AGRICULTURE (UPLIFT-AG)

Capacity Building for University-Industry Networking & Collaboration

Author: Prof. Dr. Thomas Bayer

UPLIFT AGRICULTURE

Funded by the European Union

CONTENTS

INTRODUCTION

0.1 Erasmus+ project UPLIFT-Ag

Agricultural higher education institutions (HEIs) in Kenya, Rwanda, Burundi, and Zimbabwe are expected to deliver quality training, impactful research, and effective technology transfer. Yet, outdated curricula, theory-heavy teaching, weak industry collaboration, and limited innovation capacity undermine their ability to prepare graduates for employment and entrepreneurship. Many HEIs also lack systems to protect and commercialize intellectual property, and innovation centres often operate below capacity.

The UPLIFT-Ag project seeks to address these challenges by strengthening the institutional effectiveness of agriculture-teaching HEIs. Its objectives are to:

1. Improve agricultural teaching through industry engagement and co-teaching;
2. Enhance HEI–industry collaboration for relevant curricula and research;
3. Build innovation and entrepreneurial capacity by strengthening incubation centres and technology transfer offices.

The project brings together nine African HEIs and three European partners (Germany, Italy, Denmark), with broad participation from agricultural stakeholders. Funded by the Erasmus+ programme (Grant Agreement No. 101129421), UPLIFT-Ag has a budget of EUR 789,900 and runs from December 2023 to November 2026.

Through co-designed curricula, interactive teaching, joint research agendas, and stronger innovation systems, UPLIFT-Ag supports more responsive, practice-oriented, and entrepreneurial agricultural education in Africa, thus helping HEIs drive food security, inclusive employment, and sustainable development.

Website:
https://uplift-ag.org/

Project Coordinator:
Prof. Maina Mwangi
School of Agriculture and Environmental Sciences
Kenyatta University

Partners:

Kenya
Kenyatta University
Chuka University
Taita Taveta University
Burundi
The University of Ngozi - Burundi
University of Burundi
Rwanda
University of Rwanda
University of Lay Adventists of Kigali
Zimbabwe
Chinhoyi University of Technology
Zimbabwe Open University
European Union Partners
Università Politecnica delle Marche
Neu-Ulm University of Applied Sciences

Picture 1: *Capacity building workshop on 29. October 2025 at Chuka University*

0.2 Goals of the capacity building programme

As part of the UPLIFT-Ag project, the capacity building programme was developed with the goal to strengthen the ability of agricultural HEIs and their partners to collaborate effectively in driving innovation, research, and knowledge transfer. Building on UPLIFT-Ag's broader objectives, the programme focuses on developing both individual competencies and institutional practices that support impactful partnerships between universities and the industry.

The programme is designed to help lecturers, researchers, and decision makers at universities, as well as representatives from industry, government, and civil society organizations, to see and act upon the opportunities that arise from collaboration. Participants will learn how to connect teaching, research, and innovation with real-world agricultural challenges, co-create knowledge, and establish partnerships that generate tangible benefits for students, universities, industry, and society.
The present report serves as a compendium to practice-oriented teaching, research and transfer, to help African HEIs gain an overview of these important topics. It is accompanied by a set of power point slides used during interactive training sessions as part of the project activities. Together, these two resources can facilitate multiplication of the content to various stakeholders.

Picture 2: *Capacity building workshop on 29. October 2025 at Chuka University*

Target Groups

Lecturers and researchers at universities
Decision makers at universities
Representatives of outside-university organizations (companies, communities, governmental and non-governmental organisations)*
Decision makers at such organizations

(*) The many different types of outside-university organizations will be grouped together in this programme under the terms "industry" and/or "industry partners"

Box 2: *Target groups of the capacity building programme*

Learning outcomes

Understanding the relevance of university-industry linkages for the creation of innovations
Enabling the initiation of university-industry relations on individual and organizational levels
Knowing how applied research can be conducted effectively by university and industry representatives in collaboration
Learning how meaningful knowledge transfer between university and industry partners can start at student teaching level
Understanding the opportunities for both sides in the commercialization** of research
Contributing to a common mindset and culture of knowledge sharing and joint knowledge creation

(**) The term "commercialization of research" is used in this programme in a broad sense, referring to engagement and relationship-building processes that have the potential to develop into commercial collaborations between industry and university partners.

Box 1: *Learning outcomes of the capacity building programme*

0.3 How to use this document

This predominantly text-based document serves as an accompanying "course script," either for rehearsal, self-paced learning or as a memory aid. It is accompanied by a set of slides meant to facilitate interactive face-to-face learning.

Click to access the full presentation slides on the UPLIFT-Ag website.

https://uplift-ag.org/work-packages#wp5

MODULE 1 : ESTABLISHING LINKAGES BETWEEN INDUSTRY AND UNIVERSITIES

1.1 Why is it important?

1.1.1 Driving factors for university-industry collaboration

Collaboration between universities and industry has become increasingly essential in today's fast-changing economic and technological landscape. By understanding these drivers, universities and industries can build stronger, mutually beneficial partnerships that address both practical and societal needs. What are the main advantages of university-industry collaboration?

- **From the university perspective:** Academic institutions are generating ever-increasing volumes of scientific knowledge, while research costs continue to rise. Universities often face difficulties securing funding and resources and are under pressure to commercialize their knowledge and research outputs (TEBD, n.y.; Ervits, 2024).

- **From the industry perspective:** Companies face rapid technological transformations, shortening product and service life cycles, and intense global competition. They also require financial support, particularly for research activities, and need skilled human resources to remain competitive (TEBD, n.y.; Ervits, 2024).

- **From society's perspective:** There is a growing expectation that universities should play a central role in economic development. Research results are expected to translate into positive economic outcomes through commercialization, while training programs should equip students with skills relevant to fast-evolving technologies. Moreover, society increasingly looks to universities for solutions to pressing social, ecological, and economic challenges (TEBD, n.y.; Ervits, 2024).

Collaboration between universities and industry is driven by variety of factors. Understanding these motivations helps univers ties and companies design collaborations that are mutually ben ficial, foster innovation, knowledge exchange, and societal impact.

The motivations can be grouped into several categories (Ankrah et al., 2015, p. 392):

1. Necessity

Collaboration is often driven by external and internal pressures. Universities align with government policies and their own strategic goals, while companies respond to government initiatives and pursue their business objectives. These pressures create a shared necessity to cooperate. For example, a university may collaborate with a renewable energy firm to support a national green energy initiative.

2. Reciprocity

Partnerships allow both sides to access complementary resources. Universities benefit from expertise, state-of-the-art equipment, and opportunities to employ graduates, while companies gain access to students for internships or hiring and benefit from faculty expertise. For instance, an engineering department may provide lab facilities for a company project, while students gain practical experience.

3. Efficiency

Collaboration increases the efficiency of research and innovation. Universities gain funding, practical applications for theoretical knowledge, and business opportunities. Companies can commercialize university technologies, reduce costs, accelerate product development, and train future employees. For example, a university developing a new battery technology can collaborate with an industrial partner to test and market it, benefiting both sides.

4. Stability

Partnerships help both sides manage risk and ensure continuity. Universities can develop research networks and test theories in practical settings, while companies can solve specific technical problems and share the burden of innovation. For example, a pharmaceutical firm might co-develop a new drug with a university lab, sharing research risks and resources.

5. Legitimacy

Collaboration enhances credibility and societal recognition. Universities strengthen their reputation and promote innovation, while companies gain public trust. For instance, a university-industry project on sustainable packaging can demonstrate social responsibility, enhancing the image of both the university and the partner company.

6. Asymmetry

Certain motivations are unique to one side, creating potential for friction. Companies typically prioritize maintaining control over proprietary technologies. For example, a tech company may license software developed at a university while retaining exclusive rights to commercialize it.

7. Economic-related motivations

Both sides pursue tangible economic outcomes. Universities can generate patents and revenue, while companies benefit from improved products, competitiveness, and access to grants. For instance, a joint project on advanced robotics may result in new commercial products and patents, generating economic value for both sides. Such partnerships also contribute to the overall economic development of the region.

8. Social-related motivations

Collaboration benefits society and education. Universities expose students and faculty to practical challenges, stimulating research, while companies demonstrate social responsibility and address societal needs. For example, a university-industry partnership developing affordable water purification systems provides learning opportunities for students and solutions for communities.

9. Institutional-related motivations

Long-term institutional benefits strengthen both sides. Universities can influence research directions, develop new programs, and access networks, while companies guide research, test products, and develop talent. For instance, a joint cybersecurity research centre allows the university to expand its curriculum and the company to benefit from trained graduates and applied research.

Concluding from all these points, establishing linkages between universities and industry is crucial not only for the institutions but also for society. Collaborations help translate research into practical solutions for social, ecological, and economic challenges, while improving graduate employability by providing students with relevant skills and work experience. Companies benefit from access to knowledge, expertise, and talent, and together both sides drive innovation, regional economic growth, and sustainable development (TEBD, n.y.; Ervits, 2024; Ankrah et al., 2015, p. 392).

1.2 Existing gaps and implications

1.2.1 The R&D Valley

However, university-industry collaboration does not always proceed smoothly. Several gaps exist, and these can have significant implications. One well-known challenge is the so-called "valley of death" in research and development, which describes the substantial gap between an initial research result with a proof-of-concept and its full commercialization as a product, service, or software through scaled industrial processes. Many promising research outcomes, particularly from public research organizations and universities, fail to cross this gap due to lack of funding, interest, awareness, or other barriers, resulting in the loss of valuable resources and knowledge.

The typical stages of bringing research results with early proofs-of-concept to the commercial market include:

1. Feasibility studies:
Initial analyses evaluate the factors and options for turning research into potential products.

2. Technical validation and prototyping:
The most promising options are tested from relevant technical perspectives, and first working prototypes are developed.

3. User evaluation:
Prototypes are presented to potential customers or users to assess their fit to needs, usability, and practical applicability.

4. Industrial scale-up and market launch:
Optimized product concepts are put into scalable production and introduced to the market through appropriate marketing and sales channels.

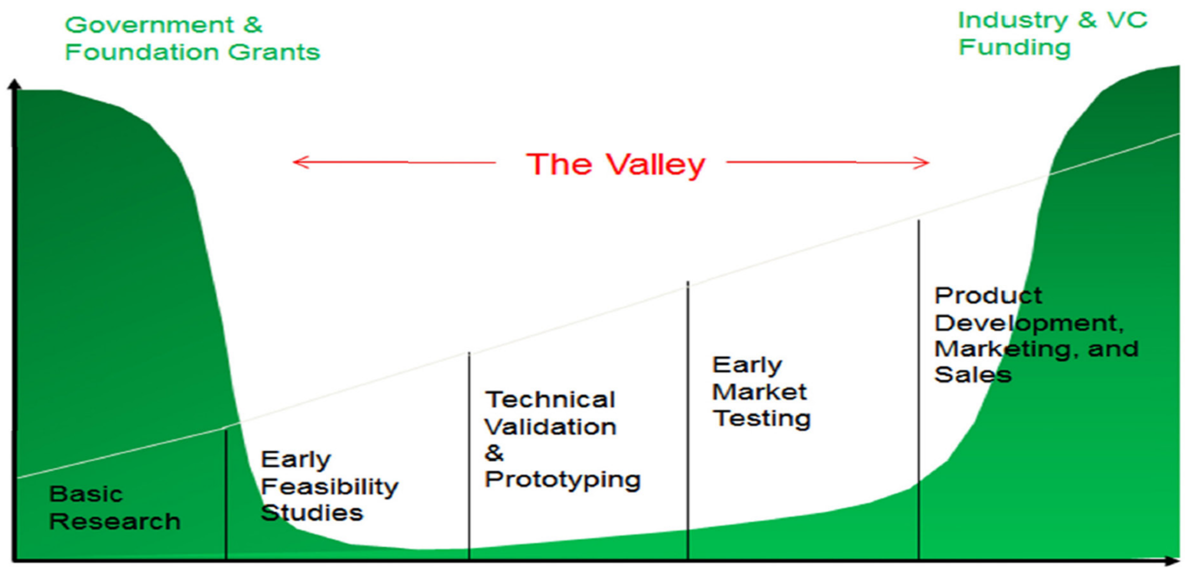

Figure 1: *The so-called ‚valley of death': precious resources and know-how are lost for societal progress*
Source: © Orin Herskowitz, Columbia University, NYC

These steps require financial investment, expertise from both technical and market specialists, and process knowledge to successfully bring innovations to market (see Figure 1).

Bridging the gap between research and commercialization can follow two main approaches, depending on whether the innovation originates from basic research or from identified market needs.

The **push strategy** is driven by basic research findings that were not initially intended to solve a specific real-world problem. These might include new materials, formulas, or substances. Researchers must identify potential practical applications and then convince investors or industry partners to help develop these findings into marketable products. For example, a university lab might discover a new biodegradable polymer; the researchers would need to demonstrate potential applications, such as eco-friendly packaging, to attract commercial interest. This approach typically requires significant effort from the researchers, as the results are actively "pushed" toward commercialization.

The **pull strategy** starts from verified needs or demands from users or industry partners. Applied research is guided by a clear problem statement, making the potential for successful commercialization evident from the outset. For instance, an electronics company might request a more efficient battery design, and a university engineering team develops a prototype to meet that need. In this case, industry partners are often ready to support scaling, and investors can more easily see the commercial potential, requiring less effort from researchers to engage partners.

Regardless of the approach, successful commercialization depends on strong, collaborative relationships between academic researchers and industry representatives. Such linkages help ensure that research findings move effectively from the laboratory to real-world applications, bridging the gap between innovation and market-ready solutions.

1.2.2 Factors facilitating or impeding university-industry collaboration

Successful collaboration between universities and industry in the agricultural sector depends on a combination of resources, management, technology, and broader social and political contexts (Ankrah et al., 2015, p. 397).

Capacity and resources form the foundation of effective partnerships: universities require adequate funding, skilled staff, and modern facilities to conduct relevant research. Well-designed incentive structures can encourage researchers to engage in applied work rather than focusing solely on publishing in high-impact academic journals. Technology transfer offices and extension services provide essential infrastructure for linking academic research with agribusiness, while capacity constraints among smallholders and agribusinesses must also be addressed. Without these resources, even promising research may fail to reach farmers or local industries.

Legal and organizational conditions also matter. Rigid university policies on intellectual property and licensing can hinder commercialization, while research with farmers, livestock, or communities must comply with ethical and regulatory standards. Strong leadership, clear communication, trust, and the presence of collaboration champions can help overcome these challenges. Mechanisms such as internships and joint projects with agribusinesses further strengthen relationships and facilitate knowledge transfer.

Technology, political, and social factors also shape the outcomes of university–industry collaboration. The nature of innovations influences transferability: tacit knowledge, such as traditional farming techniques adapted through research, is more difficult to transfer than explicit innovations like seed varieties or farm software. Political support in the form of policies, subsidies, or advisory programs can increase the feasibility of partnerships, while social credibility enhances engagement. Additional factors, including awareness of university research capabilities, the role of intermediaries such as extension agencies, the risks involved in farming trials, differences across sectors, and geographic proximity, also influence results.

By addressing these interconnected factors, universities and industry can create sustainable collaborations that translate research into practical solutions, improve farmer livelihoods, foster innovation, and support regional development.

1.2.3 Potential drawbacks and barriers for university-industry collaboration

While collaborations between universities and industry offer many benefits, they also come with potential challenges (Ankrah et al., 2015, p. 399). For universities, working closely with agribusinesses can sometimes threaten research independence. For example, a project developing a new drought-tolerant maize variety may be pressured to focus on short-term commercial results rather than long-term field trials, or confidentiality agreements may limit the sharing of findings with other researchers. Staff time and energy may also be diverted from teaching or fundamental research

.From the industry side, slow university procedures can delay the development of useful technologies, such as improved irrigation systems, and collaboration may require additional managerial effort. Differences in priorities may lead to impractical solutions if academic recommendations are too theoretical, or conflicts may arise over intellectual property, data sharing, or the timing of publishing results. Financial and market risks also exist if a new technology does not perform as expected.

The UPLIFT-Ag baseline study (WP2) confirms that both universities and industry experience these barriers in practice, emphasizing the importance of clear agreements, communication, and aligned expectations to make collaborations successful (UPLIFT-Ag, WP2, n.d.). By anticipating these challenges, universities can design partnerships that protect academic integrity, reduce risk, and ensure that research benefits farmers, students, and the wider community.

https://uplift-ag.org/work-packages#wp5

1.2.4 How to overcome potential barriers

To address the challenges and barriers in university-industry collaboration, it is essential to actively manage potential sources of conflict or misunderstanding and focus on creating a shared understanding. Success depends on developing a common mind-set between partners and leveraging as many facilitating factors as possible, including those related to resources, management, technology, and social or political support.

A key step is advancing inputs: the industrial partner must share sufficient knowledge about their specific context so that the academic team understands the company's needs and the value they can contribute. Commitment and trust are also critical, as both sides must recognize that time, effort, and financial resources are being invested and that the risks of failure affect everyone involved.

Finally, cultivating a long-term relationship is important. It may take time before collaborative efforts yield tangible results. Initial smaller joint activities can serve as a "test phase" to evaluate personal fit and establish a foundation for deeper collaboration.

1.3 Innovation & technology transfer – a brief introduction

"Research transforms money into knowledge … technology transfer transforms knowledge into money."

Geoffrey Nicholson, "Father of the Post-It"

1.3.1 Turning failures into breakthroughs: the story of the Post-it notes

Figure 2 : *3M's Post-It notes; source: www.hardwarezone.com.sg*

The story of 3M's Post-It notes (see Fig. 2) provides a valuable lesson for researchers and students in agricultural universities: innovation often comes from unexpected failures, and persistence combined with creative thinking can turn setbacks into major successes (Whitefield, 1985).

3M, originally founded as Minnesota Mining & Manufacturing, is a multinational company known for its innovations in adhesives, consumer products, and other industrial solutions. In 1973, 3M researchers Spence Silver and Bob Olivera developed an adhesive that failed to meet conventional standards it didn't stick well at all. Initially considered a "failed" product, it seemed to have little practical value. The breakthrough came when Arthur Fry, a 3M employee and part-time church choir singer, encountered a practical problem. While singing in the choir, he used slips of paper to mark his place in the hymnal, but they kept falling out. He needed a marker that would stick temporarily without damaging the pages a "permanently temporary" solution. Remembering Silver and Olivera's unusual adhesive, Fry realized it could solve his problem. By combining his real-world observation with their invention, he created what would become the Post-It note.

Fry's idea needed someone to champion it within 3M to reach full commercialization. Geoffrey Nicholson, the new-product manager for 3M's commercial tape division, recognized the potential of Fry's concept, guided its development, and facilitated its introduction to the market. Nicholson's vision, persistence, and advocacy earned him the title "father of the Post-It," as he played a decisive role in transforming a quirky idea into a globally successful product.

However, bringing this novel idea to market was challenging. 3M had to refine the adhesive formula, design new machines to produce the notes, and identify the right distribution channels. Initial sales through traditional distributors were slow. The turning point came when 3M shifted to direct distribution to consumers, reaching the people who actually used the product in offices, schools, and homes. This approach revealed strong demand, quickly boosting sales and eventually exceeding $100 million per year, making Post-It 3M's most successful product (Whitefield, 1985).

For agricultural universities in East Africa, this story illustrates several key lessons:

- **Failures can be opportunities** – Experimental results that initially seem unpromising may lead to valuable solutions when applied creatively.
- **Solve real-world problems** – Understanding farmers' challenges, such as seed storage or irrigation, can reveal new applications for research outputs.
- **Engage end users early** – Iteratively testing solutions with farmers or local communities increases the likelihood of adoption and impact.

By fostering a culture of experimentation, encouraging cross-disciplinary collaboration, and maintaining close links with communities and industry partners, agricultural universities can increase the chances that research findings will lead to practical, widely adopted innovations.

1.3.2 A modern understanding of technology transfer: the three missions of a university

Modern understanding of technology transfer emphasizes a recursive and ongoing exchange of ideas, technologies, knowledge, and capabilities among the key actors of national innovation systems, including universities, industry, government, and communities or NGOs. This contrasts with the traditional, "one-way" model, where knowledge created at universities or research organizations was simply transferred to industry or community partners. While this one-way approach has sometimes succeeded, it often limited the adoption and practical application of innovations because the research outputs did not adequately match the needs of companies, users, or communities. A more interactive, multi-actor approach ensures that innovations are co-developed, better aligned with real-world needs, and more likely to achieve tangible impact. All four actor groups in an innovation system, namely industries, universities, communities and government organizations, have special skills, knowledge, technologies and facilities. The recurring exchange and flow of capabilities and ideas between these actor groups generates meaningful innovation in such a system (see Fig. 3).

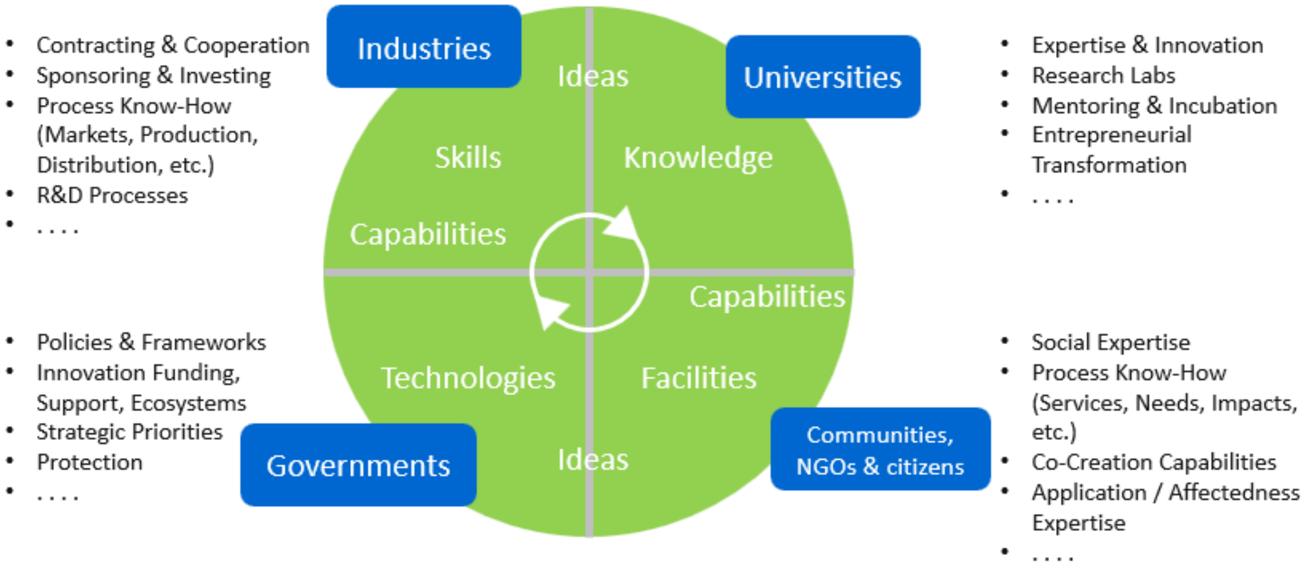

Figure 3: *exchanges in a technology transfer network; source: adapted from https://ec.europa.eu;*

The specific role of universities in a society's technology transfer and innovation system is captured by their so-called Third Mission. Beyond the traditional missions of education and research, the Third Mission emphasizes the entrepreneurial engagement of universities with societal and economic needs, ensuring that knowledge and innovations are actively applied to real-world challenges. A university's three missions are illustrated in Fig. 4.
For agricultural universities, this can include developing improved crop varieties in collaboration with farmers, creating sustainable irrigation technologies with local communities, or providing training and advisory services to agribusinesses. By embracing the Third Mission, universities not only advance scientific knowledge but also enhance societal impact, economic development, and graduate employability, making research outputs directly relevant to the regions they serve.

1. **Education:**
   qualification of society's human capital with relevancy to practice

2. **Research:**
   generation of new knowledge valuable for society's challenges and goals

3. **Transfer (incl. "Outreach"):**
   entrepreneurial engagement with societal and economic needs and demands

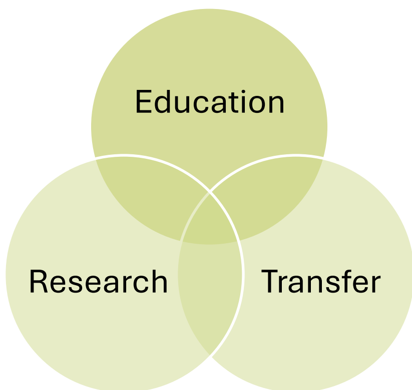

Figure 4: *Three missions of a university*

1.3.3 Innovation processes and ecosytems

"An invention is any useful process, machine, composition of matter, or any new or useful improvement of the same." (tlo.mit.edu)

"An invention is a unique or novel device, method, composition, idea or process."
(en.wikipedia.org)

"Innovation is: production, adoption/assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome."

Box 3: *definitions of invention and innovation*

Economically viable and successful innovations often do not involve creating something entirely new. More commonly, they arise from combining or adapting existing technologies, processes, ideas, or materials in novel ways to address specific problems or improve outcomes. The process can be understood in three practical steps:

1. Identify an existing technology, process, idea, or material that has potential for adaptation.
2. Combine or apply it in a new or improved way to create added value or solve a problem.
3. Implement the solution to address a challenge or enhance impact, whether in productivity, efficiency, sustainability, or societal benefit.

Innovation is often about creative recombination and practical application, rather than starting entirely from scratch.

"It takes a village to raise a child, and it takes an ecosystem to scale an innovation."
(International Development Innovation Alliance, n.d.)

Successfully scaling an innovation requires the coordinated efforts of many active players within a so-called innovation ecosystem. An innovation ecosystem is the network of organizations, institutions, and individuals that interact to generate, develop, and bring innovations to market. Governments play a critical role in enabling, supporting, and fostering these ecosystems, helping to create the conditions for collaboration and occasionally facilitating connections among different actors.

The innovation process can be understood as a series of stages, each supported by specific ecosystem players (International Development Innovation Alliance, n.d.), as illustrated in Fig. 5

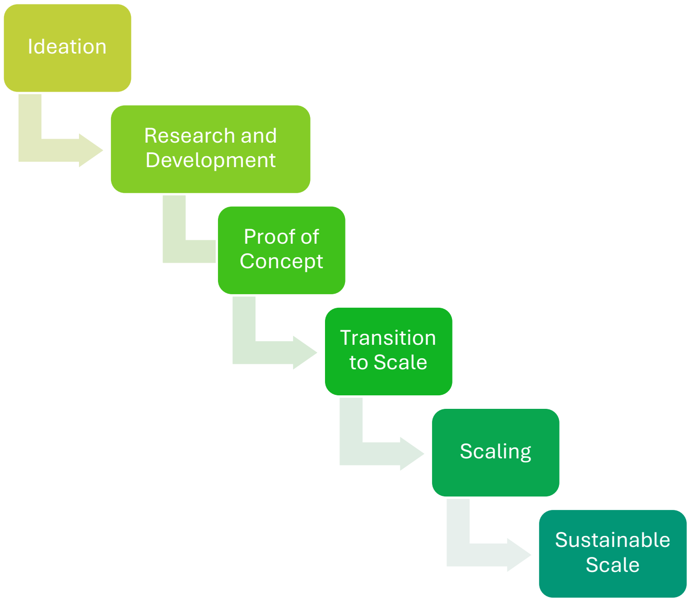

Figure 5: *Stages of the innovation process*

4. **Ideation:** Ideas often emerge from research institutions, universities, and startups. Input from professionals, civil society organizations, and development agencies can help identify pressing societal and agricultural challenges that innovations could address.
5. **Research and development (R&D):** Universities, research centers, and private companies collaborate to develop potential solutions, with incubators and accelerators providing guidance, mentorship, and infrastructure to transform ideas into tangible prototypes.
6. **Proof of concept:** Innovations are tested and validated in controlled or small-scale environments. Here, startups, private companies, and intermediaries play a role in evaluating feasibility, while angel investors, venture capitalists, and friends and family may provide early-stage funding.
7. **Transition to scale:** Once proven, innovations require support to move toward larger-scale deployment. Market facilitators, private equity firms, and government programs can help navigate regulatory requirements, supply chains, and market entry.
8. **Scaling:** Wider adoption of the innovation depends on sustained collaboration among private companies, startups, development agencies, and civil society organizations to reach target users, such as smallholder farmers or agribusinesses.
9. **Sustainable scale:** Finally, achieving long-term impact requires creating feedback loops, continuous improvement, and supportive policies. Governments, research institutions, and industry partners ensure that innovations remain effective, accessible, and adaptable to changing contexts.

By understanding the stages of innovation and the roles of different actors, agricultural universities can better position themselves within these ecosystems. They can not only contribute research and technical expertise but also serve as connectors, facilitators, and trainers, ensuring that innovations move efficiently from ideas to sustainable, real-world solutions.

"... innovation arises by combining knowledge of different types from different sources in new ways. In turn, the interaction between knowledge carriers, namely the communication between them, plays a decisive role."
(Piller, F. et al., 2021, p. 150)

Scaling meaningful innovations always involves multiple parties within an innovation network. Effective communication between these diverse knowledge carriers is therefore a key success factor in technology transfer and innovation scaling. Technology brokers, such as university technology transfer offices (TTOs) or non-partisan national and international agencies, play a vital role in facilitating communication and collaboration among the relevant actors in the network (see Fig. 6).
A fundamental prerequisite for this process to succeed is the competence and willingness of individuals to actively engage in communication and interaction. This applies to all participants, including researchers, industry representatives, investment experts, and other stakeholders. Without the motivation and ability to share knowledge, coordinate activities, and build trust, even the most promising innovations may fail to reach their full potential (Uecke, 2012, p. 78; Piller et al., 2021, p. 151).

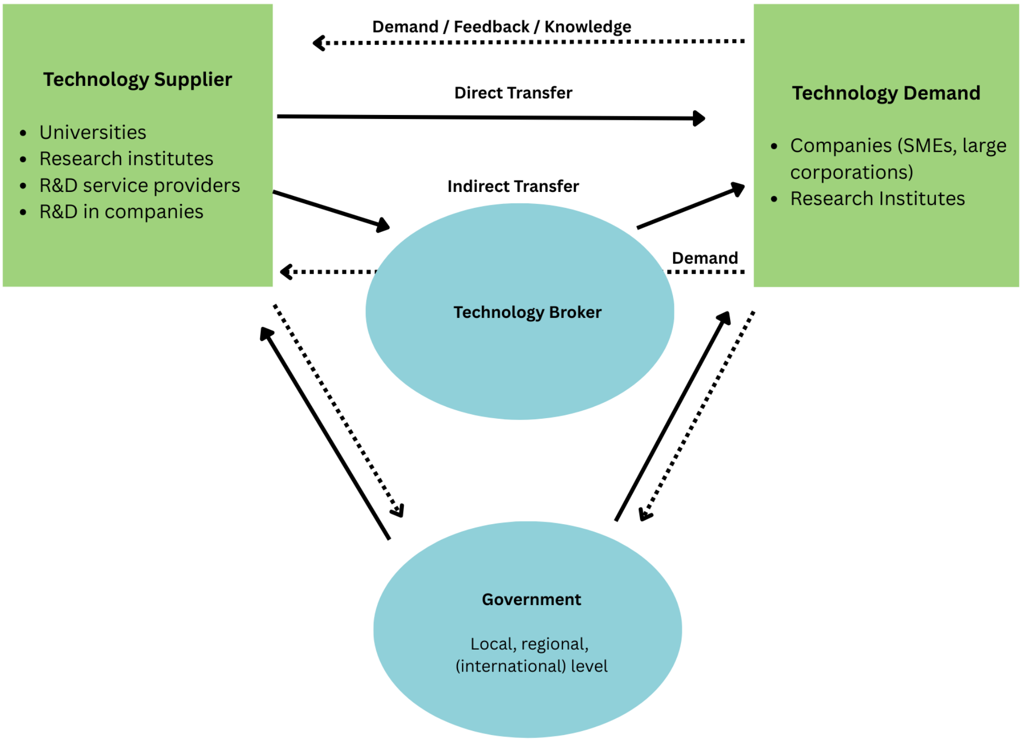

Figure 6: *Processes in an innovation ecosystem; source: recreated from Uecke. O. (2012), p.78*

1.4 How to establish university-industry relationships

1.4.1 Formal and informal approaches

Successfully establishing collaborations between universities and industry requires navigating both formal structures and informal relationship dynamics. These two dimensions, though distinct, are deeply intertwined and mutually reinforcing.
On the formal side, collaboration unfolds through a structured process, often described in five key stages (Ankrah et al., 2015, p. 394):

1. **Partnership identification:** Begin by researching organizations that could be relevant collaborators. Gather information on their areas of expertise, previous projects, strategic goals, and industry standing.
2. **Establishment of initial contacts:** Reach out to relevant representatives. Leverage prior relationships if available to facilitate trust and open dialogue.
3. **Partner assessment and selection:** Evaluate the organization's willingness to collaborate, its capabilities, strategic goals, and alignment of research interests. Select partners with the greatest potential for mutual benefit.
4. **Partnership negotiation:** Define shared objectives, resources, and realistic first projects. This stage requires clear communication, compromise, and alignment of expectations.
5. **Formalize agreements:** Conclude agreements covering responsibilities, resource allocation, timelines, and intellectual property rights, ensuring clarity and preventing conflicts.

Alongside this formal process, the informal, relational side focuses on building trust and mutual understanding between the individuals involved:

1. **Credible determination to collaborate:** Show commitment and genuine interest in working together.
2. **First project with mutually beneficial results:** Start small to ensure early wins that build credibility.
3. **Established mutual trust:** Foster openness and reliability through consistent communication and shared successes.
4. **Developing a long-term relationship**: Maintain engagement beyond the first project to deepen collaboration.
5. **Developing and realizing advanced projects**: Leverage trust and shared learning to tackle more complex and ambitious initiatives.

Successful relational collaboration does not emerge from formal agreements alone but from the way partners interact and grow together over time. It begins with a genuine effort to understand one another's needs and areas of expertise, which creates a foundation for mutual learning. From there, shared topics of interest help focus the collaboration, while a careful balance between flexibility and clear goals keeps the partnership both adaptive and purposeful. Formal prerequisites such as contracts or NDAs provide necessary structure, yet trust is built just as much by starting with manageable projects and realistic timelines. Along the way, openness about progress, achievements, and setbacks ensures transparency, while appreciation and support nurture motivation. When a project concludes, taking time for structured reflection allows lessons learned to be carried forward, and celebrating successes reinforces the sense of shared achievement that makes future collaborations stronger. While formal processes provide structure and clarity, the relational side ensures trust, mutual understanding, and long-term commitment, making the collaboration resilient and productive.

1.4.2 Effective practices to build university-industry relationships

There are many ways to establish meaningful connections between university staff and industry representatives. Fig. 7 gives an overview.

Figure 7: *Effective practices to build university-industry relationships*

Joining business or industry associations allows academics to meet professionals and learn about relevant sector topics. Offering executive or employee training brings scientists and lecturers into direct contact with industry, while alumni who move into companies often act as natural bridges, making networking events with graduates particularly valuable. Universities can also host industry-focused events or student hackathons on real-world problems, providing opportunities for collaboration and hands-on engagement. Online platforms, such as specialized social media groups, offer additional ways to connect with like-minded professionals. Attending industrial fairs and conferences exposes academics to company practices and facilitates networking. Direct outreach, via emails, calls, or social media can also be effective, especially when the topic aligns with industry interests and university titles like Dr. or Prof. help establish credibility.

1.4.3 A top-down procedure for faculties and departments

Fig. 8 presents a structured approach that a university department or faculty can use to plan and develop relationships with relevant companies and industry partners. The process begins with defining targets and strategy at the faculty level, followed by the establishment of a small industry-focused team or committee to coordinate activities. Next, the most relevant companies are identified, and initial contact is made to explore potential engagement. Understanding the companies' needs for applied research allows the university to engage the appropriate specialists within the school. Based on this understanding, alternative collaboration proposals can be developed and discussed with company managers. The proposals are then refined according to the feedback received, laying the groundwork for initiating the first collaboration.

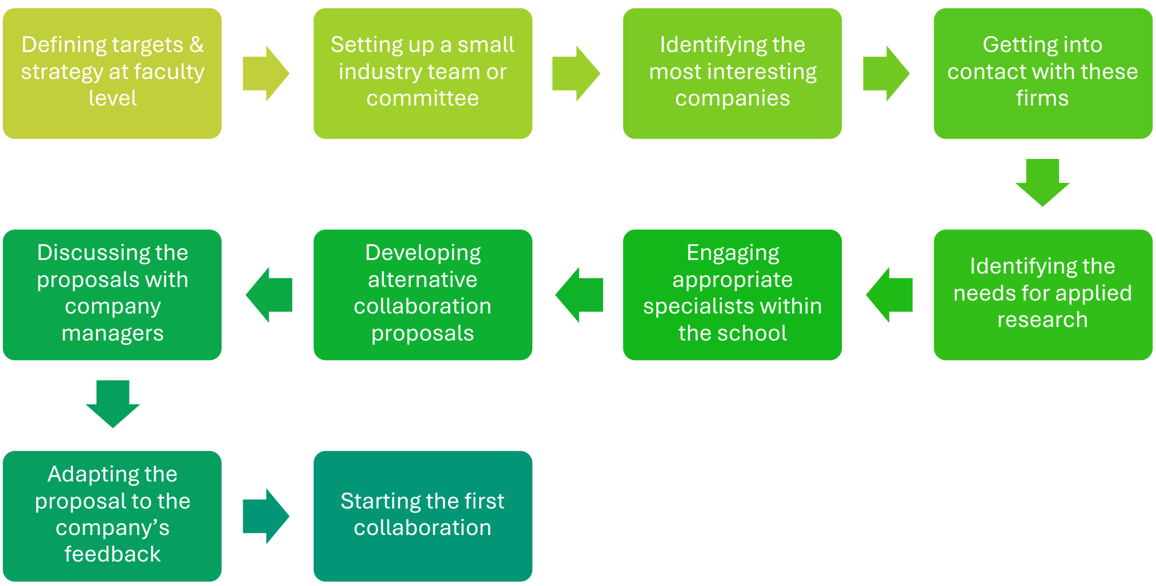

Figure 8: *A top-down procedure to establish industry collaborations for faculties and departments*

1.4.4 How universities can effectively communicate with industry partners

The key to capturing attention and generating interest in an initial meeting with industry representatives is the ability to engage on topics that are important to them. This requires a clear understanding of the fundamental issues and priorities on the industry side and presenting the university's capabilities and expertise in meaningful relation to these concerns. Emphasis should be placed on addressing specific needs of the company or sector involved.

Checklist for crafting the university's message ahead of a first meeting with industry partners

1. **Research the organisation**
   - ✓ Review their goals, products or services, current situation, key topics, and recent news.
   - ✓ Identify the individuals relevant to your topics and learn about their positions, responsibilities, and backgrounds.

2. **Connect your expertise**
   - ✓ Pinpoint where your research or university expertise links to the organisation's interests.
   - ✓ Select the topics to which you can contribute meaningfully.

3. **Prepare for the conversation**
   - ✓ Draft questions that help you understand the company better.
   - ✓ Prepare guiding questions to steer the discussion in useful directions.

4. **Shape your message**
   - ✓ Craft a concise summary or short presentation of your own capabilities and experiences.
   - ✓ Focus on the topics that are most relevant for the organisation.
   - ✓ Reflect the organisation's wording where appropriate to strengthen the connection.
   - ✓ Keep it clear and focused rather than exhaustive.
   - ✓ Stay flexible and adjust your positioning based on what you learn during the meeting.

5. **Stay focused and balanced**
   - ✓ Avoid overselling by presenting everything you could possibly offer.
   - ✓ A well-targeted, selective message creates stronger interest than an overloaded "vendor's tray."

Box 4 *Checklist for preparing message to firms*

MODULE 2: TRANSFER-ORIENTED APPLIED RESEARCH

2.1 Distinction between fundamental and applied research

In the context of university–industry relationships, it is important to understand the distinction between fundamental and applied research, as it helps avoid misunderstandings and ensures that academic and industry partners align their expectations.
Table 1 outlines the key differences between the two approaches, while also showing that both share the common foundation of scientific validity and rigorous methodology.

Fundamental research	Applied research
✓ Exploration of issues and elements ✓ Creation of new knowledge ✓ Expansion of existing knowledge ✓ Formulation of theories ✓ Generalisations ✓ Self-initiated by subject ✓ Internal validity important	✓ Finding solutions for an immediate problem of an existing organisation ✓ Findings resolve real world issues in society and/or business ✓ Research objectives set by clients / sponsors together with researcher ✓ External validity important
Scientific validity and methodologies are important for both approaches	

Table 1 *Distinction between fundamental and applied research*

Applied research plays a central role in fulfilling universities' Third Mission, which extends beyond teaching and fundamental research to include active engagement with society and industry. By focusing on practical problem-solving, applied research enables universities to contribute directly to innovation, regional development, and the competitiveness of companies. It also strengthens trust-based partnerships, generates societal impact, and demonstrates the relevance of academic expertise beyond the university. Nevertheless, both fundamental and applied research remain important, and conducting applied research entails both advantages and disadvantages, as outlined in Table 2.

Advantages	Disadvantages
• applied research can be helpful in solving specific problems in business and other settings • applied research results can create direct benefit for the problem owners / cooperation partners • applied research projects create credibility and reputation for the researcher among industry representatives	• results of applied research projects usually cannot be generalized • not all applied research project results can be published • applied studies usually have tighter deadlines, set by external clients / sponsors which are not / less flexible

Table 2 *Advantages and disadvantages of conducting applied research*

2.2 Deriving research fields from real world problems

2.2.1 From problem awareness to research design

Strong collaboration between universities and industry depends on research that responds directly to the challenges faced by businesses, communities, and organizations. To uncover these challenges, researchers need to cultivate problem awareness within their field of competence and interest.

This process begins by engaging with society in all its forms: industries such as agriculture and logistics, service companies, public institutions, NGOs, and local communities. To prepare these conversations, background research in practitioner journals, trade media, and policy documents helps build a picture of the sector's pressing concerns. Most importantly, researchers should listen carefully to the people working in these environments to understand the problems they face, the practical solutions they already use, and the knowledge gaps that remain.

Once a general field of concern is identified, the next step is to conduct a systematic problem analysis. This can be supported by several structured tools that help organize complex realities and reveal deeper insights. Four methods that are particularly useful are problem tree analysis, the Five Whys technique, the fishbone diagram, and force field analysis. Each offers a different way of mapping causes and effects, and each can be applied to agricultural challenges commonly observed in East African countries.

2.2.2 Problem analysis tools

Problem tree analysis (Fig. 9) is especially helpful when researchers want to visualize the web of causes and consequences around a central issue. Imagine, for example, farmers in northern Tanzania reporting consistently low maize yields. The central problem, or trunk of the tree, is declining productivity. The roots of this problem might include poor soil fertility, limited access to improved seeds, erratic rainfall, and a lack of training in sustainable farming practices. The branches, or effects, include reduced household income, heightened food insecurity, and the migration of young people to urban areas. By laying out these relationships visually, researchers and practitioners can see not only where interventions might be most effective, but also how tackling one root cause may have ripple effects across the whole system.

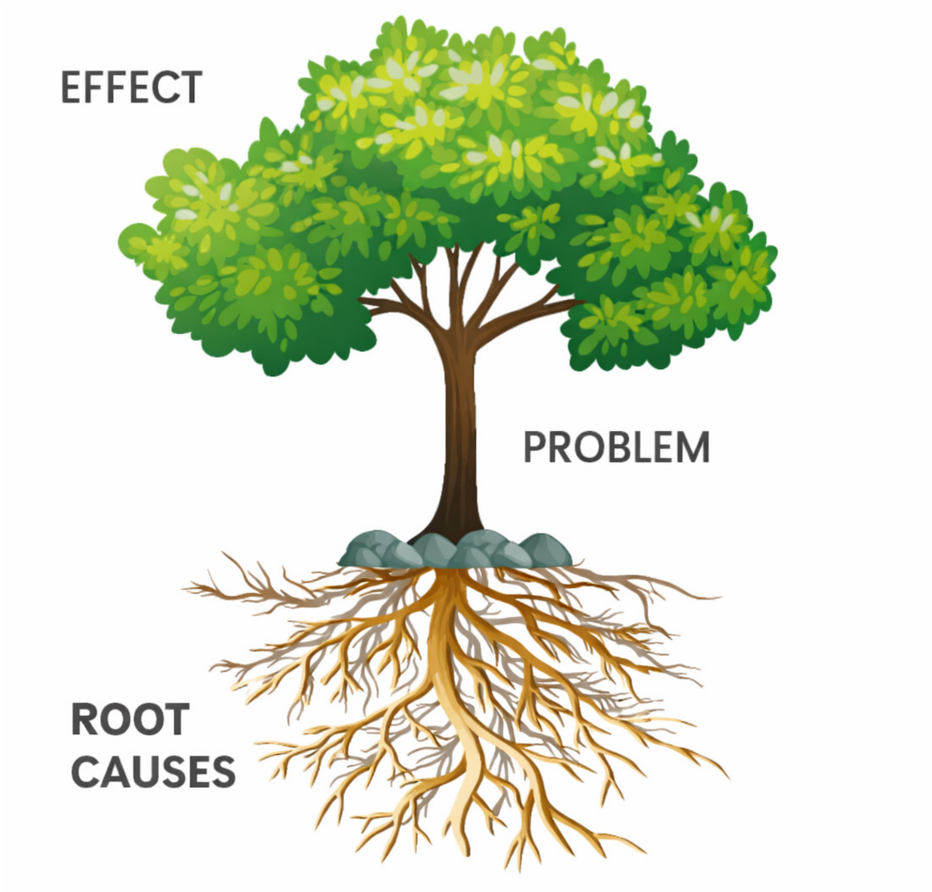

Figure 9 *Problem tree analysis; source: https://www.opexity.com/blog/fta-fault-tree-analysis/4*

The Five Whys (Fig. 10) technique (or root cause analysis) provides another lens for exploring problems by encouraging repeated questioning until the underlying cause comes to light. A common case from Kenyan dairy farming illustrates this method well. Farmers often complain that their milk spoils before reaching the market. Asking why leads to the observation that milk is not cooled immediately after milking. Asking again reveals that village cooperatives lack chilling facilities. Probing further uncovers that electricity-based cooling is unaffordable, primarily because tariffs are high. Continuing the questioning shows that renewable energy solutions, which might provide an affordable alternative, are not widely adopted. By the fifth "why," the root cause emerges as a lack of access to sustainable energy infrastructure. This deeper understanding points research and innovation not toward superficial fixes, but toward energy solutions tailored to rural contexts.

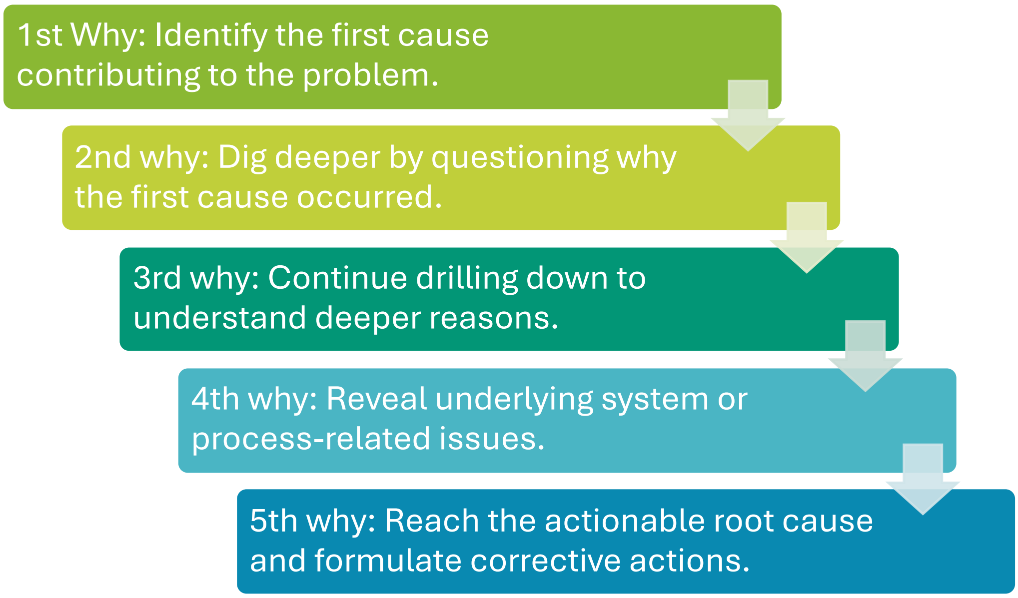

Figure 10 *5 Whys or Root Cause Analysis*

Where problems have many interlinked causes, the fishbone diagram (Fig. 11), also known as the Ishikawa or cause-and-effect diagram, provides a structured way of categorizing them. Take tomato farming in Uganda as an example, where post-harvest losses are significant. If researchers and farmers draw a fishbone diagram, they might place the central "head" of the fish as the problem of spoilage, with the bones branching out into categories. Under "people," limited knowledge of handling practices emerges. Under "processes," harvesting and transport are inefficient. Under "equipment," there is a lack of cooling and storage facilities. "Materials" points to the use of unsuitable packaging, "environment" highlights the challenges of high temperatures, and "policies" reflects weak market standards. This structured view prevents important contributing factors from being overlooked and encourages more holistic interventions.

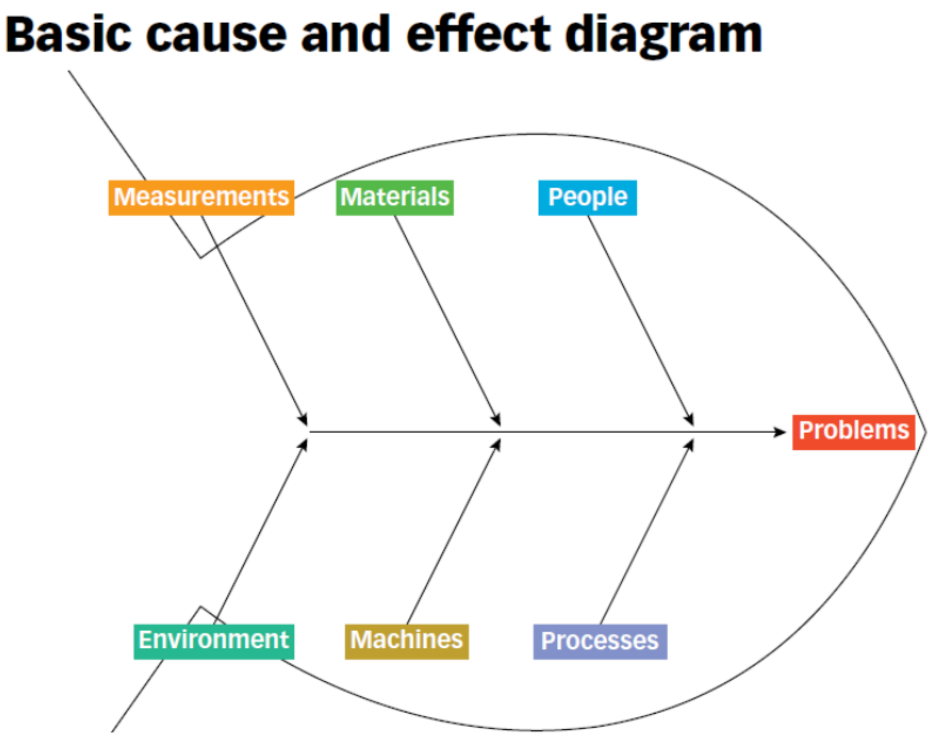

Figure 11 *Fishbone diagram, source: American Society for Quality, n.d.*

Finally, force field analysis (Table 3) helps when change is already on the horizon but adoption is uneven. In Ethiopia, for instance, drip irrigation has been introduced as a response to increasing water scarcity. On one side, driving forces such as NGO training programs, government subsidies, and evidence of higher yields support adoption. On the other side, restraining forces like high installation costs, limited technical expertise, and resistance to moving away from traditional irrigation methods slow progress. Mapping these opposing dynamics allows researchers and practitioners to see where to act—strengthening the drivers, such as expanding access to subsidies, while weakening the barriers, for example by offering farmer-to-farmer demonstration projects.

Driving Forces (supporting adoption)	Restraining Forces (hindering adoption)
Water scarcity increases urgency for efficient irrigation	High initial installation costs for drip systems
NGO training programs build farmer awareness	Limited technical expertise for maintenance and repair
Government subsidies reduce initial investment burden	Resistance to moving away from traditional flood irrigation
Proven yield increases demonstrated in pilot projects	Unreliable access to spare parts and equipment in rural areas

Table 3 *Force field analysis*

2.2.3 Research problem classification matrix

For a systematic comparison, it is helpful to position the identified problem areas within a classification system such as the one shown in Fig. 12. Once potential areas of concern are mapped, the next task is to formulate clear problem statements that can guide further research. This can be done in several ways. Reviewing open questions from earlier applied research projects often reveals issues that remain unresolved or that require deeper investigation. Direct conversations with individual stakeholders, such as farmers, cooperative leaders, or extension officers, provide insight into specific challenges from a practitioner's perspective. Group workshops with so-called "problem owners" allow researchers to capture a wider range of experiences and perspectives, while structured observation of real-world processes, such as harvesting, storage, or distribution practices, offers valuable first-hand understanding of where inefficiencies or difficulties arise. By combining these approaches, researchers can ensure that problem statements are not only academically relevant but also grounded in the lived realities of those who face them every day.

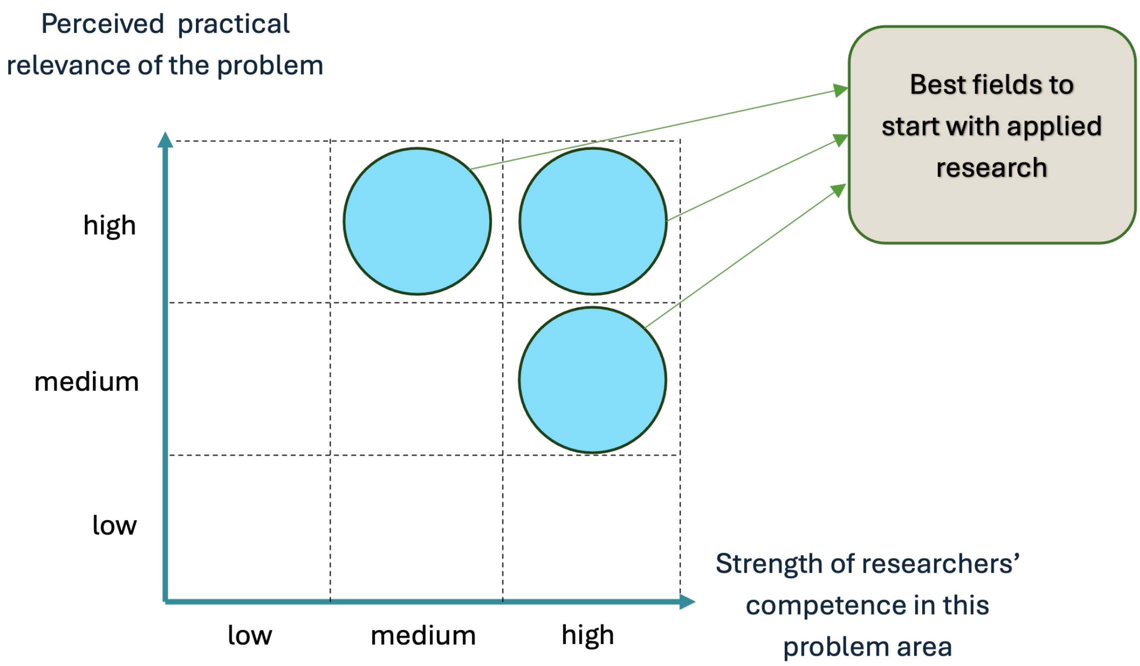

Figure 12 *Classification matrix for promising research fields; source: Prof. Dr. Thomas Bayer, based on input from Prof. Dr. Bernard Wagemann*

A well-formulated problem statement distils complex realities into a concise and concrete summary that can guide research. It should set the context by highlighting what is already known, describe the precise issue that requires attention, and demonstrate why gaining new insights is relevant and urgent.

Example of an effective problem statement:

"In East African agriculture, smallholder farmers are central to national food security, yet post-harvest losses continue to undermine productivity and income. While previous studies have documented the scale of these losses, less is known about the interaction between storage practices, market dynamics, and local infrastructure. Understanding these links is crucial, as reducing post-harvest waste would not only improve household resilience but also strengthen regional food systems and contribute to broader development goals."

2.3 How to plan, structure and conduct applied research projects

2.3.1 The complexity of real-world problems

Many real-world problems that applied research seeks to address are complex and multidimensional, often involving environmental, economic, and social aspects simultaneously. Traditional disciplinary research has achieved many successes and deepened understanding within individual fields, but it has also produced increasingly narrow specializations and a proliferation of sub-disciplines. As a result, addressing complex problems today often requires collaboration across multiple areas of expertise and a holistic perspective that goes beyond traditional boundaries. This is called a transdisciplinary approach.

In the 21st century, societies face grand challenges: issues that affect human well-being and the planet at a fundamental level. The United Nations' 17 Sustainable Development Goals (SDGs) provide a widely recognized framework for describing these challenges. Goals such as ending hunger, ensuring access to clean water, and taking urgent action on climate change cannot be solved by a single discipline alone. Instead, integrated approaches that combine insights from multiple fields, while engaging directly with practitioners, communities, and industries, are essential.

For example, post-harvest food losses in East African agriculture contribute directly to SDG 2 on Zero Hunger, while also intersecting with SDG 12 on Responsible Consumption and Production and SDG 13 on Climate Action. Limited access to irrigation water links to SDG 6 on Clean Water and Sanitation and SDG 2. Low adoption of climate-smart farming practices touches SDG 13 and SDG 15 on Life on Land, while soil degradation and limited market access for smallholder farmers connect to SDG 15, SDG 8 on Decent Work and Economic Growth, and SDG 10 on Reduced Inequalities. Framing research in this way ensures that projects are both locally relevant and globally significant, helping to address the grand challenges of the 21st century.

Consider this example of introduction strategies for a solar-powered mini-grid system in a rural community. It illustrates a classical real-world project that spans at least three distinct dimensions, demonstrating why an interdisciplinary approach is essential. Addressing such a project effectively requires collaboration between engineering, business, and social sciences to develop solution concepts that are technically feasible, economically viable, and socially acceptable.

Energy engineering aspects	Energy engineering aspects	Energy engineering aspects
• Design of system components • Determination of system location, dimensions, and sizing • Maintenance requirements and serviceability	• Estimation of the number of potential electricity consumers, including private households and small businesses • Assessment of system establishment and operating costs • Evaluation of the available income of potential consumers	• Anticipated patterns of electricity consumption • Willingness and readiness to adapt behaviors or practices • Entrepreneurial attitudes toward exploiting new business opportunities

Table 4 *Interdisciplinary considerations of a solar mini-grid project*

In such projects, it is crucial that engineering scientists understand the importance of socio-economic research for the overall success of the system. Conversely, business and social scientists need to recognize how their findings and recommendations directly influence engineering outcomes. Effective interdisciplinary collaboration ensures that technical solutions are not only functional but also economically sustainable and socially embraced.

2.3.2 How to plan, structure and conduct applied research projects in collaboration with industry partners

Applied research projects conducted in collaboration with industry partners generally follow the same overall process as traditional research projects: starting from problem identification, moving through the formulation of research questions, research design and planning, data collection, and ending with analysis and interpretation. An additional, critical step in industry collaboration is the clarification of terms, conditions, roles, responsibilities, and deliverables. This ensures that both academic researchers and industry partners have a shared understanding of expectations and contributions.

The most important distinction between these applied projects and traditional disciplinary research lies in the continuous, cross-organizational communication and collaboration. Regular interaction between researchers and industry representatives is often an essential prerequisite for project success. Industry partners typically play a key role in multiple steps of the research process. Without effective communication, the project can appear as a "black box" from the industry perspective, potentially leading to a loss of commitment or interest. For researchers, poor communication can limit access to crucial information, data, or stakeholders, which may reduce the relevance and impact of the research findings.

The following outlines the generic steps of applied research projects, providing a structured framework for collaboration with industry partners while recognizing that each project is unique in its questions, hypotheses, and implementation.

1. **Identify the problem** at a generic level in collaboration with the industry partner

2. **Review existing solutions and literature** to understand current knowledge and gaps

3. **Specify and focus the concrete research questions** together with the industry partner

4. **Clearly define terms, concepts, roles, and deliverables** with the industry partner

5. **Define the guiding hypothesis** for the field research based on the research questions

6. **Define the population or target groups** to investigate, with input from the industry partner

7. **Develop the research plan,** selecting quantitative or qualitative approaches as appropriate

8. **Develop research instruments,** such as questionnaires, interview guides, observation records, or coding schemes

9. **Collect data,** including pre-testing instruments when working with large populations

10. **Analyse and interpret the data,** engaging the industry partner in the process

11. **Present and discuss findings** and potential next steps with the industry partner

Every applied research project involving direct collaboration with industry is like a tailor-made suit: the research questions are unique, the hypotheses are specific, and there are multiple ways the project can be realized depending on the context and goals.

2.3.3 Exemplary research questions

Applied research questions are often designed to investigate specific, actionable issues within a given context. In an agricultural context in Africa, targeted research questions might include:

- Which factors affect smallholder farmers' adoption of improved maize seed varieties in Kenya?
- How does access to irrigation infrastructure influence crop yields among smallholder farmers in northern Tanzania?
- What is the impact of post-harvest storage practices on tomato spoilage rates in Uganda?

2.3.4 Hypotheses guiding empirical investigations in applied research

Hypotheses are informed assumptions or statements derived from existing knowledge, data, or literature. They represent tentative answers to research questions and guide the design of empirical investigations. These are examples of hypotheses that can address practical challenges in an agricultural context:

- Access to improved maize seeds increases crop yields among smallholder farmers in Kenya.
- The use of post-harvest storage technologies reduces tomato spoilage in Uganda.
- Training farmers in climate-smart practices improves adoption rates of sustainable farming methods in northern Tanzania.

Hypotheses are then tested using appropriate quantitative and/or qualitative research methods, allowing researchers to confirm, refine, or reject their assumptions based on empirical evidence.

2.3.5 Research methodologies for conducting applied research projects

Applied research projects generally use the same methodological approaches as traditional, disciplinary research, with the choice of method depending on the research problem and the disciplines involved. Many applied projects are interdisciplinary, often combining engineering, natural sciences, social sciences, and economics. In such cases, qualitative methodologies frequently play a more prominent role alongside quantitative methods, resulting in a broader and more flexible methodological mix. Table 5 compares quantitative and qualitative research.

Quantitative research	Qualitative research
• Produces numerical or digital results • Covers a broad sample or population • Uses standardized methodologies, such as structured questionnaires • Offers limited flexibility during data collection • Analyzed using statistical techniques • Often applied to test known conditions or hypotheses	• Produces results in verbal or descriptive form • Focuses on depth of understanding with smaller samples • Guided by interview protocols with flexibility for exploration • Analyzed using qualitative content analysis or thematic coding • Explores the why behind behaviors, motivations, and attitudes

Table 5 *Quantitative and qualitative approaches in applied research*

Further common methodologies in applied research include:

- Content analysis: Counting and evaluating statements or phrases, systematically coding results
- Observation: Systematic monitoring of situations, behaviors, or actions (e.g., mystery tests, eye-tracking studies)
- Focus groups: Facilitated discussions with small groups (1–4 hours), guided by a set of questions
- Experiments: Comparing experimental and control groups to investigate cause–effect relationships

By combining quantitative and qualitative methods, applied research projects can capture both the breadth and depth of a problem, making findings more robust, contextually relevant, and actionable.

2.3.6 Recommended resources for interdisciplinary applied research

Truly inter- and transdisciplinary applied research is a rapidly growing field, yet it remains smaller in scale compared to traditional disciplinary research. Researchers entering this area benefit from resources that provide both theoretical foundations and practical guidance on integrating knowledge across disciplines.

A key academic resource is the Journal of Applied Interdisciplinary Research, which publishes articles on methods, case studies, and applications of interdisciplinary approaches.

The journal can be accessed here:

https://jas.bayern/index.php/jair/about

For a comprehensive theoretical framework, the book Interdisciplinary Research: Process and Theory by Repko and Szostak (2021, 4th edition) is highly recommended. It provides step-by-step guidance on designing and conducting interdisciplinary research projects, including strategies for problem identification, knowledge integration, and collaboration across fields.

MODULE 3: TRANSFER-ORIENTED TEACHING

Transfer-oriented teaching is a form of project-based teaching, which involves cooperation with industry partners through limited applied research on real-world problems. This applied research is conducted by the students under lecturer supervision and in collaboration with industry partners. The role of the industry partners in this form of transfer-oriented teaching is to provide the initial problem statement or research question to the students and to support the students by providing them with necessary organization-specific data and limited access to relevant stakeholders in the organization.
It can have two main forms:

- joint project seminars with industry partner conducted by small student groups
- joint final thesis projects with industry partners conducted by individual students

Table 6 compares the two formats, and they are explained in detail in the following sections.

Feature	Joint project seminars	Joint final thesis projects
Participants	Small groups of students	Individual student
Duration	One semester	4–6 months
Scope of Problem	Focused real-world problems, smaller in scale	Substantial real-world problems, higher complexity
Industry Involvement	Introduction of problem, ongoing communication, guidance	Problem definition, occasional consultation; student works independently for most of the period
Student Learning	Apply theory and methodologies; work in teams; stakeholder engagement	Deep application of theory; in-depth problem solving; professional independence
Lecturer Role	Facilitation, coaching, methodological support	Supervision, ensuring rigor and quality; potential for further collaboration
Industry Benefits	Fresh perspectives on multiple challenges; group analyses	Detailed, systematic analysis; actionable strategies; potential recruitment
Deliverables	Group report and presentation	Final thesis report, often including practical recommendations

Table 6 *Comparison between joint project seminars and joint final theses*

3.1 Preparing students to work on applied science topics

The preparation of students for applied science projects aims to equip them with the mindset, skills, and experiences needed to tackle real-world challenges. A central goal is to encourage students to move beyond the boundaries of their core discipline and adopt an application-oriented way of thinking, translating theoretical knowledge into practical solutions.

Students should be able to connect theory and practice, understanding how academic concepts inform real-world decision-making and how practical challenges can generate new research questions. This requires direct exposure to real-world customers, users, organizations, and companies, allowing students to experience firsthand the complexities, constraints, and opportunities beyond the classroom. Equally important is developing an appreciation for applied research methodologies, both qualitative and quantitative, and learning when and how to apply them effectively. Finally, students should broaden their perspectives by considering the different viewpoints of problem stakeholders, enabling them to design solutions that are technically sound, economically viable, and socially relevant. This format works well with student groups up to a maximum of 50 to 60 individuals.

The essential steps in preparing and engaging students to work on real-world problems in project seminars with industry partners are:

1. Prepare a few practical introductory examples illustrating problems, approaches, solutions, and effects.
2. Train students on how real-world problems can be identified and focused.
3. Form small student groups for project work.
4. Let groups research and define their own relevant real-world problems and focused research questions.
5. Train students in relevant methodologies for user-centered applied research.
6. Guide groups to map relevant stakeholders for their problem.
7. Support groups in developing hypotheses aligned with their research questions and stakeholders.
8. Help groups design appropriate empirical methods to test their hypotheses.
9. Let groups conduct empirical field analyses with stakeholder representatives.
10. Guide students in preparing and presenting their findings, discussing gaps and learnings.

3.2 Project seminars with industry partners

Joint project seminars with industry partners provide small student groups the opportunity to engage with real-world problems, applying knowledge and methodologies from their studies under the guidance of the lecturer and in close communication with industry representatives. These seminars can be organized with a single industry partner or, for larger student groups, with multiple partners, offering a wider variety of challenges for students to tackle. Typically, small groups work over the course of a semester on a problem agreed upon in collaboration with a company manager, ensuring that the research is relevant and aligned with the company's needs.

Benefits for industry partners:

- Receive problem analyses from external students who provide fresh perspectives and are not "business-blind."

Benefits for lecturers and students:

- Opportunity to apply theoretical knowledge and research methods to real-world challenges
- Gain a deeper understanding of company operations, thinking, and decision-making processes
- Develop experience in sustained teamwork over an extended period

The engagement with an industry partner in a joint project seminar typically unfolds in three phases, as illustrated in Fig. 13:

- Preparatory phase: Coordination between lecturer and industry representative
- Student working phase: Execution of the project according to the academic calendar
- Follow-up phase: Reflection on lessons learned and exploration of potential future options

The main process and didactical differences between classical lectures or seminars and project seminars involving industry partners lie in the structure, focus, and level of interaction. In project seminars, industry partners are actively involved, introducing the problems and maintaining regular direct communication with student groups. Theoretical and methodological input is provided in a focused and relatively limited amount, while students benefit from a higher number of regular group coaching sessions. Clear guidance is given on the structure and deliverables of the seminar, typically including a group project report and a final presentation.

Students are provided with an overview of the industry partner(s) and the problems to be addressed, expectations for professional behaviour in interactions with external contacts, their role within the agreed working procedures, and the role of industry partners as problem experts and providers of access to relevant data. Industry representatives are invited to present their challenges directly to the students from the organization's perspective, and the first direct meeting between each student group and the relevant industry representatives is arranged by the lecturer. Subsequent communication occurs independently between students and industry representatives, without lecturer involvement.

Necessary theoretical and methodological input is delivered through classical classroom sessions, while regular group coaching ensures students make progress and remain aligned with project objectives. This structure allows students to gain practical, hands-on experience in applied research while developing skills in collaboration, problem-solving, and professional communication within real-world contexts.

Example: Reducing post-harvest losses for smallholder farmers in Zambia

In this seminar, small student groups collaborate with a local agricultural cooperative to tackle post-harvest losses in maize and groundnuts. The project engages students, cooperative staff, and smallholder farmers to develop practical, evidence-based solutions.

Project setup:

- Preparatory phase: The lecturer and cooperative representatives define the problem scope, expected outcomes, and available resources.
- Student working phase: Over the semester, groups investigate current storage and handling practices, conduct surveys to quantify losses, and hold focus groups to understand farmer behaviors and constraints. Both quantitative and qualitative methods are applied.
- Follow-up phase: Students present their findings to the cooperative, recommending practical improvements such as improved hermetic storage bags, drying techniques, or community storage hubs. Lessons learned are documented to guide future research or expansion.
-

Roles and benefits:

- Industry partner (cooperative): Receives objective, data-driven insights from students that can inform improvements and reduce losses.
- Students: Apply theoretical knowledge to a real-world agricultural problem, gain understanding of Zambian smallholder farming practices, and learn to engage with stakeholders.
- Lecturer: Guides methodological rigor and facilitates interdisciplinary collaboration between students and the cooperative.

Box 5 *Example of a project seminar*

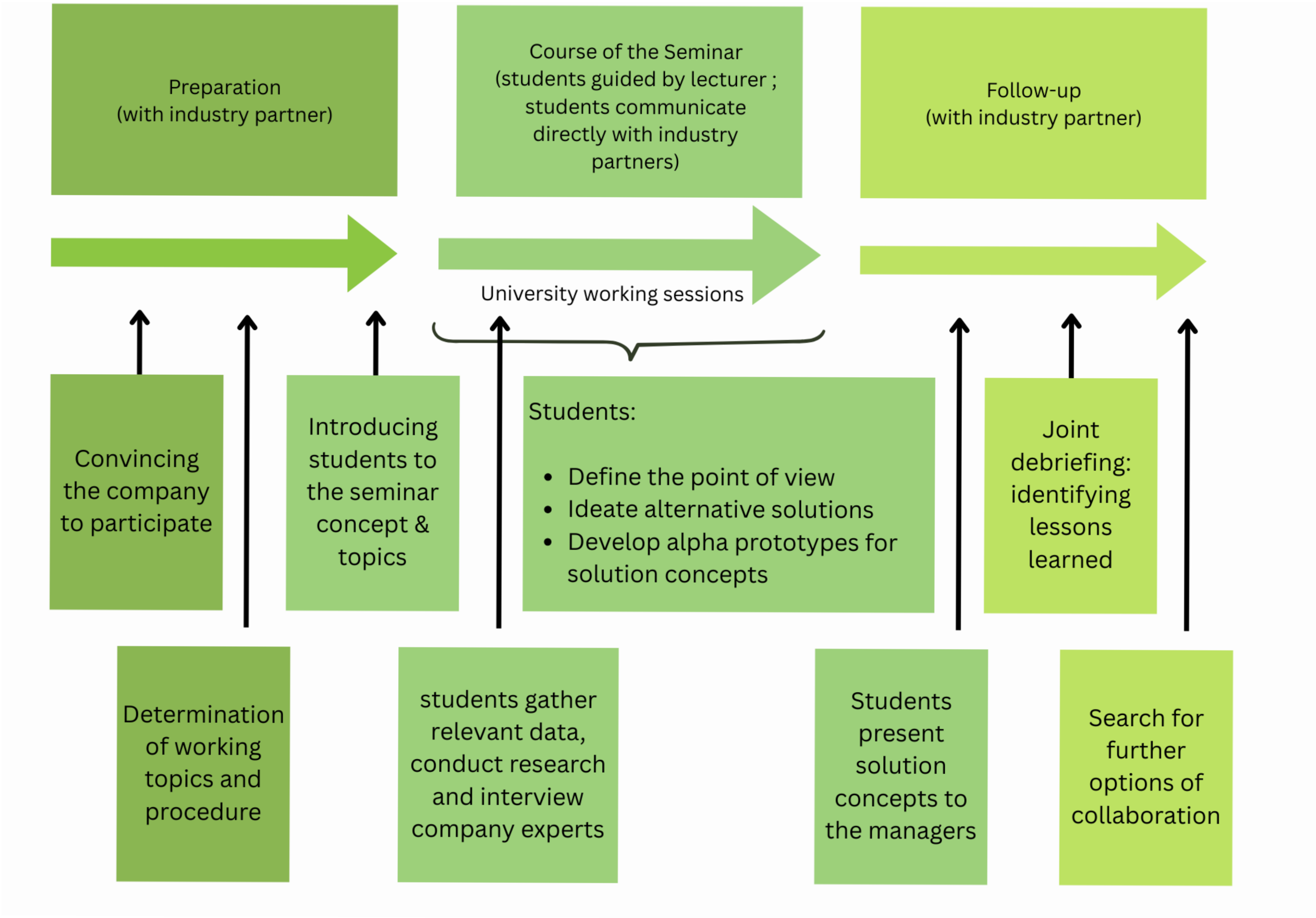

Figure 13 *Three phases of joint project seminars*

3.3 Final dissertations/theses with or for industry partners

Joint final thesis projects provide individual students with the opportunity to tackle a substantial real-world problem as the focus of their applied research. This allows the student to contribute scientifically grounded approaches and concepts to addressing an industry partner's challenge, while gaining deep insight into the practical workings of a specific part of the organization.

For industry partners, this type of collaboration can produce valuable, actionable results that can be implemented within the organization. It also offers an excellent opportunity to evaluate a talented student over several months, potentially identifying a future employee.

Given the higher requirements in terms of rigor, quality, and complexity, joint thesis projects also provide supervising lecturers with a chance to gain a deeper understanding of the industry partner's operations and to explore possibilities for further collaboration. Typically, a student works for 4–6 months on a clearly defined practical question provided by the company, forming the core of their final thesis project.

Benefits for industry partners:

- Systematic problem analysis by an external, objective individual
- Development of strategies, evaluations, or practical application proposals relevant to the organization

Benefits for lecturer and student:

- Deeper insight into company operations and the practical world of work
- Establishment of personal connections with potential employers
- Identification of topics for future joint research projects

Example: Improving rice storage and market access for smallholder farmers in Burundi

In this joint final thesis project, an individual student collaborates with a local agricultural cooperative in Burundi to address post-harvest losses and limited market access for rice farmers. The student's research focuses on designing practical, evidence-based solutions that can improve storage practices, reduce losses, and enhance farmers' access to regional markets.

Project setup:

• **Problem definition:** The cooperative and the student agree on a well-defined research question, such as identifying the most cost-effective storage solutions for smallholder rice farmers.

• **Student work:** Over 4–6 months, the student conducts field visits to farms, surveys farmers on curret storage practices, and applies both quantitative (e.g., measuring loss rates) and qualitative methods (e.g., interviews and focus groups) to understand constraints and opportunities.

• **Deliverables:** The student develops a detailed thesis report with practical recommendations for improved storage methods, potential supply chain adjustments, and market linkage strategies.

Benefits:

• **Industry partner (cooperative):** Gains systematic, scientifically grounded insights and actionable strategies to reduce losses and improve market access.

• **Student:** Applies theoretical knowledge to a real-world agricultural problem, gains insight into Burundian smallholder farming practices, and develops professional independence.

• **Lecturer:** Supports methodological rigor while exploring potential for future collaboration with the cooperative.

Box 6 *Example of a joint final thesis project*

3.4 Overview of activities to start university-industry collaborations

Figure 14 illustrates key activities and entry points for university-industry collaboration, distinguishing between transfer-oriented teaching (blue) and applied research (orange). The diagram also highlights the multiple pathways connecting teaching and research, showing how initiatives can flow from classroom-based activities to applied research projects and vice versa.• Identification of topics for future joint research projects

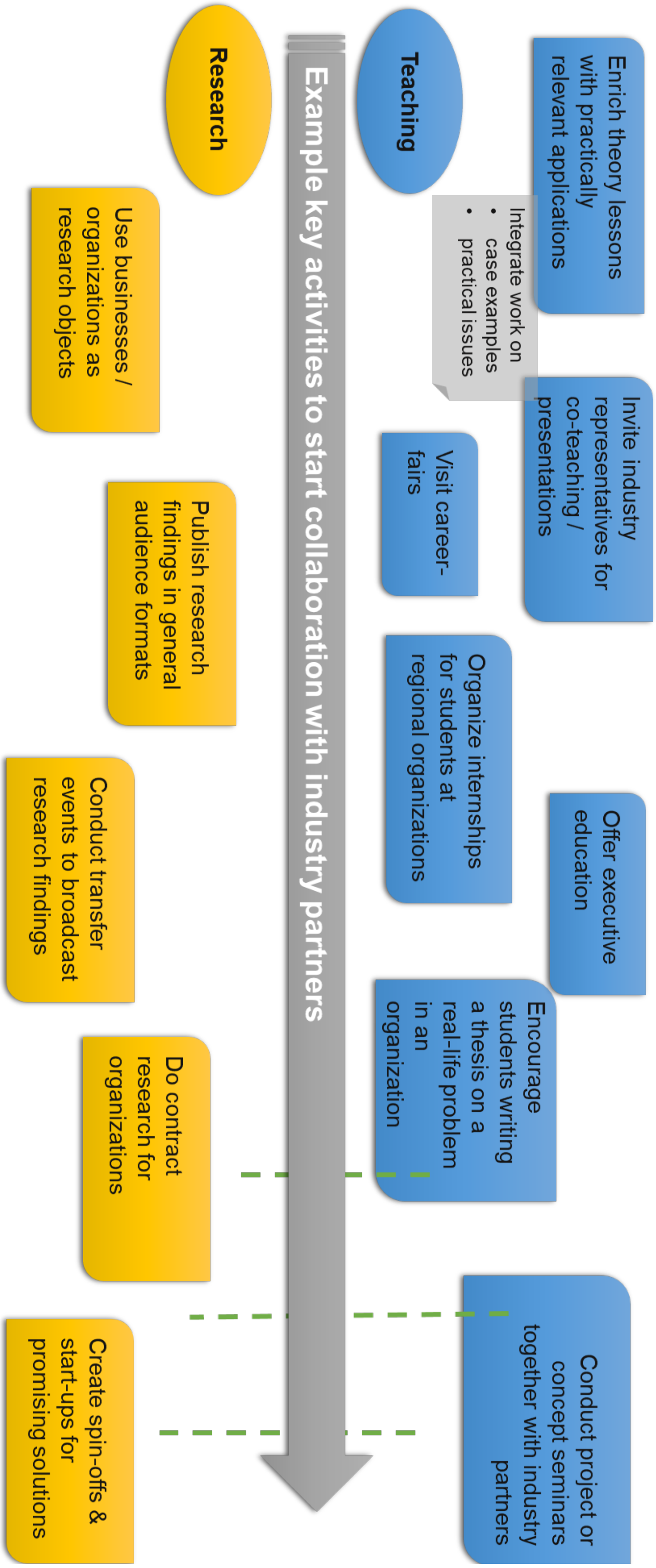

Figure 14 *Summary of collaboration formats between universities and industry partners*

MODULE 4: CASE STUDIES FROM THE UPLIFT-AG PARTNER CONSORTIUM

This section introduces case studies from the East African partner universities of the UPLIFT-Ag project consortium, that put the theoretical content covered in this capacity building programme into practice.

4.1 Kenyatta University and University of Nairobi: Identification and commercialisation of effective indigenous biocontrol microbial agents for plant diseases management

4.1.1 Collaboration structure and objectives

Kenyatta University (KU) and the University of Nairobi (UoN) partnered with Osho Chemical Industries, KALRO, the Pest Control Products Board, and farmers' groups in a four-year project to identify and commercialise indigenous microbial agents for managing crop diseases. KU's Department of Agricultural Science and Technology and UoN's Department of Plant Science and Crop Protection led the academic activities, supervising eight Master's students on full scholarships. University laboratories were upgraded, and staff engaged directly with industry personnel.

Osho Chemical Industries provided funding, research facilities, access to advanced molecular testing, and managed intellectual property for commercially viable microbial strains. KALRO and farmers supplied research sites, while the Pest Control Products Board supported regulatory aspects.

The project aimed to isolate, characterise, and test local microorganisms to develop sustainable alternatives to chemical pesticides. Outcomes included over ten effective microbial strains entering Osho's commercialisation pipeline, seven Master's theses, multiple publications, and financial gains of approximately 15 million KES for the universities. Students gained advanced training and practical industry experience.

4.1.2 Success factors and challenges

Success was driven by strong leadership, fully funded scholarships, skilled academic staff, and effective communication with industry and farmer networks. Challenges included slow university administrative processes, conflicts between industry confidentiality and academic publishing, leadership changes, and unresolved intellectual property ownership. Limited in-house molecular facilities meant some analyses had to be outsourced.

4.1.3 Key learnings

Students were fast-tracked through academic processes, publication agreements protected research dissemination, and leadership shifted to the Dean to maintain project momentum. Regular meetings with industry partners addressed emerging issues.

Universities learned the importance of personal relationships with industry leaders, clear IP agreements, and institutional mechanisms for managing partnerships. Industry partners gained insight into universities' research capacity, while also navigating academic bureaucracy.

4.2 Chuka University: A sustainable agricultural portfolio that is resilient to climate change challenges

4.2.1 Collaboration structure and objectives

Chuka University partnered with Ideal Concept Farms Limited (ICFL), a private agribusiness, to enhance practical training for students and promote climate-resilient farming practices. The Animal Sciences and Plant Science Departments led student placements, coordinated by the Vice-Chancellor and Dean of the Faculty of Agriculture. ICFL, active in avocado and macadamia production, livestock, beekeeping, fodder production, agro-tourism, and farm advisory services, was represented by its Project Director, who oversaw implementation and the MoU.

The collaboration aimed to provide students with hands-on experience in integrated farming systems while developing sustainable practices adaptable to climate change. Since October 2023, eight Certificate in Animal Health and Production students have completed internships at ICFL, gaining exposure to livestock and crop management in commercial operations.

4.2.2 Success factors and challenges

Success was driven by ICFL's large, diversified farm operations and the formal MoU, which clarified roles and expectations. Challenges included the limited practical experience of incoming students, requiring extra time and resources for adaptation and training. This revealed a gap between academic preparation and industry needs.

4.2.3 Key learnings

To address these gaps, Chuka University enhanced field-based components in its curriculum and considered involving industry partners in on-campus practical sessions. The partnership highlighted for the university the importance of aligning academic training with industry requirements. For ICFL, the key lesson was the need for patience and resource investment to develop interns' practical skills, reinforcing the company's role in long-term capacity building in agriculture.

4.3 Taita Taveta University, Kenya: The establishment of a tissue culture seedling propagation laboratory

4.3.1 Collaboration structure and objectives

Taita Taveta University (TTU) partnered with the Micro Enterprise Support Programme Trust (MESPT) and the County Government of Taita Taveta (CGTT) to establish a tissue culture banana laboratory. The Department of Agricultural Sciences at TTU led the project, with a Principal Implementer managing equipment procurement, stakeholder meetings, and intern supervision. MESPT provided funding through the Danida Market Development Partnership Programme, while CGTT facilitated farmer linkages via its Department of Agriculture, Livestock, Fisheries, and Irrigation.

The collaboration aimed to renovate and equip the laboratory, operationalize it with reagents and nursery materials, and initiate production of affordable tissue culture banana plantlets for local farmers.

The project successfully produced tissue culture banana plantlets of various varieties and trained three interns in plantlet production and nursery management. The laboratory was fully equipped with refrigerators, air conditioners, photo sensors, water distillers, and thermometers, creating a functional and sustainable facility.

4.3.2 Success factors and challenges

Key success factors included timely funding, rapid procurement, experienced trainers, and effective coordination among TTU, MESPT, and CGTT. Challenges involved occasional slow processing of intern allowances, equipment needs exceeding initial plans, and lower-than-expected quality of some reagents.

4.3.3 Key learnings

The team adjusted procurement plans, maintained close engagement with TTU's Finance Directorate, and sourced reliable reagents. University participants learned the value of dedicated offices for managing industry partnerships, while MESPT highlighted the benefits of purchasing items on behalf of the university to avoid bureaucratic delays.

4.4 University of Rwanda: Capacity strengthening in technology transfer and commercialization of university intellectual property

4.4.1 Collaboration structure and objectives

The University of Rwanda (UR) implemented the TT-CUIP project to enhance capacity in technology transfer, intellectual property (IP) management, and commercialization of research outputs. Key university units included the Department of Rural and Agricultural Economics, Career Guidance Office, Grid Innovation and Incubation Hub (GIIH), University Innovation Pod (UniPod), and the Centre for Promotion of Student Innovation and Entrepreneurship. The project was funded by the German Academic Exchange Service (DAAD) and conducted in collaboration with Kenyatta University, Kenya, and Neu-Ulm University of Applied Sciences, Germany.
Rwandan industry and community partners included Inyange Agro-Industries Ltd, Urwibutso Enterprises Ltd, Kinazi Cassava Plant, Bella Flowers Ltd, Duharanira Amajyambere y'Icyaro, and Imbaraga Farmers Association. Partners supported internships, attachments, mentorship, partial scholarships, and employment opportunities. Key individuals from these organizations participated in MoUs and letters of intent, providing guidance and support to students and staff.

The project aimed to strengthen UR's mechanisms for IP commercialization, build staff and student capacity in innovation and entrepreneurship, and enhance partnerships supporting research and development.

Ten individuals at University of Rwanda were trained in IP management and patent drafting. The university held a Career Fair and Research & Innovation Day, showcasing student prototypes and business ideas to industry partners. Several partners expressed interest in supporting internships and industrial attachments under existing MoUs.

4.4.2 Success factors and challenges

Success was enabled by formal MoUs, joint training sessions, workshops, and benchmarking visits that strengthened collaboration. Challenges included limited availability of industry partners, heavy academic workloads, and the absence of a sustainable funding model. Strategies included awareness seminars, practical innovation training, development of a policy framework, and planning for joint funding to support long-term activities.

4.4.3 Key learnings

University participants learned the importance of translating research into commercial products and integrating industry experience into teaching. Industry partners recognized the value of university collaboration to reduce skills gaps, promote practical training, and establish knowledge-exchange platforms for innovation and IP commercialization.

4.5 University of Lay Adventists of Kigali, Rwanda: Capacity building of rice farmers in Nyanza and Rwamagana districts

4.5.1 Collaboration structure and objectives

UNILAK partnered with local cooperatives and agricultural stakeholders in Nyanza and Rwamagana Districts to strengthen farmer innovation and entrepreneurial capacity. The Departments of Rural Development and Cooperative Management led the university's involvement, supported by the Dean of Economic Sciences and an Expert in Entrepreneurship. The Uplift Project Team coordinated activities to align with UNILAK's mission of community-centered education.

Partners included RWAMACU Cooperative, TWIBUMBE Union, local rice processors, and agronomists, who mobilized farmers, identified training needs, and supported field-based learning. The project aimed to enhance agricultural training and technology transfer, reduce the skills gap in agribusiness, and create mechanisms for knowledge exchange between the university and cooperatives.

The project established agribusiness start-ups, applied a living lab approach, and conducted entrepreneurship bootcamps, technical workshops, and hands-on training in rice farming. Farmers gained skills in production, business management, and the use of new technologies, supported by training materials and equipment.

4.5.2 Success factors and challenges

Success was driven by active partner involvement, co-designed curricula, and regular coordination meetings. Challenges included initial resistance to new technologies among farmers and unfamiliarity with participatory teaching among staff. Strategies included awareness campaigns, demonstration sessions, and continuous feedback to adapt training to local needs.

4.5.3 Key learnings

The university learned the value of integrating practical engagement into teaching and research, while partners gained insights into improved farming systems and the benefits of co-developing knowledge with higher education institutions.

4.6 University of Ngozi, Burundi: Collaboration for agricultural innovation and capacity building

4.6.1 Collaboration structure and objectives

The University of Ngozi (UNG) partnered with IFDC, Food for the Hungry, CEDECA, SCTA, Burundi Brewery, and Imena Soma Usubire to promote agricultural innovation and student capacity building. The Faculties of Agricultural Sciences and Economics coordinated research, training, and entrepreneurship initiatives. Key university staff included the Vice-Chancellor, Deans, and senior academic personnel.

Partners contributed through research on biofertilizers and biopesticides, agri-entrepreneurship training, internships, and joint exhibitions. The collaboration aimed to advance sustainable agricultural technologies, strengthen institutional and human capacity, and create pathways for technology transfer.

Projects produced a biofertilizer prototype under IFDC, trained over 500 students through CEDECA, and facilitated internships and joint innovation exhibitions with SCTA, Burundi Brewery, and Imena Soma Usubire. These activities enhanced student skills, supported research, and strengthened university–industry linkages.

4.6.2 Success factors and challenges

Success was driven by strong, continuous relationships, shared goals, and partner willingness to engage students and co-develop research. Challenges included rising costs of lab materials, expired MoUs, and personnel turnover. Strategies included renewing agreements, establishing permanent collaboration frameworks, developing clear action plans, and conducting regular review meetings.ion students have completed internships at ICFL, gaining exposure to livestock and crop management in commercial operations.

4.6.3 Key learnings

University staff learned the importance of formalized agreements, clear planning, and succession strategies to maintain institutional knowledge. Partners recognized the value of flexibility, continuous communication, and joint monitoring for sustainable engagement.

4.7 University of Burundi, Burundi: Partnership agreement between the University of Burundi and Mineral Consulting International

4.7.1 Collaboration structure and objectives

The University of Burundi (UB) partnered with Mineral Consulting International (MCI) to enhance academic–industry collaboration in Earth Sciences. The Earth Sciences Department, supported by the Vice Chancellor and Dean of Science, coordinated student training, internships, and research activities. MCI contributed technical expertise, supervised internships, hosted workshops, and supported joint research projects. The collaboration aimed to train mining professionals, provide hands-on industrial experience, execute joint research, and promote innovation and technology transfer in the mining and environmental sectors.
The partnership strengthened educational programs, expanded research opportunities, enhanced student and staff capacity, fostered community engagement, and contributed to policy development in sustainable mining practices.

4.7.2 Success factors and challenges

Success was driven by shared goals, clear roles, and strong communication. Challenges included cultural differences, limited resources, divergent priorities, and intellectual property concerns. Strategies included cultural awareness workshops, resource-sharing agreements, strategic planning sessions, and establishing an IP framework to protect research outputs.

4.7.3 Key learnings

University staff learned the value of interdisciplinary cooperation, applied research, and sustainable practices, while students gained practical and research skills. MCI recognized the benefits of collaborative research, capacity building, and strong academic–industry networks.

4.8 Chinhoyi University of Technology, Zimbabwe: The Tobacco Leaf Exporters Association Innovation Competition

4.8.1 Collaboration structure and objectives

Chinhoyi University of Technology (CUT) partnered with the Tobacco Leaf Exporters Association of Zimbabwe (TLEAZ) to organize the 2025 student innovation competition, focusing on low-cost water heaters for tobacco farmers. CUT's Directorate of Research and Postgraduate Studies, along with the Departments of Mechatronic Engineering, Fuels and Energy, and Biotechnology, coordinated the competition. The Dean of Engineering and the Director of Research provided academic oversight.

TLEAZ, responsible for coordinating tobacco exports and managing out-grower schemes, sponsored the competition and provided advisory support through its CEO and Agronomy Consultant. The collaboration aimed to foster student innovation, create practical technological solutions, and strengthen university–industry linkages.

Over six months (November 2024–April 2025), students developed five functional water heater prototypes. The two best designs were selected for potential mass production and deployment in the local tobacco sector.

4.8.2 Success factors and challenges

Success was driven by motivated and innovative students, financial incentives, and a clearly defined problem addressing real industry needs. The main challenge was limited supervision by academic mentors, which was addressed by engaging faculty in prototype adjudication and feedback, increasing academic oversight and mentorship.

4.8.3 Key learnings

For the university, the project highlighted the value of structured industry engagement in stimulating student innovation. For TLEAZ, it demonstrated that universities are a rich source of talent and creativity, and challenge-based competitions can efficiently produce relevant technological solutions.

4.9 Zimbabwe Open University, Zimbabwe: Ration formulation for dairy animals in the Chitomborwizi small holder area

4.9.1 Collaboration structure and objectives

The Zimbabwe Open University (ZOU), through its Department of Animal Science, partnered with the Chitomborwizi Network of Farmers, Msengezi Community, ZADF, Fivet Animal Health Zimbabwe, AARDSD, Rural Women's Assembly (RWA), and Nestlé Zimbabwe. The collaboration aimed to reduce milk production costs, improve milk yield and quality, and strengthen farmer livelihoods through on-farm feed formulation using forage legumes.

ZOU's Dean coordinated research activities while three Research Fellows conducted field trials. Farmers provided cows and land, veterinarians ensured animal health, nutritionists advised on feed formulation, and researchers monitored outcomes. Industry and community partners provided technical support, market access, and facilitated farmer participation.

The project produced innovative feed rations and trained a larger number of farmers in dairy management and feed formulation. Intercropping maize with forage legumes improved silage protein content and increased milk production from approximately 15 to 20 litres per cow per day. Farmers also gained skills in milk processing into cheese, yoghurt, and sour milk, demonstrating viable alternatives to commercial dairy concentrates. Research findings were published and disseminated through seminars.

4.9.2 Success factors and challenges

Success stemmed from strong collaboration, active participation of farmers and researchers, and complementary expertise among partners. Challenges included erratic rainfall, inadequate funding, differences in agronomic practices, limited irrigation, and unreliable transport. These were mitigated through early land preparation, additional funding for irrigation, close coordination during field activities, and maintaining open communication with farmers. Future research will explore integrating small grain crops to enhance drought resilience.

4.9.3 Key learnings

University researchers gained practical experience in feed formulation, intercropping, and rural engagement, while learning the importance of patience in building partnerships. Industry and community partners recognized the potential of smallholder farmers to contribute to national milk production, the benefits of alternative feeding technologies, and the need to manage prevalent dairy diseases for sustainable productivity.

MODULE 5: COMMERCIALIZATION OF RESEARCH

"Research commercialisation is the process by which new or improved technologies, products, processes and services that have arisen from research are brought to market. It is a valuable mechanism that enables us to solve real problems and fulfil unmet needs, creating significant economic and societal value as a result." (UK Research and Innovation).

"The process by which any Intellectual Property assets may be adapted or used for any purpose that may provide any benefit to society or commercial use on reasonable terms. It includes assignment, licensing, and establishment of spin-offs to offer the Intellectual Property as a product or service." (Kenya National Innovation Agency).

Box 7 *Defining commercialization of research*

5.1 Benefits of research commercialization

Commercialization of research refers to the process of translating research outputs into practical applications, products, services, or processes that create value for society, organizations, or individuals. A key factor supporting effective knowledge transfer between science and industry is geographic proximity, which facilitates collaboration, faster exchange of ideas, and successful commercialization, as observed in both the USA and Europe (OECD, 2019).

Although patenting by public research institutions and universities has grown faster than industry patenting, their share of total patents remains low—just 1.6 % in 2014. Collaborative patents involving both public research institutions and industry, however, are increasing more rapidly, highlighting the advantages of joint innovation efforts (OECD, 2019). Patents can generate financial opportunities, for example through licensing contracts, but the majority never produce direct monetary returns. This underscores that the benefits of research commercialization extend far beyond financial gain.

The complementary investment behaviours of businesses and higher education institutions further emphasize the potential of collaboration. Industry typically prioritizes investment in product and service development, while universities focus on basic and applied research. This combination of strengths demonstrates the potential of joint applied research to create innovative products and solutions. Globally, co-authored publications between research institutions and industry partners are steadily increasing (Elsevier, 2021). University researchers excel at identifying challenging problems and exploring diverse solutions, while companies are skilled at developing discoveries into practical applications. As figure 12 demonstrates, research co-authored with industry partners also tends to achieve higher citation impact across all regions, countering the common belief among academics that such collaborations receive less recognition (Elsevier, 2021).

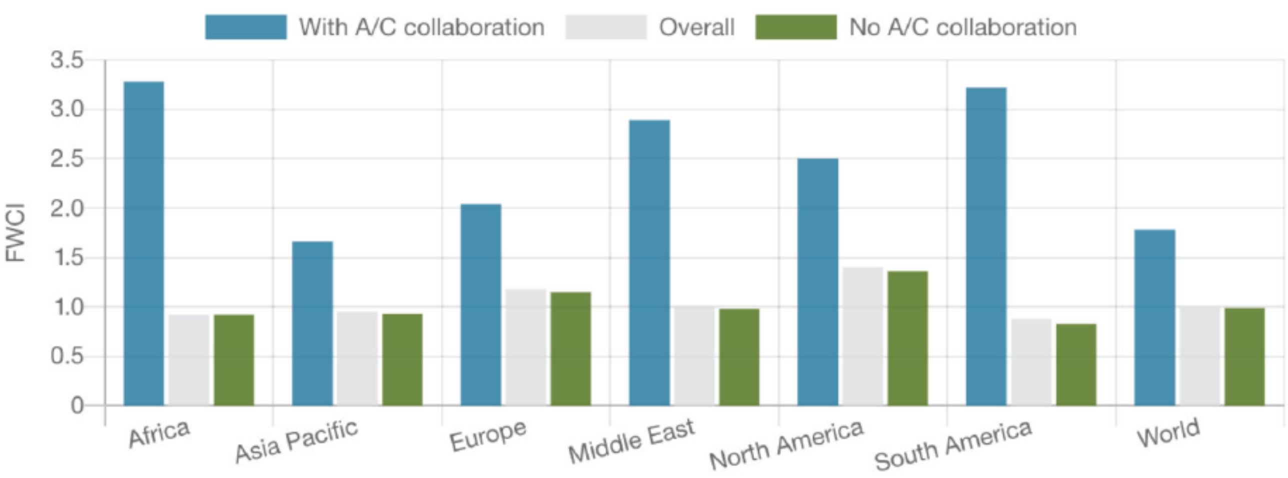

Figure 15 *Citation impacts of academic articles co-authored with industry; Source: Elsevier (Ed.)(2021); Key: A/C collaboration = Academic-company collaboration; FWCI = field-weighted citation impact*

Key beneficiaries of research commercialization include researchers and lecturers, students, university graduates and alumni, industry and companies, and society at large. Beyond financial returns, non-monetary benefits include:

- Researchers and alumni: enhanced reputation, visibility, credibility, and collaborative opportunities
- Students and graduates: hands-on learning, practical skills, entrepreneurial mindsets, and improved employability
- Industry and companies: access to new technologies, collaboration opportunities, and increased competitiveness
- Society: solutions to societal challenges, economic growth, job creation, and improved quality of life

Research commercialization begins with applied education and applied research, often in collaboration with industry partners. For researchers, this creates opportunities for external collaboration, joint publications, and engagement in contract research. For students and graduates, it provides practical skills, entrepreneurial experience, and stronger career prospects. Figure 13 captures these dynamics.

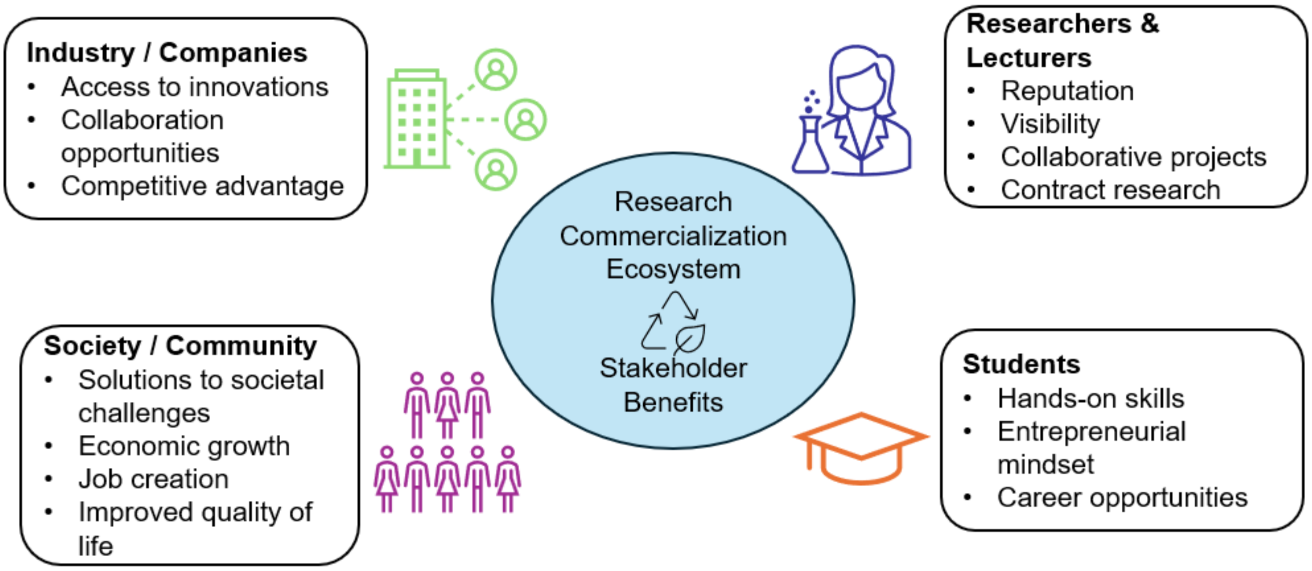

Figure 16 *Benefits of commercialization extend beyond monetary gains*

5.2 Process of research commercialization

5.2.1 Steps of the MIT process cycle for technology commercialization

The commercialization of research results into patents and licenses at MIT (USA) follows a structured process cycle. This cycle ensures that discoveries and inventions are systematically evaluated, protected, and transferred to industry or startups for market deployment.

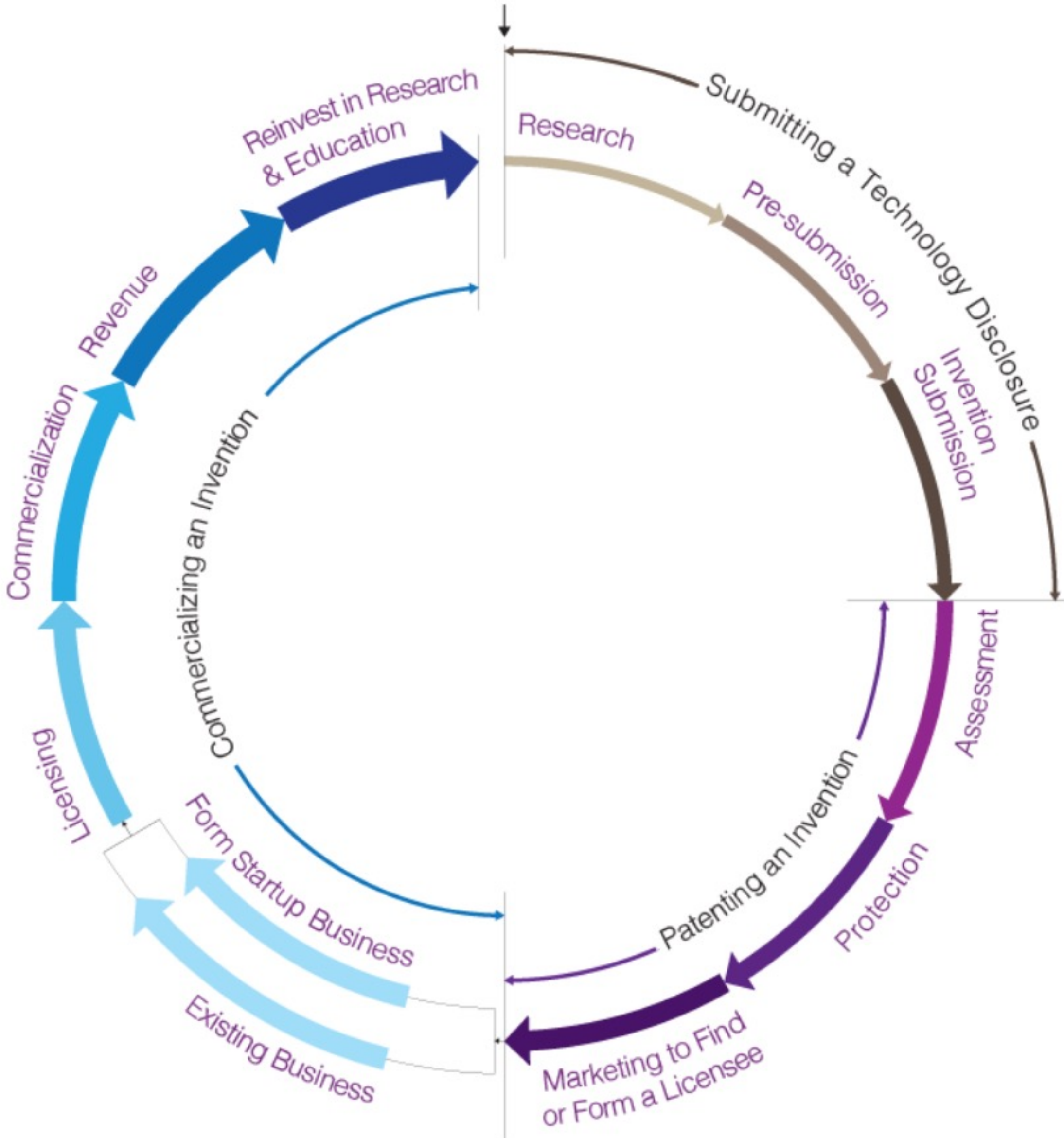

Figure 17 *MIT research commercialization process cycle; Source: MIT Technology Licensing Office*

In this training manual, we use the MIT process as a model (see Fig. 14). While the MIT process provides a clear, structured example, it is intended to be adapted to local circumstances, resources, and regulations. The steps outlined here illustrate best practices that can guide universities in Africa to establish or strengthen their own technology transfer and commercialization processes.

1. Research (Researcher)
Researchers generate discoveries and inventions through systematic observations and experiments. These research results form the foundation for potential commercialization.

2. Pre-submission Consultation (Researcher & Technology Transfer Office, TTO)
Before formally submitting an invention, researchers engage with the Technology Transfer Office (TTO). This early consultation provides information on the process steps, explores commercialization options, and allows for an initial discussion of potential strategies.

3. Invention Submission (Researcher)
Once a researcher decides to pursue commercialization, the invention is officially submitted to the TTO. The submission includes a detailed written description of the invention, marking the formal start of the technology transfer process.

4. Assessment (TTO)
The TTO evaluates the invention through patent searches, market analysis, and competitive landscape studies. The goal is to assess the potential for licensing or startup formation and determine the invention's commercial viability.

5. Protection (TTO & Researcher)
Based on the assessment, the TTO and researcher select the appropriate legal protection, which may include patents, copyrights, or trademarks. Required documents are prepared and submitted to the relevant national or international authorities.

6. Marketing to Identify Licensees (TTO)
With legal protection in place, the TTO identifies potential companies to license the technology or decides on the possibility of forming a startup to commercialize the invention.

7. Forming a Startup or Engaging Existing Businesses (Researcher & TTO / TTO)
Depending on the chosen commercialization path, either a startup company is established with support from the TTO, or negotiations with existing companies are initiated to bring the invention to market.

8. Licensing (TTO)
The TTO negotiates and finalizes licensing agreements, either with the newly formed startup or with existing companies, establishing formal terms for commercialization.

9. Commercialization (Business / Startup)
The business responsible for commercialization develops the invention into a market-ready product or service. The duration of this step varies depending on technical, regulatory, and market complexities, ranging from under one year to over ten years.

10. Revenue (TTO)
Revenue generated from licensing agreements flows back to the researcher and the university. This provides financial recognition for researchers and resources for the organization.

11. Reinvestment in Research and Education (University)
The university reinvests revenue from commercialization into new research projects, technology transfer initiatives, and education programs, creating a sustainable cycle of innovation.

5.2.2 Essential university support for effective commercialization

To ensure effective technology transfer, universities must provide a strong foundation of supportive policies, services, and infrastructure. A clear university support policy is essential, offering reliable conditions for researcher support, appropriate incentives, and the autonomy necessary for innovation. It is equally important for the university to define a strategic set of prioritized research and innovation areas to guide focused efforts. Central to the technology transfer process is a well-functioning Technology Transfer Office (TTO). The TTO should provide platforms that connect research outputs with industry demand, integrate industry relations across faculties to leverage synergies, and assist researchers in marketing their capabilities while fostering professional networks.

Legal services play a critical role in supporting contracting and intellectual property (IP) management. This includes providing templates and drafting assistance for collaboration agreements, as well as guidance on alternative IP protection strategies. Legal support also ensures that researchers and the university can navigate patent registration and other IP management processes effectively.

Equally important is a dedicated service centre for budgeting, financial management, and project support. Such a centre facilitates administration for project-based collaborations with external partners and provides support for budgeting, accounting, and reporting activities linked to commercialization initiatives.

By establishing these structures and processes, universities create an environment in which research results are systematically protected, commercialized, and reinvested. Adapting the MIT process to local circumstances enables African agricultural universities to strengthen innovation, enhance technology transfer, and promote applied learning across their institutions.

5.3 Methods of research commercialization

Conducting applied research as a prerequisite for potential successful research commercialization can have various organizational forms. Researchers basically can engage as individuals or in a collaborative group.
Starting as an individual, researchers can engage in applied research topics and create relevant projects on their own. They may also do this in direct collaboration as individuals with industry partners focusing on topics of mutual interest for both sides.

Collaborative groups of researchers may act as informal project teams agreeing on common topics and fields for applied research – with or without industry partner collaboration. These groups may also establish formal organization structures for long-term collaboration, which could be Centers of Competence, Research Institutes or Joint Ventures with outside organizations, see Fig. 18.

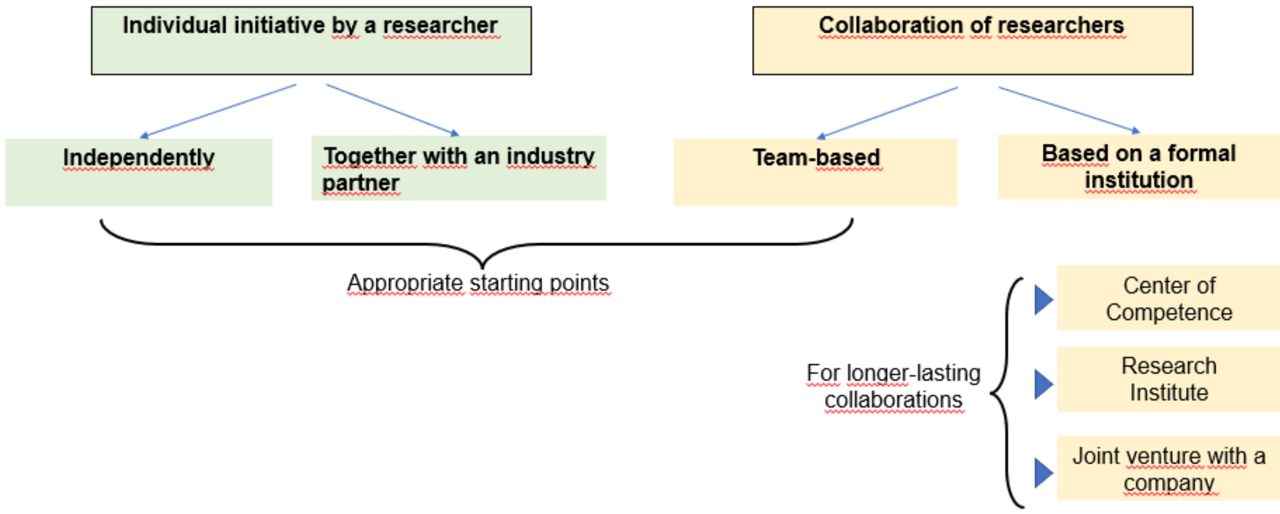

Figure 18 *Different organizational forms to conduct applied research; Source: Prof. Dr. Thomas Bayer, based on input of Prof. Dr. Bernard Wagemann*

Imagine a platform where researchers can turn their ideas into market-ready solutions without the burden of setting up their own company. This is exactly what the Steinbeis Foundation in Germany offers. Established in 1971, the foundation connects university researchers with industry through "transfer enterprises." These can be started by a single researcher or a small team and operate as independent profit-and-loss centers under the Steinbeis umbrella.
Steinbeis provides centralized business support, legal advice, technology marketing, office space, and financial accounting, allowing researchers to focus on innovation. In return, transfer enterprises contribute a small service fee of about 9% of their income. Today, over 1,100 transfer enterprises involve more than 600 professors and nearly 2,000 employees, covering activities from R&D and consulting to training and professional development.
This model demonstrates how structured support can lower barriers for applied research commercialization, enabling researchers to translate knowledge into practical impact efficiently and sustainably.

Box 8 *Steinbeis Foundation: bridging research and industry*

Applied research can be brought to the market through several pathways, depending on whether the researcher collaborates directly with companies or takes on the role of an entrepreneur and producer of intellectual property (see Table 6). Researchers working with companies have multiple options to translate their knowledge into practical impact. They may offer training sessions or seminars to share expertise and build capacity within a company, or provide consulting services to address specific technical or strategic challenges. Short-term contract research allows researchers to carry out company-commissioned projects with clearly defined objectives, while longer-term research cooperation fosters deeper partnerships with shared goals and resources. Researchers may also participate in company externships, gaining hands-on experience and exchanging knowledge in a practical setting. Collaborations can result in joint publications, combining academic rigor with industry relevance, or teaching and conceptual seminars designed to convey research insights in ways directly useful to company operations.

Alternatively, researchers can take on the role of entrepreneur and intellectual property producer, commercializing their innovations more independently. This can involve licensing patents or other IP to companies in exchange for royalties, selling patents outright, or founding a startup or spinoff to develop research-based innovations into market-ready products or services. These approaches allow researchers to leverage their expertise and intellectual property to create economic and societal impact while retaining some degree of control over how their work is applied.

Researcher engaging with companies	Researcher as entrepreneur and IP producer
• Training / seminars for companies • Company consulting • Contract research (shorter term) • Research cooperation (longer term) • Researcher externship • Joint publications Teaching / conceptual seminars	• Licensing of IP • Patent sales • Startup, spinoff

Table 7 *Forms to market applied research results*

FINAL TAKEAWAY

By connecting research, teaching, and industry engagement, African agricultural universities can turn knowledge into innovation, empowering researchers and students to create practical solutions that drive sustainable development.

Box 9 *Closing words*

Accompanying interactive learning materials about intellectual property, technology transfer offices and technology valuation can be found here

https://elearning.hnu.de/course/view.php?id=17083

Instructions:

1. Open link
2. Click on “Anmelden als Gast”

REFERENCES

- American Society for Quality. (n.d.). What is a fishbone diagram? Ishikawa cause & effect. ASQ. Retrieved September 1, 2025, from https://asq.org/quality-resources/fishbone

- Amoroso, S., Link, A.N., Wright, M. (Eds.)(2019): Science and Technology Parks and Regional Economic Development. Palgrave Macmillan.

- Ankrah, S., AL-Tabbaa, O. (2015): Universities-industry collaboration: A systematic review. In: Scandinavian Journal of Management (2015) 31, 387-408. http://dx.doi.org/10.1016/j.scaman.2015.02.003

- Elsevier (Ed.)(2021): University-industry collaboration: A closer look for research leaders. https://www.elsevier.com/research-intelligence/university-industry-collaboration

- Ervits, I. (2024): Developing indicators for the social benefits of university-industry collaborations. In: International Journal of Corporate Social Responsibility, (2024)9:8. https://doi.org/10.1186/s40991-024-00097-9

- Fantoni, S., Casagli, N., Solidoro, C., Cobal, M. (Eds.)(2024): Quantitative Sustainability. Interdisciplinary Research for Sustainable Development Goals. Springer.

- Freepik. (n.d.). Icon of notebook [Icon]. Flaticon. Retrieved September 15, 2025, from https://www.flaticon.com/de/suche?word=Heft

- Gassmann, O., Schweitzer, F. (Eds.)(2014): Management of the Fuzzy Front End of Innovation. Springer

- Granieri, M., Basso, A. (Eds.)(2019): Capacity Building in Technology Transfer. The European Experience. Springer.

- Inpart (Ed.)(2022): University-industry collaboration: A glossary of terms. https://www.inpart.io/blog/university-industry-collaboration-a-glossary-of-terms

- KeNIA (Ed.)(n.y.): Commercialisation Toolkit. https://www.innovationagency.go.ke/storage/pub-docs/ken_pub_CommercialisationToolkit.pdf

- Klein, J.T. (2010): Creating interdisciplinary campus cultures: A model for strength and sustainability. Jossey-Bass, Wiley.

- Mahmoud, Y., & Fredholm, A. (2024). From recipients of skills to facilitators of socially robust knowledge: Teaching students in co-generative learning and participatory methodology. In Promoting Inclusion and Justice in University Teaching (S. 101–110). Edward Elgar Publishing. https://www.elgaronline.com/edcollchap-oa/book/9781035323456/book-part-9781035323456-15.xml

- Miezner, D., Schultz, C. (Eds.)(2021): New Perspectives in Technology Transfer. Theories, Concepts, and Practices in an Age of Complexity. Springer.

- MIT Technology Licensing Office (Ed.): https://tlo.mit.edu/

- O´Dwyer, M., Filieri, R., O´Malley, L. (2022), Establishing successful university-industry collaborations: barriers and enablers deconstructed. The Journal of Technology Transfer (2023) 48:900–931 https://doi.org/10.1007/s10961-022-09932-2

- OECD (Ed.)(2019): University-Industry Collaboration : New Evidence and Policy Options, OECD Publishing, Paris. https://doi.org/10.1787/e9c1e648-en

- Piller, F., Hilgers, D., Schmidthuber, L. (2021): The Relevance of Technology Transfer. In Miezner, D. et al.(2021): New Perspectives in Technology Transfer, p.149-164.

- Repko, A.F., Szostak, R. (2021): Interdisciplinary Research. Process and Theory. 4th Edition, SAGE Publications.

- Schütz, F., Muschner, A., Ullrich, R., Schäfer, A. (n.y.): Innovation Ecosystem Strategy Tool. Center for Responsible Research and Innovation of Fraunhofer IAO.

- Sjöö, K., Hellström, T. (2019): University-industry collaboration: A literature review and synthesis. Industry & higher education, 33(4): 275-285. http://dx.doi.org/10.1177/0950422219829697

- TEBD (Ed.)(n.y.): University-Industry Collaboration Framework. Turkey-EU Business Dialogue. www.isotebd.com

- Uecke, O. (2012): How to Commercialise Research in Biotechnology? Effectiveness of the Innovation Process and of Technology Transfer in the Biotechnology Sector. Springer.

- UPLIFT-Ag Project. (n.d.). WP2 baseline study: University-industry collaboration barriers in East African agricultural universities.
- Whitefield, D. (1985): 'Post-Its' Beat the Odds: Glue´s Failure Backs 3M´s Biggest Success. Los Angeles Times. https://www.latimes.com/archives/la-xpm-1985-12-14-fi-590-story.html

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Status: August 2025

The work is funded by the European Commission and was created as part of the Erasmus+ project UPLIFT-Ag.

Website: https://uplift-ag.org/