TECHNOLOGY TRANSFER

TRAINING HANDBOOK

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Target Groups:	o Small and medium-sized enterprises o Regional public authorities o Researchers within higher education institutions and research institutes

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CONTENT

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PART I.

• Introduction – the aim and expected results of this training course

The objective of this training course to provide a quick and comprehensive overview for the participants about the benefits of the transnational partnership focusing predominantly of the SME's. The participants will gain a relevant and up-to-date landscape about the main barriers related to the growth-orientation an internationalization of SME's and the incentives and measures to eliminate these problems. The training also aims to share ideas experiences and know-how in the field of transnational partnership with stakeholders from different institutions that can contributes to bridging the gap between R&D and innovation and business creation.
The ultimate objective of the training is to initiate the rise of transnational partnerships through the knowledge of multi-stakeholder partnerships.

Based on the Territorial Analysis of SE-Europe, the Danube Macro-Region has challenges to overcome in relation to the following difficulties: a) significant gaps in the relationship between R&D and market participants b) lack of ability to implement the knowledge-based and technology-intensive innovative activities in the SE-European regions c) modest flow of information and knowledge between region and d) lack of knowledge and internationalization of SME's.

Technology is used to better commercialize products or to improve management structure, control and communication, reducing cost of production, maintain consistency in quality, improve productivity and finally develop the competitiveness of the enterprise. In this globalised era, where markets are evolving incessantly with launch of products with new functions or designs on a regular basis, companies are forced to innovate comprehensively by acquiring or developing new technologies.

Emerging markets integration of domestic and international markets through continuing deregulation and liberalization has further strengthen a thrust on all firms, especially small and medium enterprises worldwide thus created a strong urge to access new technologies. While larger enterprises in developing countries have been able to enhance their performance by borrowing technologies available in the world, for SMEs technology access is still a grave challenge.

Technology transfer is the process of sharing of skills, knowledge, technologies and methods to develop and exploit the technology into new products, processes, applications, materials or services. Generally, technology transfer is considered as knowledge transfer. Transfer here does not mean movement or delivery; transfer can only happen if technology has already been used.

After this training the participants will be able to overview the main trend, challenges and the channels of the technology transfer processes and get effective and efficient methods, tips in their

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hands to manage the technology process successfully in the future to bridge the gap between R&D, innovation and business creation. In the course of the training the participants sharing the best practices and experiences related to this area to each other and draw the main lessons learnt from this courses, which all participant can take into practice.

The expected results of the training:

The trainings will improve the technology transfer capabilities of the SMEs and HERs in order to transform ideas into marketable products and services. At the end of the training participants:

- will have a better understanding of the conceptual framework of technology transfer
- the expectations and needs of involving actors.
- furthermore, SMEs and HERs will be more equipped with the necessary skills and confidence to generate technology transfer opportunities for their organization.

The aim is to activate the innovation potentials of SMEs through a better cooperation with researchers, transferring and using new knowledge and ideas.

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- Review the phenomenon of technology transfer

- Concept, role, process and benefits of technology transfer

According to the definition of the World Intellectual Property Organization (WIPO), technology is a systematic knowledge about manufacturing of products, application of process or rendering of service regardless whether this knowledge is reflected in the invention, industrial sample, useful model, new processing system, technical information, services or assistance provided by the specialists in design, installation, management of production or its activity.

There are several existing different definitions of technology transfer as you can see in the below table 1

YEAR	AUTHOR	DEFINITION
1983	*McCardel*	Technology transfer is "the process of communicating research results to potential users"
1990	*Souder,Nashar, and Padmanabhan,*	The transferring technology process is actually an integration process involving provider and receiver. Technology transfer is not a unidirectional process, but a dialogue between varieties of actors at the sender/receiver site(s) at any point in time.
1993	*Padmanabhan and Souder*	"Technology transfer is the managed process of successfully conveying a technology from some point of origin to its routine application among users"
1995	*Spann,Adams and Souder*	"Technology transfer has been generally defined as the managed process of conveying a technology from one party to its adoption by another".
2000	*Robert Krull*	Technology transfer is a process by which existing technology is transferred or transformed to fulfill the user's needs. Technology transfer is the process by which research and other new technologies are transferred into useful processes, products, and programs. Another way of saying the same thing is: technology transfer is the process by which a better way of doing something is put into use as quickly as possible
2004	*Hill*	Technology transfer as a process through which resources are transferred in the development of products and services between the organizations.
2010	*Chen et al.*	Technology transfer is the process of sharing of skills, knowledge, technologies, methods, and samples of manufacturing, and facilities among governments, and other institutions to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, application, materials or services.

Table 1: Overview of the different definitions of technology transfer

Source: http://ijbel.com/wp-content/uploads/2014/06/Critical-Success-Factors-Csfs-On-Technology-Transfer-Effectiveness-In-Manufacturing-Industry-A-Critical-Review-Farizah-Binti-Mamat-alias-Mohd-Nor-Shashazrina-Binti-Roslan.pdf (International Journal of Business, Economics and Law 2012, Vol. 1 ISSN 2289-1552)

Basically, the technology transfer is the process of transferring knowledge, skills, technology or solutions generally between public or research intensive entities and the industrial environment. In other words, technology transfer is the transfer process of knowledge from producers to users by different interactions aiming sharing of skills, knowledge, technologies and methods to develop and exploit the technology into new products, processes, applications, materials or services.

There are two types of knowledge:

- Explicit knowledge is that which can be recorded or encoded. Explicit knowledge is easy to formalize and it can be presented in the form of a text, a sound, a video, and so on.
- Tacit knowledge is that which one can feel and understand, but which is practically impossible to express. There are no formal procedures which would allow to adequately and fully presenting tacit knowledge. Tacit knowledge is a product of personal experience

of a person. To transfer tacit knowledge one frequently uses analogies, examples, and so forth.

“Knowledge management is the explicit and systematic management of vital knowledge and its associated processes of creating, gathering, organizing, diffusion, use and exploitation. It requires turning personal knowledge into corporate knowledge that can be widely shared throughout an organization and appropriately applied.”

Transfer of knowledge from one type to another defines the model of knowledge creation:
Socialization (from nonformalized to nonformalized). In this case one person (for example, master or trainer) gives tacit knowledge to another person (to the student) directly. Knowledge is the result of observation, imitation and practice.

Combination (from formalized to formalized). New knowledge may also appear due to combination of parts of already existing formalized knowledge. For example, having analysed the income of the company for each year over 10 years, we obtain new knowledge about the income of the company for 10 years.

Externalization (from unformalized to formalized). An example of externalization can be an industrial robot. People's knowledge about actions during welding, loading, painting and other operations is formalized and is used to create the electromechanical device. The robot contains a mechanical part and a control system for this mechanical part, which in its turn receives signals from a sensor part. Mechanical part of the robot mimics movements of a person, the control system performs the work of a nervous system, and sensor part mimics the work of human sense organs.

Internalization (from formalized to nonformalized). For example, formalized knowledge about the method of tying a tie, presented in the form of illustrated instructions and applied several times, will eventually lead to appearance of tacit knowledge on how it's done. These four models of knowledge creation exist in dynamic interaction, forming a knowledge spiral.

Knowledge management based on interaction of 3 components: people, processes and technologies.

People. One of the most difficult tasks is to analyse the culture of organization, its values, and behaviour of its employees. Generally speaking, organizational culture should support continuous training and knowledge sharing, openness, mutual respect and support. Employees of the organization should be motivated for innovation activity and gaining of experience from mistakes. On the other hand, the unfavourable environment for knowledge management is the organization where knowledge is a competitive advantage and employees are reluctant to share it; where people are under constant pressure of necessity to act and have no time to search for knowledge and reflection, a “blame and shame” culture is also unfavourable.

Processes. In this case we mean business processes existing in the organization. Sometimes it is necessary to modify the internal processes or even the structure of the organization as a whole to overcome barriers in creation, exchange and use of
knowledge.

Technologies. Technologies are an important component of knowledge management, as they can facilitate and accelerate all processes related to it. It is important that applied technologies "fit" the processes of a particular organization and the people working in it, otherwise they simply won't be used.

We will deal with the details of the technology transfer.

According to the Rouach (2003) the goals of effective technology transfer can be described as; to develop technology that

- fits the strategic needs of the client,
- to ensure that the quality and costs of the technology meet the need of the client,
- to implement technology in a timely manner,
- to ensure that the technology is widely and routinely used.

Furthermore, Bhatia (1998) state that the basic conclusion of technology transfers is a communication process. Whatever, facilitates communications between persons will facilitate technology transfer. Technology transfer should not be a once for all singular process, but becomes iterative arrangement that begins with an understanding of the business units markets, opportunities, and customer needs.
However, Stock and Tatikonda (2000) the effectiveness of the technology transfer process by defined it as the degree to which the utilization of the transferred technology fulfills the recipient firm's intended functional objectives within cost and time targets

Pursell (2000) suggests that are appropriateness of a technology influences the transfer of an innovation. Appropriate technologies are

- inexpensive,
- easily maintained,
- suitable, and compatible with one's need for creativity,
- relatively easy to learn to use and
- match the needs and wants of the receiving individual or group.

A critical point to the technology transfer success is the market and commercial validity of the object of transfer. To this purpose, it is true that universities and research entities hold an impressive number of patents, technologies and know-how but the ultimate decision of transferability is of the company based on market information.

The general purpose of technology transfer is to commercially exploit implementable, marketable, competitive research & development results to market innovations.

There are several ways through which such a process can occur:

- Spin-offs – there are several ways in which research results can be transposed into a research spin-off:
  A company that has financial investment from a university;

    o A company that has licensing agreements from public research institutes and universities for technologies, know-how or other type of research output from that specific public entity;

o Companies which have been founded by or with the support of the university of public research institute;

- Specialized consulting – there are several business models in which specialized consulting can be viewed as technology transfer. It is actually know-how and knowledge transfer, where the specialist provides specialized support for solving highly technical and personalized problems through know-how acquisition and innovative solutions. Such a service can be provided through a university, Technology Transfer Office or by individually contracting the desired specialist (which is the hardest). Some of the most common types of contracts (Technische Universitat Munchen, 2011) utilized are as follows:
  - Contracts for Work and Services – has a very specific and identifiable goal and reflects the client's interests. It does not involve any protection clauses, meaning that in general the results' IPR pertain to the provider;
  - o Research and Development Agreements – address research projects developed in common with an outside (generally from the industrial environment) organization. It formulates a research program but does not specify definitive results. It is written both on the behalf of the scientist (publication potential and IPR authorship – for scientific credentials) and the beneficiary (right of use and sometimes even ownership of the IPR);
  - EU Consortium Agreements – cover the rights and obligation of all partners when deploying and EU collaborative project – where the main financer id the EU;
  - Exploitation or Licensing Agreements – where utilization of the license is attributed to a certain entity. It covers license fees, geographical coverage, exclusivity, further development, usage, marketing or other license transfer possibilities.
- Technology transfer offices – these are generally set-up inside universities or research centers. They are responsible for gathering all research related information, basically centralizing all the research results from all research centers and identify their market and commercial potential. Their role is to act as a bridge between research entities and industry players. There are several operational models which are utilized by technology transfer offices some of which include:
  - Scouting for potential fits for the existing technologies where technology transfer offices strive to find commercial applications for existing research results, patents or innovation;

  o Organizing brokerage events with the presence of both researchers and industry players in order to pair the needs form the industry with the offer form the researchers.

  - Offering consultancy and database services for companies and other types of potential beneficiaries

Technology Transfer processes can be classified into following categories:

- **International/regional:**
- **Cross industry or cross sector:**
- **Inter-firm:**
- **Intra- firm:**
- **University-firm**:

Main channels of knowledge and technology transfer

- Internal R & D: company relies on its own human and technical resources to develop the technology in house.
- Sub-contracting: company gets the technology developed from outside the organization (such as R&D laboratory, a technical institute, a manufacturing organization, experts etc.)
- Licensing: the receiver purchases the right to utilize someone else's technology
- Franchise: form of licensing with continual support to the receiver (marketing support, supply of raw material, training etc.)
- **Joint Venture:** two or more entities combine their interests in a business enterprise (they share knowledge and resources to develop a technology, produce a product, or use their respective know how to complement another one)
- **Turnkey projects:** a country/company buys a complete project from outside source and the project is designed, implemented and delivered ready to operate.
- **Foreign Direct Investment (FDI)**: a multinational firm decides to produce products or invest its resources abroad.
- **Technical consortium and joint R&D projects:** it takes place between two countries or two conglomerates in order to combine their technical and financial resources to develop expensive technology

Main steps of technology transfers:

While, technology transfer processes can be complex and intertwined certain stages can be identified. These may include assessment of conditions of transfer, agreement and implementation. From the previous processes technology transfer selected, there are 3 main processes involves in the technology transfer process which are: planning/strategy, negotiation and implementation.

According to an other approach, the main elements oft he technology transfer process can be:

- **Identification of Technology Need**
- **Sources of Technology:**
  A company identifies the sources from where the required technology can be acquired, mode of transfer, choice of potential partners, clients, typical agreements.
- **Technology evaluation:**
  A company evaluates the price of technology, including guarantees offered, training, R&D and marketing support, buy back arrangement, intellectual property, packaging, quality and efficiency of technology, payment terms, etc.
- **Negotiations and agreement**

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A Brief Overview of Some Qualitative TT Models

The summary of the technology transfer process models are shown below in table 2.

YEAR	AUTHOR	PROCESS
1976	*Behram, Wallander, Thunmen, Stock and Tatikonda.*	Identified → namely→ pre-negotiation stage→ negotiation stage→ technology transfer start-up→ long-term development stage
1987	*Enos and Park*	planning→ negotiation between suppliers of → technology and recipients→ plant and equipment design→ procurement and construction→ installation and start-up→ production and improvement→ subsequent annovation
1987	*Noling and Gilreath*	discovery→evaluation→adaptation→implementation
1992	*Risdon*	Technology innovation → technology confirmation → targeting technology consumers→ technology marketing→ technology application→ technology evaluation
2002	*Kelly and Wiseall*	strategy→ commission→ research→ evaluation → application
2004	*Hill*	identify→ assessment → strategy development → protection→ implementation
2005	*Goktepe*	identification of needs→ choice of technology→ assessment of conditions of transfer→ evaluation→ adjustment to local conditions→ agreement→ replication→ implementation

Table 2: Summary of the different technology transfer process model

Source: http://ijbel.com/wp-content/uploads/2014/06/Critical-Success-Factors-Csfs-On-Technology-Transfer-Effectiveness-In-Manufacturing-Industry-A-Critical-Review-Farizah-Binti-Mamat-alias-Mohd-Nor-Shashazrina-Binti-Roslan.pdf (International Journal of Business, Economics and Law 2012, Vol. 1 ISSN 2289-1552)

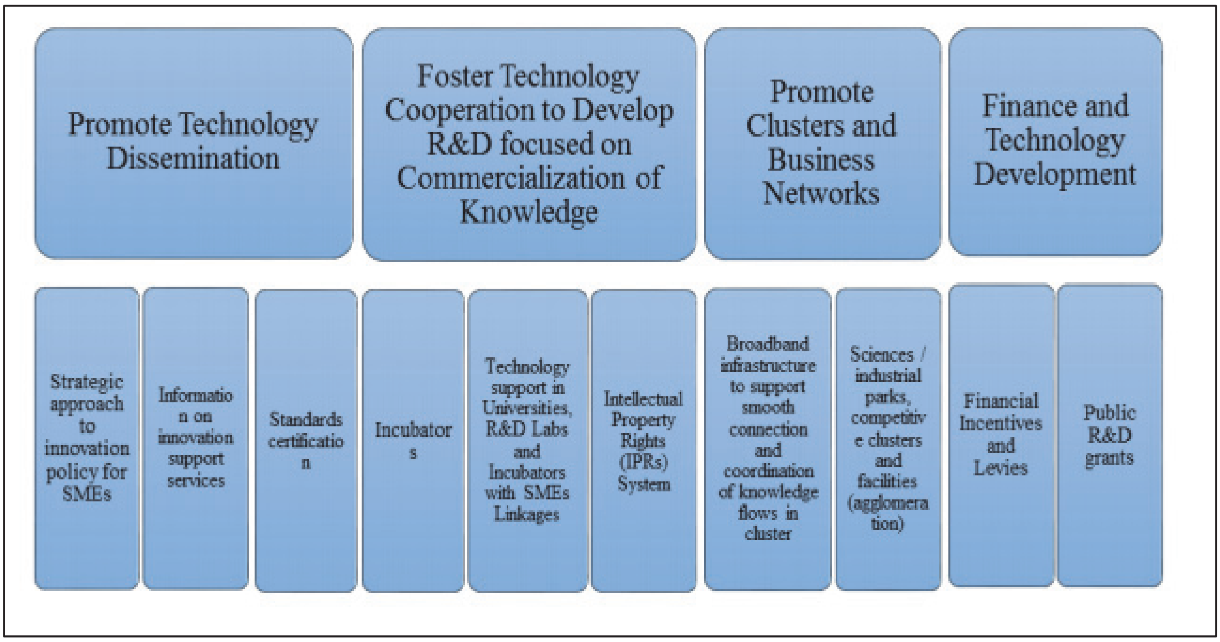

Figure 1: Frames for Technology and Technology Transfer

Sources:

- ERIA and OECD (2014), http://www.eria.org/Key_Report_FY2012_No.8_chapter_5.pdf
- http://tto.boun.edu.tr/files/1383813118_An%20overview%20of%20TT%20and%20TT%20Models.pdf
- http://www.jatit.org/volumes/Vol78No1/12Vol78No1.pdf
- http://www.wipo.int/export/sites/www/sme/en/newsletter/2011/attachments/apax_tech_transfer.pdf

Main tasks of technology transfer

The stage of research work consists of four stages:

- decision on the direction of research;
- theoretical and experimental research;
- generalisation and estimation of research results, preparation of reporting documentation;
- acceptance of research work (RW).

At the stage of research work the following tasks are carried out:

- selection, analysis and generalisation of scientific and technical, and patent documentation;
- consideration of possible directions for research and their evaluation the stage of research work the following tasks are carried out:
- selection, analysis and generalisation of scientific and technical, and patent
- documentation;
- consideration of possible directions for research and their evaluation;
- decision on the direction of research;

- motivation of the accepted research direction;
- development, harmonization and approval of terms of reference for the components of research work (if necessary);
- development and harmonization of methodology and of the work program on carrying out a research;
- making and processing of the progress stage report;
- consideration of results and acceptance of the stage, if it is stipulated by the terms of reference.

At the stage of 'theoretical and experimental research' there are the following tasks:

- theoretical search, calculations and investigation of principal questions;
- elaboration of documentation, production and check-out of mock-ups, models or test samples of the future products, programs and algorithms (if necessary);
- performance of experimental work and research;
- processing and correction of results of theoretical and experimental research;
- drawing of conclusions according to the research results;
- making and processing of the stage report;
- consideration of results and acceptance of the stage, if it is stipulated by the terms of reference.

At the stage of "generalisation and estimation of research results, preparation of report documentation" there are the following tasks:

- generalization of results of theoretical research and experimental work;
- evaluation of comprehensiveness and performance quality of the assigned tasks;
- synthesis of materials of a patent search and preparation of report on patent
- research (if necessary);
- drawing up of patent protection for potential objects of intellectual property and working out of measures to preserve a know-how;
- elaboration of terms of reference for the next research work in case of the need for further research, or elaboration of terms of reference for design and development or technological work;
- preparation of report documentation package;
- drawing up of conclusions on the basis of research results and working out of guidelines on the use of research results;
- consideration of research results;
- submission of work for formal acceptance.

At the stage of "acceptance of research work" there are the following tasks:

- preparation activities for acceptance of research work;
- acceptance and registration of research work, if it is stipulated by the legislation.

The stage of development of a technology or a product consists of four steps:

- technical proposal;
- draft design;
- engineering design;
- working design documentation of the pilot sample (test batch) of the item to be produced.

At the stage of "technical proposal" the following tasks are carried out:

- selection and synthesis of scientific and technical, and patent documents, preparation of analytical review;
- development of technical proposal basing on the analysis of scientific and technical, patent and normative documents, marketing research and terms of reference for design, development and technological work;
- consideration and approval of technical proposal.

Preparation of production, as a rule, starts simultaneously with elaboration of technical documentation and manufacturing (if necessary) of separate product components or of the whole product.

Mastering of production, if it was not implemented earlier, is carried out in the course of manufacturing of a setting batch (first-off production batch). At the same time, onecarries out activities aimed at trying out of technology and training of the staff for production of goods with stable properties in the given output volume.

To confirm the readiness of an enterprise for serial (mass) production of goods, one has to check the completeness of manufacturing process, quality and consistency of production steps as well as carry out qualification tests of the setting batch samples (first-off production batch).

Qualification tests are also carried out while starting the full-scale production of goods which was earlier coped with at another enterprise or manufactured under the license.

The results of qualification tests enter the protocol (statement).

If qualification test results are positive, mastering of production is considered to be finished and produced goods can be delivered to the customer (user) under the certified documentation.

At the stage of marketing of innovative produce the main tasks are as follows:

- carrying out of marketing research;
- identification of market segments and positioning on this segment;
- implementation of product, pricing, communication and sales policies;
- delivery, distribution, etc.

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Apart from the above-listed tasks of technology transfer, at the stages of innovative product life cycle there are a lot of specific tasks which can recur at different stages. For example:

- search for strategic business partners;
- search and attraction of investment;
- business planning;
- management of intellectual property;
- value appraisal of technology and its components;
- signing of license and other contracts;
- estimation of amount of flow of funds;
- carrying out of patent-market research;
- information support of technology transfer;
- establishment of contacts between holders of technology transfer and others.

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- Overview of challenges at different stages of technology transfer, expectations and needs of different actors

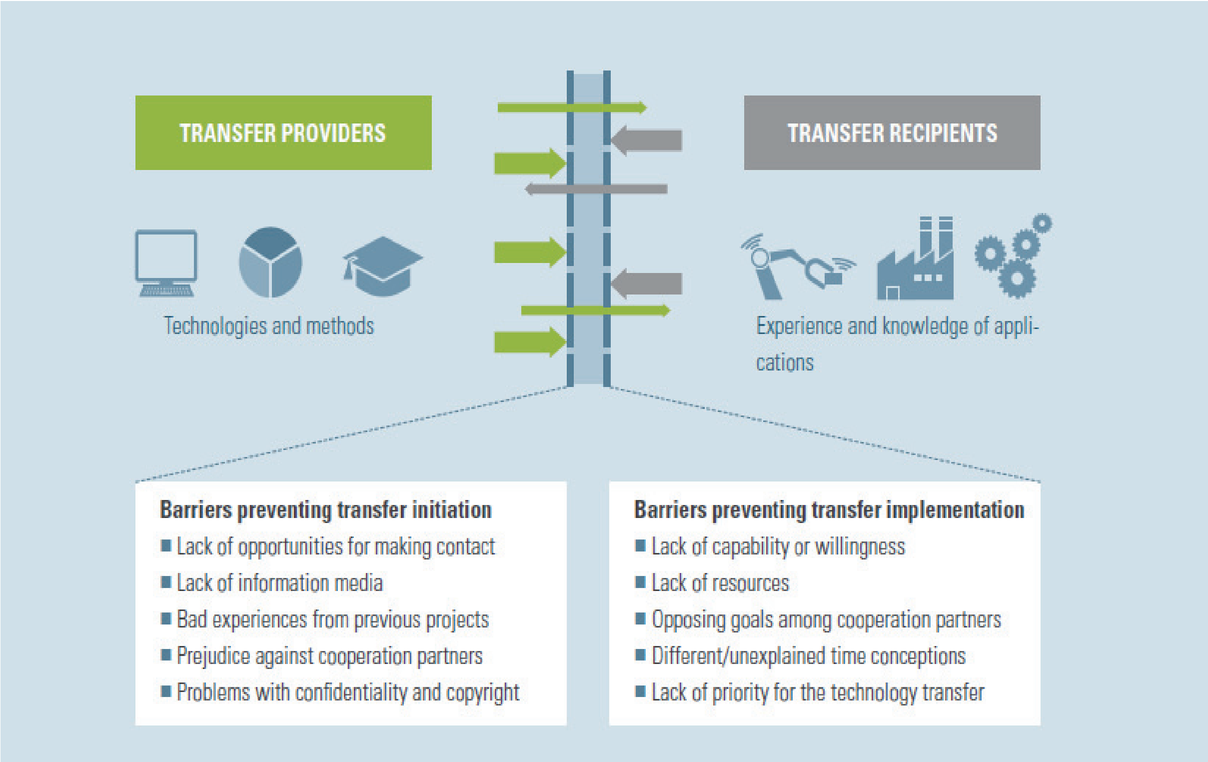

Figure 2: BARRIERS PREVENTING TECHNOLOGY TRANSFER

Source: ON THE ROAD TO INDUSTRY 4.0: TECHNOLOGY TRANSFER IN THE SME SECTOR

http://www.its-owl.de/fileadmin/PDF/Informationsmaterialien/2017-Technology_Transfer_web.pdf

Taking into account the classifications of barriers proposed by other scholars and having in mind the authors' own experience in executing research projects and co-operating with industry, the authors propose their own classification of barriers comprising the following:

(1) technical barriers,

(2) organisational-economic barriers, and

(3) system barriers to technology transfer.

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Source:

Technology Transfer Barriers and Challenges Faced by R&D Organisations Adam Mazurkiewicz*, Beata Poteralska Institute for Sustainable Technologies – National Research Institute, K. Pulaskiego 6/10, 26-600 Radom, Poland Procedia Engineering 182 (2017) 457 – 465

https://ac.els-cdn.com/S1877705817312705/1-s2.0-S1877705817312705-main.pdf?_tid=d46e6b10-b7f0-11e7-bbad-00000aab0f02&acdnat=1508763244_e0066c89fc11abc087de22d93947ecb0

Technical barriers can be:

- A high level of tacit knowledge included in technologies makes technology transfer more difficult (especially with regard to the newest solutions),
- **New technologies need to be tested and demonstrated thoroughly** before public agencies will accept them in competition with other, well-established technologies
- **Technology is too sophisticated**, making it difficult or impossible to change in order to make it suitable for the requesting production/market
- T**he recipients are not able to discern the level and characteristics of the technology needed**
- **Multiplication of solutions**: R&D organisations often have the capacity to develop a single professional solution. Since its development is connected with high technical and personnel requirements, problems concerning its acquisition by the potential producer may arise
- **A long time is needed for technology development**, resulting from the fact that the technologies offered are mainly of an unit character, which may lead to the discouragement of the potential clients who wish the technology to be developed as quickly as possible
- **Innovative technologies represent a short series or unit character**, which means that their production is very expensive; therefore, they are less competitive
- **Technological concepts are changed** in the course or even after the contract execution
- **A prototype version of a technology is often not compatible with the demands of mass productio**n – achieved high technical parameters vs. unsatisfactory economic parameters. • The interest of industry in financing the final result, not the research process itself
- **The lack of professional marketing as well as the lack of skills and practice in technology transfer** resulting in the low effectiveness of such activities.

Organisational-economic barriers are the group of barriers that includes the following among others:

- **Different orientations exist between the technology provider (R&D organisation) and its user (business**) concerning the aspect of time (long vs. short term), goal (scientific vs. techno-economic market) and risk (high risk vs. low risk expectance),
- **Large asymmetries exist between the provider and the recipient** in terms of having different characteristics, e.g., skills, prices, endowments, internal structure, size, and experience,
- **Different approaches are taken by the technology provider and recipient towards the desired results**. Usually, these approaches include innovation-oriented vs. market-oriented approaches or focus on superior technologies vs. easily implemented technologies

- **Imperfect technical information transmission and insufficient co-operation between the R&D organisation and the technology user** at the stage of technology development are often evident
- **Unsatisfactory or poor business management and negotiation skills exist on both sides** (the technology provider and recipient); however, this problem is usually mostly on the provider's side
- **There are often problems with selecting the most appropriate technology transfer mechanisms**
- **The lack of an accurate assessment of technology transfer** frequently exist
- **There is often the lack of a plan for the implementation** of research results and ex-post analysis of implementation outcomes
- **R&D organisations focus too much on the advancement and dissemination of knowledge, e.g., making results public before their patenting, which deeply collide with the demands of industry**
- **Technology providers frequently have insufficient knowledge about potential markets** and consumers
- **There is frequently insufficient time for testing and the demonstration of new technologies** before they can compete with well-established technologies, which hampers the process of the practical application of technology.
- **Problems concerning Intellectual Property Rights** resulting from the joint development of an innovation by the consortium, particularly when one or more partners are from business
- **Inspiring industry by ideas revealed or discussed at the early stages of co-operation preceding the signing of a contract**, frequently stimulating ideas by industry, which tries to apply them by themselves
- **The existing triad of co-operation extremely profitable only for the industry side: the lowest possible price** (without costs of research and development) – complete takeover of property rights by enterprises – R&D organisation responsible for possible losses in the course of using the technology
- **Organisational changes in industrial enterprises**
- Different work organisation in business and in science

Another group of barriers, which is also relatively frequently analysed in literature, comprise system barriers. Both in the literature and in practice, system barriers are of great importance. The most often mentioned ones are as follows:

- **The lack of developed infrastructures, market and public incentives exist**
- **The absence of a technological development plan** is observed at a national level, because the public decisionmaking power is not able to create conditions of promotion, support, and a coherent target for public and private R&D and innovation
- **Standard-setting groups offer a safeguard against unexpected failure** that often deliberate and can delay implementation of innovations
- **Lobbies or interest groups effectively impede change** and amelioration in the legal system, making technology transfer impossible or inefficient.

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- **The lack of skills and procedures necessary for the effective commercialisation of research results**
- The assessment system of R&D organisations focused on research results, not implementations
- **The lack of funding, e.g., from the state budget,** for the very costly phase of the implementation of technologies in business practice, particularly in the SME sector, resulting in a limited scale of implementations
- **Project proposals submitted by SMEs rejected by evaluators because of a low scientific level** of technologies planned for the development within the project, although bringing potentially huge income
- **The lack of effective organisational structures supporting the implementation of the advanced technologies to the market,** mainly in the transnational dimension, and particularly in the situation when an institution developing even significant technologies does not have a well-known brand.

All the mentioned types of barriers may occur at different levels: strategic, tactical, and operational ones.

Barriers that are at present the most difficult to overcome <u>at the strategic national level comprise the following:</u>

- **The constant process of restructuring the sector of research entities resulting in a lack of scientific specialisation** and in focusing largely on administrative matters rather than scientific
- **The clash of different attitudes in science and industry**: in science – stable academic structure based on years of professional advancement – in the industry: mobility, flexibility, commitment, and change
- **Generating research problems by the industry** – most of the financial resources in the operational programmes are directed to the industry.

<u>At the tactic level the most important barriers comprise as follows:</u>

- **A lack of high specialisation of R&D organisations**, which is a key to success for science-industry co-operation, requires continuous development of the research potential
- **During the preparation stage of project proposals**, research entities provide their ideas, but during the implementation stage, they can be excluded as a result of tenders or the taking over of their ideas by industry
- **Preparation of an application for a project** requires expertise and operational competence. Project proposals are submitted by the companies on the formal level, but they are prepared by the research entities
- **The evaluation of research projects is carried out by experts selected regardless of the importance of the projects and their budgets**. Key projects of strategic importance to the economy with large budgets should be evaluated by experts with the highest practical experience and competence. Last, but not least, at the operational level concerning the execution of individual projects, the most important barriers comprise the following:

- **The developed solutions are characterised by a high level of innovation and market demand, but often have a high unit price unacceptable for the industry**
- The salaries of research staff are inadequate to qualifications at both a national and international level
- **There is a need for sustainable development of scientific solutions** that have achieved successful application
- **Dissemination of the results of projects requires specialised marketing skills**, which is often missing in research entities
- **Innovation must be effectively correlated with management and commercialisation processes**. R&D organisations involved in innovative technologies development and transfer meet the above listed barriers in their everyday activity. In the next chapter, a few examples of technology transfer barriers that the authors of the paper encountered in practice in the period of several years of conducting research and implementation activity by ITeE-PIB are presented.

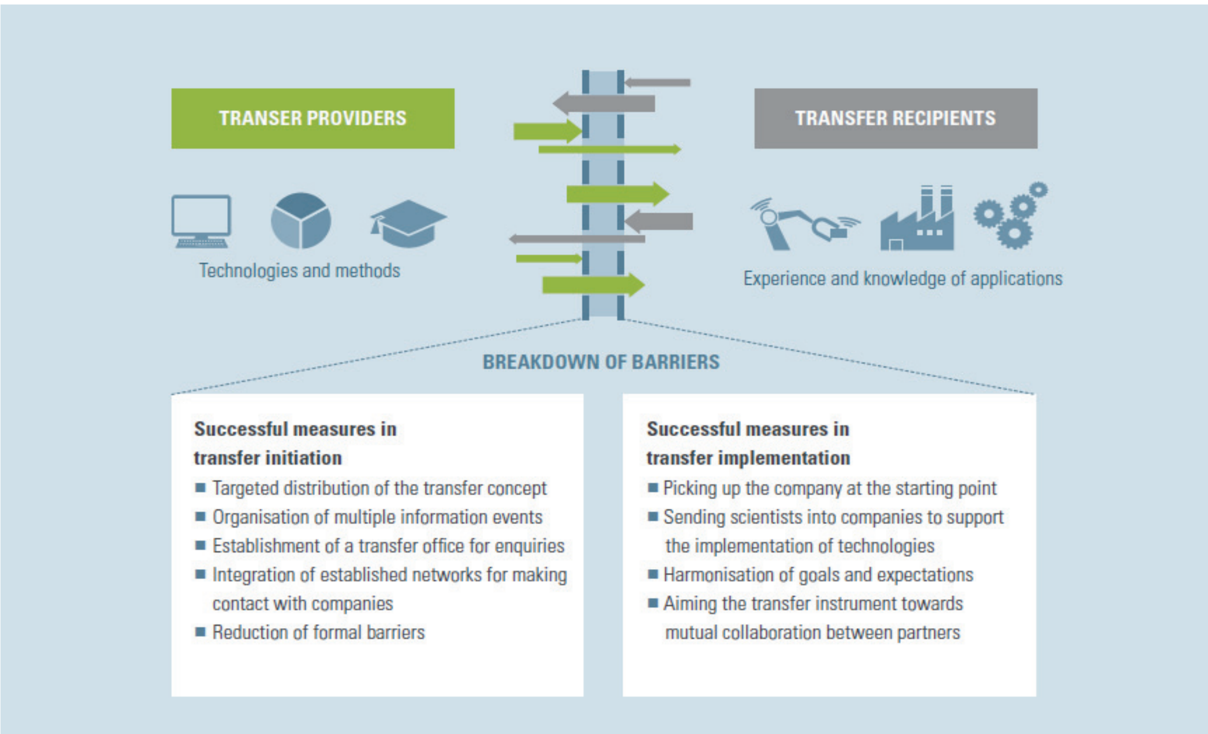

Figure 3: REDUCTION OF BARRIERS THROUGH SUCCESSFUL TECHNOLOGY TRANSFER

Source: ON THE ROAD TO INDUSTRY 4.0: TECHNOLOGY TRANSFER IN THE SME SECTOR

http://www.its-owl.de/fileadmin/PDF/Informationsmaterialien/2017-Technology_Transfer_web.pdf

KEY NEEDS OF SME SECTOR

Technology licensing

- Finding large company development / distribution partner (e.g. supplier, subcontractor)
- Strategic alliances, networking & crosslicensing to other SMEs/stakeholders (e.g. cluster, platform, etc.)

Technology acquisition

- Acquiring technology - game changer for the company
- Filling product performance gaps

Patent management

- Selling patents as an alternative to fundraising
- Selling patents in business disposal (Capital Value Partners)
- Access to business/innovation management consultancy services

KEY VALUE ADDED OF INTERMEDIARIES

Connectivity

- Deep reach into corporate technical staffs
- Access to key gatekeepers (tech transfer & tech acquisition)
- Relationships with venture capital and SMEs
- Cross-industry, cross-geography

Confidentiality

- Opportunity screening and initial discussions
- Protect client name and application

Expertise

- Evaluation and communication methods
- Market and buy-side knowledge, Business formation and commercialization skills

External perspective

- Unbiased evaluation and critical thinking
- Networked to cross-domain technical expertise

Source: http://www.oecd.org/sti/sci-tech/35428635.pdf

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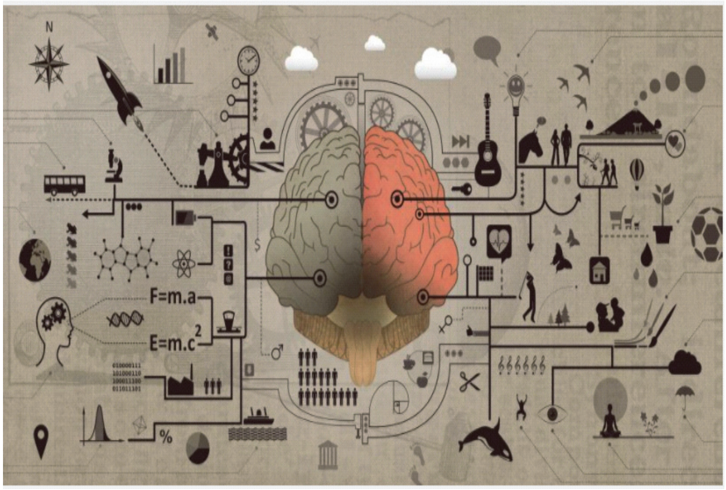
PART II.

Key aspects in technology transfer and business development II.



- Basics of intellectual property rights

Photo courtesy of and copyright Free Range Stock : https://freerangestock.com/photos/61470/learning-and-education--brain-functions-development-

Sources:

- P. Tsybulov, Y. Lashyna, S. Shukayev, R. Gohla, D. Chiran: Technology Transfer in the Field of Renewable Energy Sources Training for Researchers – Handbook 1st edition 2014 | Steinbeis-Edition, Stuttgart ISBN 978-3-95663-014-9
- https://ec.europa.eu/taxation_customs/eu-training/general-overview/intellectual-property-rights-elearning-course_en
- What is Intellectual Property, WIPO Publication No. 450(E) ISBN 978-92-805-1555-0 http://www.wipo.int/edocs/pubdocs/en/intproperty/450/wipo_pub_450.pdf

What is Intellectual Property?

Intellectual property refers to creations of the mind: inventions; literary and artistic works; and symbols, names and images used in commerce.

Intellectual property is complex concept and it can be divided into the following categories:

- Industrial Property includes patents for inventions, trademarks, industrial designs and geographical indications.
- Copyright covers literary works (such as novels, poems and plays), films, music, artistic works (e.g., drawings, paintings, photographs and sculptures) and architectural design. Rights related to copyright include those of performing artists in their performances, producers of phonograms in their recordings, and broadcasters in their radio and television programs.
- Others

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- know-how (e.g. expertise, skilled craftsmanship, training capability, understanding of how something works),
- trade secrets (a protected formula or method, undisclosed customer or technical information, algorithms, etc.),

What are intellectual property rights?

Intellectual property rights are like any other property right. They allow creators, or owners, of patents, trademarks or copyrighted works to benefit from their own work or investment in a creation.
These rights are outlined in Article 27 of the Universal Declaration of Human Rights, which provides for the right to benefit from the protection of moral and material interests resulting from authorship of scientific, literary or artistic productions.

The importance of intellectual property was first recognized in the **Paris Convention for the Protection of Industrial Property (1883) and the Berne Convention for the Protection of Literary and Artistic Works (1886).** Both treaties are administered by the World Intellectual Property Organization (WIPO).

Why promote and protect intellectual property?
There are several compelling reasons.

- First, the progress and well-being of humanity rest on its capacity to create and invent new works in the areas of technology and culture.
- Second, the legal protection of new creations encourages the commitment of additional resources for further innovation.
- Third, the promotion and protection of intellectual property spurs economic growth, creates new jobs and industries, and enhances the quality and enjoyment of life. An efficient and equitable intellectual property system can help all countries to realize intellectual property's potential as a catalyst for economic development and social and cultural well-being.

The intellectual property system helps strike a balance between the interests of innovators and the public interest, providing an environment in which creativity and invention can flourish, for the benefit of all.

How does the average person benefit?
Intellectual property rights reward creativity and human endeavor, which fuel the progress of humankind.
Some examples:

- The multibillion dollar film, recording, publishing and software industries – which bring pleasure to millions of people worldwide – would not exist without copyright protection.
- Without the rewards provided by the patent system, researchers and inventors would have little incentive to continue producing better and more efficient products for consumers.
- Consumers would have no means to confidently buy products or services without reliable, international trademark protection and enforcement mechanisms to discourage counterfeiting and piracy.

You can draw the conclusions that:

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- Intellectual Property (IP) is a key element needed to maintain a competitive edge in the market
- IP as a business asset is an intergral part of the business process
- Effective acquisition, management and protection of IP can mean the difference between success and failure in business today
- For business growth of any enterprise it is important to protect the original ideas, innovation and ensure that IP rights of any third party are not infringed

A) What is a Patent?

A patent is an exclusive right granted for an invention – a product or process that provides a new way of doing something, or that offers a new technical solution to a problem. A patent provides patent owners with protection for their inventions. Protection is granted for a limited period, generally 20 years.

Why are patents necessary?

Patents provide incentives to individuals by recognizing their creativity and offering the possibility of material reward for their marketable inventions. These incentives encourage innovation, which in turn enhances the quality of human life.

What kind of protection do patents offer?

Patent protection means an invention cannot be commercially made, used, distributed or sold without the patent owner's consent. Patent rights are usually enforced in courts that, in most systems, hold the authority to stop patent infringement. Conversely, a court can also declare a patent invalid upon a successful challenge by a third party.

What rights do patent owners have?

A patent owner has the right to decide who may – or may not – use the patented invention for the period during which it is protected. **Patent owners may give permission to, or license, other parties to use their inventions on mutually agreed terms. Owners may also sell their invention rights to someone else, who then becomes the new owner of the patent**. Once a patent expires, protection ends and the invention enters the public domain. This is also known as becoming off patent, meaning the owner no longer holds exclusive rights to the invention, and it becomes available for commercial exploitation by others.

How is a patent granted?

The first step in securing a patent is to file a patent application. The application generally contains the title of the invention, as well as an indication of its technical field. It must include the background and a description of the invention, in clear language and enough detail that an individual with an average understanding of the field could use or reproduce the invention. Such descriptions are usually accompanied by visual materials – drawings, plans or diagrams – that describe the invention in greater detail. The application also contains various "claims", that is, information to help determine the extent of protection to be granted by the patent.

An invention must, in general, fulfill the following conditions to be protected by a patent.

- It must be of practical use; it must show an element of "novelty", meaning some new characteristic that is not part of the body of existing knowledge in its particular technical field. That body of existing knowledge is called "prior art".
- The invention must show an "inventive step" that could not be deduced by a person with average knowledge of the technical field.

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- Its subject matter must be accepted as "patentable" under law. In many countries, scientific theories, mathematical methods, plant or animal varieties, discoveries of natural substances, commercial methods or methods of medical treatment (as opposed to medical products) are not generally patentable

Who grants patents?
Patents are granted by national patent offices or by regional offices that carry out examination work for a group of countries – for example, the European Patent Office (EPO) and the African Intellectual Property Organization (OAPI). Under such regional systems, an applicant requests protection for an invention in one or more countries, and each country decides whether to offer patent protection within its borders.
The WIPO-administered Patent Cooperation Treaty (PCT) provides for the filing of a single international patent application that has the same effect as national applications filed in the designated countries. An applicant seeking protection may file one application and request protection in as many signatory states as needed.

B) What is a trademark?
A trademark is a distinctive sign that identifies certain goods or services produced or provided by an individual or a company. Its origin dates back to ancient times when craftsmen reproduced their signatures, or "marks", on their artistic works or products of a functional or practical nature. Over the years, these marks have evolved into today's system of trademark registration and protection. The system helps consumers to identify and purchase a product or service based on whether its specific characteristics and quality – as indicated by its unique trademark – meet their needs
Trademark protection ensures that the owners of marks have the exclusive right to use them to identify goods or services, or to authorize others to use them in return for payment. The period of protection varies, but a trademark can be renewed indefinitely upon payment of the corresponding fees. Trademark protection is legally enforced by courts that, in most systems, have the authority to stop trademark infringement. In a larger sense, trademarks promote initiative and enterprise worldwide by rewarding their owners with recognition and financial profit. Trademark protection also hinders the efforts of unfair competitors, such as counterfeiters, to use similar distinctive signs to market inferior or different products or services.

What kinds of trademarks can be registered?
Trademarks may be one or a combination of words, letters and numerals. They may consist of drawings, symbols or threedimensional signs, such as the shape and packaging of goods. In some countries, non-traditional marks may be registered for distinguishing features such as holograms, motion, color and non-visible signs (sound, smell or taste). In addition to identifying the commercial source of goods or services, several other trademark categories also exist.

C) What is an Industrial Design?
An industrial design refers to the ornamental or aesthetic aspects of an article. A design may consist of three-dimensional features, such as the shape or surface of an article, or two-dimensional features, such as patterns, lines or color. Industrial designs are applied to a wide variety of industrial products and handicrafts: from technical and medical instruments to watches, jewelry and other luxury items; from house wares and electrical appliances to vehicles and architectural structures; from textile designs to leisure goods.
To be protected under most national laws, an industrial design must be new or original and nonfunctional. This means that an industrial design is primarily of an aesthetic nature, and any

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technical features of the article to which it is applied are not protected by the design registration. However, those features could be protected by a patent.
Protecting industrial designs helps to promote economic development by encouraging creativity in the industrial and manufacturing sectors, as well as in traditional arts and crafts. Designs contribute to the expansion of commercial activity and the export of national products.

Generally, industrial design protection is limited to the country in which protection is granted.

> The Hague Agreement Concerning the International Registration of Industrial Designs, a WIPOadministered treaty, offers a procedure for international registration of designs. Applicants can file a single international application either with WIPO or the national or regional office of a country party to the treaty. The design will then be protected in as many member countries of the treaty as the applicant designate.

Generally, "new" means that no identical or very similar design is known to have previously existed. Once a design is registered, a registration certificate is issued. Following that, the term of protection granted is generally five years, with the possibility of further renewal, in most cases for a period of up to 15 years.

D) What is a Geographical Indication?

A geographical indication is a sign used on goods that have a specific geographical origin and possess qualities or a reputation due to that place of origin. Most commonly, a geographical indication consists of the name of the place of origin of the goods. Agricultural products typically have qualities that derive from their place of production and are influenced by specific local geographical factors, such as climate and soil. Whether a sign functions as a geographical indication is a matter of national law and consumer perception. Geographical indications may be used for a wide variety of agricultural products, such as, for example, "Tuscany" for olive oil produced in a specific area of Italy, or "Roquefort" for cheese produced in that region of France. The use of geographical indications is not limited to agricultural products. They may also highlight specific qualities of a product that are due to human factors found in the product's place of origin, such as specific manufacturing skills and traditions. The place of origin may be a village or town, a region or a country

Geographical indications are understood by consumers to denote the origin and quality of products. Many of them have acquired valuable reputations which, if not adequately protected, may be misrepresented by commercial operators. False use of geographical indications by unauthorized parties, for example "Darjeeling" for tea that was not grown in the tea gardens of Darjeeling, is detrimental to consumers and legitimate producers.

> IMPORTANT
>
> A trademark is a sign used by a company to distinguish its goods and services from those produced by others. It gives its owner the right to prevent others from using the trademark.
>
> A geographical indication guarantees to consumers that a product was produced in a certain place and has certain characteristics that are due to that place of production. It may be used by all producers who make products that share certain qualities in the place designated by a geographical indication.

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E) <u>What are Copyright and Related Rights?</u>

Copyright laws grant authors, artists and other creators protection for their literary and artistic creations, generally referred to as "works". A closely associated field is "related rights" or rights related to copyright that encompass rights similar or identical to those of copyright, although sometimes more limited and of shorter duration.

The beneficiaries of related rights are:

- performers (such as actors and musicians) in their performances;
- producers of phonograms (for example, compact discs) in their sound recordings; and
- broadcasting organizations in their radio and television programs.

Works covered by copyright include, but are not limited to: novels, poems, plays, reference works, newspapers, advertisements, computer programs, databases, films, musical compositions, choreography, paintings, drawings, photographs, sculpture, architecture, maps and technical drawings.

What rights do copyright and related rights provide?

The creators of works protected by copyright, and their heirs and successors (generally referred to as "right holders"), have certain basic rights under copyright law.

They hold the exclusive right to use or authorize others to use the work on agreed terms. The right holder(s) of a work can authorize or prohibit:

- its reproduction in all forms, including print form and sound recording;
- its public performance and communication to the public;
- its broadcasting; its translation into other languages; and
- its adaptation, such as from a novel to a screenplay for a film.

Similar rights of, among others, fixation (recording) and reproduction are granted under related rights. Many types of works protected under the laws of copyright and related rights require mass distribution, communication and financial investment for their successful dissemination (for example, publications, sound recordings and films).

Hence, creators often transfer these rights to companies better able to develop and market the works, in return for compensation in the form of payments and/or royalties (compensation based on a percentage of revenues generated by the work).

The economic rights relating to copyright are of limited duration – as provided for in the relevant WIPO treaties – beginning with the creation and fixation of the work, and lasting for not less than 50 years after the creator's death. National laws may establish longer terms of protection. This term of protection enables both creators and their heirs and successors to benefit financially for a reasonable period of time. Related rights enjoy shorter terms, normally 50 years after the performance, recording or broadcast has taken place. Copyright and the protection of performers also include moral rights, meaning the right to claim authorship of a work, and the right to oppose changes to the work that could harm the creator's reputation.

How have copyright and related rights kept up with advances in technology?

The field of copyright and related rights has expanded enormously during the last several decades with the spectacular progress of technological development that has, in turn, yielded new ways of disseminating creations by such forms of communication as satellite broadcasting, compact discs and DVDs. Widespread dissemination of works via the Internet raises difficult questions concerning copyright and related rights in this global medium.

WIPO is fully involved in the ongoing international debate to shape new standards for copyright protection in cyberspace. In that regard, the Organization administers the WIPO Copyright Treaty (WCT) and the WIPO Performances and Phonograms Treaty (WPPT), known as the "Internet Treaties". These treaties clarify international norms aimed at preventing unauthorized access to and use of creative works on the Internet

IP as a property:

- Can be sold
- Can be bought
- Can be lease or rent
- Can pass under a will
- Can be assigned

Technology commercialization

- License out
- License In
- Collaborate
- Acquisitions
- Auctions
- Sales

Benefits:	Researchers share the benefits:
❖ Raise Capital ❖ Transfer Risks ❖ Apply appropriate skill sets ❖ Brand association	❖ Royalties from licences ❖ Equity in spinout companies ❖ Income from personal consultancy ❖ Dividends and Exits from spin-out companies

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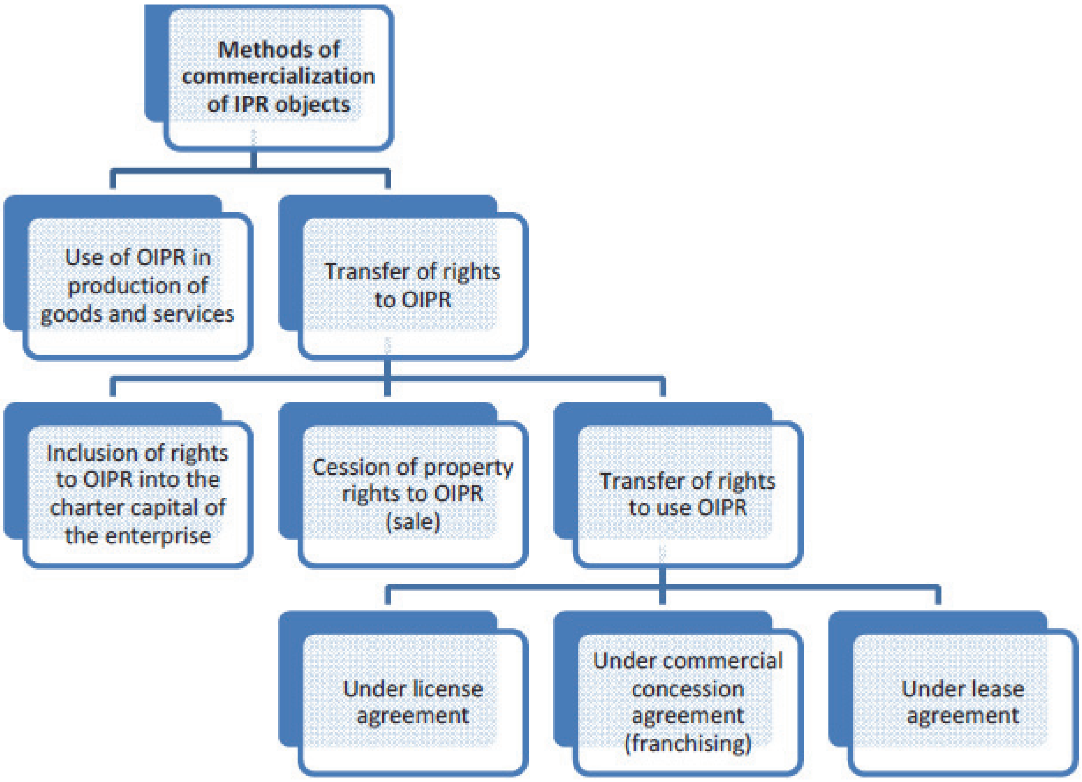

Figure 4: Methods for commercialization of intellectual property
Source: Pavlo Tsybulov, Yuliya Lashyna, Sergiy Shukayev, Robert Gohla, Daniela Chiran: Training for Researchers – Handbook 1st edition 2014 | Steinbeis-Edition, Stuttgart, ISBN 978-3-95663-014-9

Source:
WIPO: Successful Technology Licensing Publication No. 903E 2015 Edition ISBN 978-92-805-2633-2 http://www.wipo.int/edocs/pubdocs/en/licensing/903/wipo_pub_903.pdf

Intellectual Property (IP) licensing is a frequently used means of exploitation of IP, including in the process of commercialization of research results generated in universities and publically funded research institutions. In today's knowledge-based economies, the prevailing model of IP collaboration among academic and business organizations is "open innovation", based on licensing deals among various participating partners.

The World Intellectual Property Organization (WIPO) published in 2015 a „Successful Technology Licensing (STL) Manual" as a response to requests for a user-friendly manual aimed primarily at an audience of businesspersons, technology managers and scientists who are dealing with licensing in the course of their work. **Licensing occurs in the context of various business and collaboration relations, such as mergers and acquisitions, joint ventures, research collaboration agreements, joint research and development arrangements**

An introduction to successful technology licensing may be summarized by six fundamental and simple ideas.

1) **Technology licensing only occurs when one of the parties owns valuable intangible assets, known as Intellectual Property (IP),** and because of that ownership has the legal right to prevent the other party from using it. A license is a consent by the owner to the use of IP in exchange for money or something else of value. Technology licensing does not occur when there is no IP.
2) **There are different kinds of technology licenses.**
Licenses may be for certain IP rights only (e.g. a license to practice an identified patent or to copy and distribute a certain work of authorship).
Licenses may be for all the IP rights of any kind that are necessary to reproduce, make, use, market, and sell products based on a type of technology (e.g. a license to develop IP Assets Management Series new software product that is protected by patent, copyright, trademark and trade secret law).
A license may also be for all the IP rights necessary in order to create and market a product that complies with a technical standard or specification (e.g., a group of enterprises has agreed on a technical standard to ensure interoperability of devices and owners of IP essential to practice the standard pool their IP rights and license to anyone who wishes to use the standard on reasonable and nondiscriminatory terms).

3) **Technology licensing occurs in the context of a business relationship in which other agreements are often important**

4) **Technology licensing negotiations, like all negotiations, have sides (parties) whose interests are different, but must coincide in some ways**
Successful technology licensing occurs only when the negotiator understands thoroughly the benefits that are available to both parties. Unlike sales transactions involving physical property, IP licenses generally involve more than the simple question: "how much?" The goal is to find a good balance of value so that the license is a "win-win" transaction

5) **Technology licensing involves reaching agreement on a complex set of terms, each of which has several possible solutions**. Therefore, advance preparation is essential

6) **Technology licensing is not necessarily synonymous with technology transfer.**
The fact that two parties reach a deal on licensing does not mean that the subject matter of the deal is actually transferred. Because technology licensing concerns not only knowledge that is Successful Technology Licensing expressed in writing, but also knowledge in the form of practical know-how or trade secrets (generally kept secret). **It becomes an actual transfer when the licensor delivers the technology and knowledge to the licensee and the licensee learns how to effectively use, adapt and where possible improve the technology and knowledge**

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This term sheet is to facilitate discussion only and is not intended to be legally binding on either party. A party may withdraw from negotiation at any time upon notice to other party. Any agreement between the parties is subject to negotiation and execution of an appropriate,definitive contract document that is approved by the senior management and/or board of directors of each party and signed by officers of both parties.

Name of potential licensor (or licensee) and contact info:

Name of team members and contact info:

Technology to be used in (name of product and/or product line):

Important dates and deadlines (e.g. manufacturing start, press release. Has development, manufacturing, or distribution already commenced in advance of the agreement?):

1. Subject matter (use specification, technical description, patent numbers, name of a work, trademark, etc. Are any standards applicable?):
2. Ownership (check ownership):
3. Related agreements (development, consulting, training, purchase, investment, service, etc.):
4. Development (Is the technology completed? Is it fully functional? If not, who will complete development, do further research, do prototypes, correct design flaws, etc.?):
5. Scope of license (What rights are being licensed? Non-exclusive or exclusive? Make, use, sell, make copies? Distribute?):
6. Derivative works, improvements (Will licensee have right to change the technology or make new products based on the technology.):
7. Sub-licensing (Will licensee have right to sub-license? If so, what rights will sub-licensees get?):
8. Geographic territory (Where can the licensee use the license?):
9. Field of Use (Are technical fields limited?):
10. Financial (What fees are to be paid to licensor? What royalties? Other payments? Any warrants, stock? Any minimums on royalties? Any caps on royalties? Advances by licensee? How to pay back advances?):
11. Term (For how long will the agreement last? (term of agreement). Does this depend on events?):
12. Future versions (Is there an agreement on license rights to future versions of the technology? Related products?):
13. Obligations (What obligations should the parties have other than the license? (e.g. testing, marketing, clinical trials, meeting standards, etc.)):
14. Disputes (Where settled? Who indemnifies against risk from 3rd party claims?):

Figure 5: Sample Internal Term Sheet of a license agreement in the course of the technology transfer negotiation

There are several technology transfer services provided in order to facilitate the process. These are generally performed by Technology Transfer Offices and Technology Licensing Offices. Some of the most common are:

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- Technology transfer process support and consulting;
- Supporting collaborative research between academia and industry;
- Templates and other predefined documents to ease the process;
- Registering patents and IPRs and related consultancy;
- Maintaining patent portfolios;
- Generating and supporting spin-offs;
- Supporting and attracting funding for newly developed companies based on a technology transfer model

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- Factors and strategies for effective and successful cooperation

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https://freerangestock.com/photos/74954/people-discussing-business-ideas--brainstorming-and-business-me.html

CRITICAL SUCCESS FACTORS ON TECHNOLOGY TRANSFER PROCESS
Source:
http://ijbel.com/wp-content/uploads/2014/06/Critical-Success-Factors-Csfs-On-Technology-Transfer-Effectiveness-In-Manufacturing-Industry-A-Critical-Review-Farizah-Binti-Mamat-alias-Mohd-Nor-Shashazrina-Binti-Roslan.pdf (International Journal of Business, Economics and Law 2012, Vol. 1 ISSN 2289-1552 2012)

Toregas et.al (2004) also has stressed several variables in their technology transfer model, which emphasized

- on leadership commitment,
- service to customers,
- staffing with talented people, and
- the use of external capabilities to augment staff are the four essential elements for successful technology transfer.

Meanwhile, Shama (1992) in his research point out six variables to measure technology transfer effectiveness from a research university:

(1) the number of invention disclosures received,

(2) the number of U.S. patents filed,

(3) the number of licenses/options executed,

(4) the number of licenses/options yielding income,

(5) the number of start-up companies, and

(6) the gross licensing income received.

Based on Watanabe (1992) his studied define that there were several key factors for successful transfer which are;

- a project manager who has strong enthusiasm and clearly sees the benefits and Excitement the new product will bring to society be appointed.
- Demonstration of creativity is crucial and should be encourage in identifying the new market with new technology.
- Engineering resources should be concentrated on selected key fields including basic works in order to incorporate sophisticated technologies into high yield production lines.
- Key R&D personnel should be transferred with the production and marketing because truly innovative products require new culture in which to incubate.
- Respect for highly skilled people should always be emphasized while skills should be channeled into focused programs which can be observed and improved by the group.

The factor of influencing the effectiveness of technology transfer not only the tangible factor but it can be identified through intangible factors. Smilor and Gibson (1991) stressed that the ways that would improve the technology transfer process by share success stories of technology transfer among program areas, which could awareness regarding to the importance of technology transfer by involving shareholder marketing and product planning personnel.

> Currently, the biggest international trend in the transfer of technology is that companies are gradually moving towards strategic alliances such as partnering, joint ventures, merges and acquisitions.

Alliances may be most useful at the cutting edge of the learning agenda, to access and internalize technologies and know-how that are embedded, largely tacit, uncodified, and thus difficult to access via contractual approaches that do not involve a close collaboration between the partners.

A study by Yves and Gary points out that, in planning for or assessing individual skill-based alliances, it is important to focus on a few critical issues:

- How will the alliance create value? It is necessary to consider the extent of co-specialization between the technologies and skills of the partners that, on the one hand, will create value from each partner’s competences and, on the other, engender risk of intrusion of one another’s technology. Page 169
- What is the strategic compatibility between the partners? It is essential to assess the potential compatibility between partners’ priorities, and the resilience of the alliances to external factors.
- How compatible are the partners’ or organizations and cultures?
- How can the process of collaboration be made to converge? This might mean matching the sequence of mutual commitments demanded from each partner with the level of under-standing and trust achieved together.
- How effective is the design of the alliances?
- How balanced are the contributions and benefits over time?
- How strong are the expectations of future benefits?

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SEVERAL STRATEGIC TIPS TO MAKE YOUR TECHNOLOGY TRANSFER PROCESS MORE EFFECTIVE AND EFFICIENT

According to (Larssonet al. 2006), when technology is to be transferred it is possible to take different approaches or strategies on how to achieve the transfer. To success on technology transfer, the technology transfer partner must have a strategy.

A) Create a partnership

There are a lot of reasons to create a partnership when dealing with technology transfer. These depend on the capabilities of all involved in the process and may create the whole chain of partners that ensures the success of the technology transfer at all its stages:

- **Forming alliances with partners who have the manufacturing capability**. Even though the inventor is able to bring the idea of a technology with all its parameters and specifications, s/he may not have the capability or resources to manufacture the product and must find someone who would manufacture the product for him/her collaboration in the manufacturing.
- **Forming alliances with partners to ensure the intellectual property protection**. The inventor may have the resources to conduct the research and development, but may not be able to take the technology through the process of patenting and licensing = collaboration in the product registration.
- **Forming alliances with partners that can progress the development to take it to the market.** The inventor/developer of certain technology may have the resources to bring the technology to aparticular state of development, but s/he may not be able to bring it to the market = collaboration in the commercialisation.
- **Forming alliances with partners who have the marketing and distribution capability**. The developer of the technology may be able to fully develop the technology, but s/he lacks the marketing and distribution channels to launch the product commercially collaboration in the marketing.Partnering in the area of technology transfer allows combining different resources from various organisations and institutions. These include not only tangible assets, but also human capital. Technology transfer using the principle of partnerships may lead to better results thanks to the fusion of knowledge of various subjects, combination of more research fields and areas of application. One of the important aspects in this regard is the decision on the share of each partner in financing of joint activities, and how the incomes from the commercialisation of joint efforts will be divided among partners. There are a lot of reasons to create a partnership when dealing with technology transfer. These depend on the capabilities of all involved in the process and may create the whole chain of partners that ensures the success of the technologytransfer at all its stages
- **Forming alliances with partners who have the manufacturing capability**. Even though the inventor is able to bring the idea of a technology with all its parameters and specifications, s/he may not havethe capability or resources to manufacture the product and must find someone who would manufacture the product for him/her collaboration in the manufacturing.
- **Forming alliances with partners to ensure the intellectual property protection**. The inventor may have the resources to conduct the research and development, but may not be able to take the technology through the process of patenting and licensing = collaboration in the product registration.
- **Forming alliances with partners that can progress the development to take it to the market.** The inventor/developer of certain technology may have the resources to bring the technology

to a particular state of development, but s/he may not be able to bring it to the market = collaboration in the commercialisation.

- **Forming alliances with partners who have the marketing and distribution capability**. The developer of the technology may be able to fully develop the technology, but s/he lacks the marketing and distribution channels to launch the product commercially collaboration in the marketing.

Partnering in the area of technology transfer allows combining different resources from various organisations and institutions. These include not only tangible assets, but also human capital. Technology transfer using the principleof partnerships may lead to better results thanks to the fusion of knowledge of various subjects, combination of more research fields and areas of application.
One of the important aspects in this regard is the decision on the share of each partner in financing of joint activities, and how the incomes from the commercialisation of joint efforts will be divided among partners.

Local or regional partnerships sometimes do not satisfy the needs of involved parties. In technology transfer, there is often a necessity to cross the border in order to find a suitable partner who would fit to the context of activities.
Therefore, transnational partnerships are getting higher importance. One of the crucial steps in building transnational partnership is to ensure, that it will bring value added to the whole process of technology transfer and that the international partner will contribute to the achievement of the aims we want to accomplish. Additional aspects have to be respected when involved in the partnership of transnational character. These include cultural aspects, regulatory framework in different countries, language and communication, etc.

All partnerships should be based on a win-win approach. It is necessary that all the partners benefit from the collaboration in the form of financial incentives or other strategic benefits. Otherwise they would not put their efforts to the tasks they perform

B) Use the methods for assesment of market attractiveness of technologies (risk assessment)

An effective tool to select the idea among several ones which are under consideration is risk analysis. It is assumed that a number of ideas which initially looked very attractive, after such a review will be discarded. The remaining technology in the future will be subject to an in-depth analysis involving methods which use quantitative characteristics. Selection procedure involves study of risks according to six aspects:

1. **Attractiveness of the market.**
   This item includes market size of the technology, growth prospects of the market, barriers on the way to the market, intensity of competition and typical profit margins.

2. **Synergy of business.**
   This item takes into account the use or disuse of professional knowledge and existing production (distribution) systems available in the company, as well as the possibility of selling to available customers. Synergy presupposes obtaining of additional profit due to these factors

3. **Validity of idea.**
   One analyses a complexity of idea underlying the technology, novelty of technology, level of its patent clearance, and the need to obtain a permission to use it

4. **Resource needs.**
   This item presupposes study of the need in additional manpower and equipment, assessment of timeline of the project and the amount of external funding
5. **Benefits for the user.**
   Here one considers the "uniqueness" of obtained benefits, functional aspects and cost benefits, as well as evidence of the need for a new technology or product.

6. **Legal protection of technology.**
   This item considers a strategy of legal protection, possibility of duplication of technology by unscrupulous competitors, possible types of licenses for developed technology

For each item one formulates positive and negative indicators which are recorded in the table. If some items turn to be insignificant, they can be ignored or replaced. There are many variants for quantitative assessment of factors under consideration. In the first approximation, one can choose the scheme by which each factor is given a score: from (+2) (for a powerful positive indicator presented in the first column) to (-2) (for a powerful negative indicator presented in the second column of the table). If for a technology under consideration the indicator has an intermediate value, it is assigned (+1), (0), or (-1). The score for each indicator is entered in the third column. After assessment of the risks for each technology under consideration and after calculation of total scores, one can easily select the technology whose implementation is associated with less risk.

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Positive indicators	Negative indicators	Scores
1. Market attractiveness		
The idea has good market prospects	The market for the idea is too small to deal with it	
This sector is growing very fast	This market sector is static or declining	
It will be relatively easy to enter this market	There are serious obstacles on the way to this market	
Competitors are weak and are not organized against the new technology or product	Market leaders are large companies with extensive resources	
It is known that profit margin in this sector is quite large	Tough competition leads to minimal profit	
2. Synergy of business		
Innovation meets the company's strategy	The idea gives a chance to diversify	
The idea can be sold to one's own customers	The idea will require the development of a new customer base	
When developing and implementing the idea there is no need for new professional skills	The company should obtain new practical experience to work with the idea	
The existing production and distribution systems can be applied at the operational phase	Operational phase will require investment in production and/or distribution system	
3. Validity of idea		
Technology underlying the idea is approved and understandable	The idea is based on a new unproven concept	
The idea implies a new application of the product or the process	The idea implies a new product concept or a new concept of the process	
Success does not depend on other developed items	Innovation depends on other developed items	
Innovation does not involve complex and unknown subsystems	Several complex systems will be integrated to result in emergence of innovation	
The use does not require any approval and permit	One will need approval and permit allowing to implement the idea	
4. Resource needs		
One needs a small amount (or does not need at all) additional resources for development and implementation of the idea	There will be a need for additional funding before one can fully realize the idea	
The idea can be quickly developed and implemented	It will take a long time before the idea is developed and put into practice	
There is an access to funds/grants for development work	Development of the idea will entirely depend on external funding	

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There will be enough staff for exploitation of the idea	One will have to hire new people to develop and implement the idea	
5. Benefits for the user		
The idea will provide unique benefits for the users	The idea will not give any special advantages for users	
The idea offers improved performance qualities of the product	Performance qualities of the product will be approximately the same as before	
Product price advantages will be significant	The new idea will not have any price advantages	
The idea will have a positive impact on the environment	Special efforts will be needed to reduce the ecological implications after implementation of the idea	
There is a clear and confirmed need for amenities derived from implementation of the idea	There is no reason to suppose that te benefits from implementation of the idea will be appreciated by users	
6. Legal protection of the idea		
For other companies it will be difficult to copy the idea	Once the idea comes into the market, others will be able to copy it	
Most likely it will be possible to obtain legal protection of technology (patents, certificates)	The prospect of effective patent protection of the idea is very weak	
One can earn additional income through licensing agreements with third parties	Income from licensing will hardly cover extra expenses	
	Total:	

Table 3.: Summary table for assessment of market attractiveness of any technology

Source: Pavlo Tsybulov, Yuliya Lashyna, Sergiy Shukayev, Robert Gohla, Daniela Chiran: Training for Researchers – Handbook 1st edition 2014 | Steinbeis-Edition, Stuttgart, ISBN 978-3-95663-014-9

C) Make your competitors analysis

Marketing competitor analysis is done with relation to your competitors. That is to say, you do the analysis of your competitor's firm. In marketing competitor analysis, you assess the strengths and weaknesses of your rivals.

Before doing a marketing competitor analysis, one has to ask the right questions. Without these questions, you cannot do your analysis. The following are some of the common questions while doing a marketing competitor analysis;

- Who are your competitors?
- What products or services are they selling?
- How much market share do they have?
- What were their past strategies?
- Are they using the same strategy?
- How aggressive are they on the advertising front?
- How competitive are they?
- Are their strengths and weaknesses the same as yours?
- How big of a threat are they to you?
- How do their strategies affect your business?

Interesting technique to determine the marketing competitor analysis is by using the competitor array. **It's a simple tool** where you follow a few steps to determine how your competitors are doing. The steps include the following;

1. **Define the industry**: The nature of the industry you and your competitors are in. The scopes available to produce your goods and services.
2. **Find out your competitors**: An industry is likely to have multiple competitors. You need to find out who is your genuine competitor that can match your level.
3. **Determine the customers**: Find out who your customer base is and what their level of expectation is
4. **Key success factors**: You find out what factors are the leading prospects in becoming successful. It does not matter if those factors have been used by you or your competitors.
5. **Rank those factors** by weighing them
6. **Rate your competitors**: You give your competitors a rating based on how much they each weight on those key factors.

D) Make your market analysis

Market analysis should illustrate and present information about market where you intend to sell product/service including

- detailed overview of market size,
- market share,
- barriers to entry (e.g. changing technology, high investment cost, lack of quality personnel, patents and proprietary knowledge etc.) and
- barriers to innovation in your company (e.g. financial constraints, competitors copying the innovation, lack of protecting intellectual property, absence of complementary assets such as production facilities and access to distribution channels, poorly developed design and manufacturing skills, and insufficiently developed technological and managerial skills to commercialize a product professionally).

It should also outline the possibilities for cooperation with other organizations and clearly describe target customers of the business.

Possible customer segmentation criteria for the customer goods markets are as follows:

- Location: country, urban/rural
- Demographics: age, sex, income, profession,
- Behaviour: frequency of product use, product application
- Buying habits: brand preferences, price consciousness

Possible customer segmentation criteria for industrial goods markets are as follows:

- Demographics: company size, industry, location
- Operations: technology employed
- Buying habits: centralized or decentralized purchasing, purchasing criteria, supplier agreements
- Situational factors: urgency of need, order size

Market Analysis to identify opportunities for your technology

- **Field of use**
- **Exclusivity**

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- **Strength and breadth of patent**
- **Geographic limitations**
- **One market or multiple markets?**
- **Single technology or bundle of technologies?**

E) Involvement mediators in the technology transfer processess

Participants of technology transfer are scientists and inventors, research institutes and design engineering bureaus, industrial enterprises, market structures, investors and other entities. And all these holders of technology transfer speak different languages. Thus, most scientists poorly imagine the practical side of the commercialisation of their research results. The manufacturers are not familiar with peculiarities of scientific search for new ideas to create innovative technologies. Investors do not understand what both the scientists and manufacturers do. In these conditions technology transfer is like building the Tower of Babel. Thus, in addition to those who are directly engaged in development and use of technologies, we need mediators who could talk to all participants about technology transfer using language which they understand for the purpose of increasing the effectiveness of technology transfer and achievement of its ultimate goal.
Mediator in technology transfer can both contribute to creation of new technologies and the use of existing ones. Taking into account the fact that application of existing technologies is much cheaper than creation of new ones, technological mediation provides additional advantages in the pursuit of innovations.

Mediators of technology transfer can be divided into four groups:

- corporate mediators;
- group mediators;
- individual mediators;
- occasional mediators.

Corporate mediators are the companies which fully dedicated themselves to technological mediation. Taking advantage of its ability to combine new technologies with the existing objects and ideas as well as a wide network of people and organisations at their disposal, this company creates a community around its innovative products and processes.

Some firms successfully practice group technological brokerage, i.e. create internal groups which are relatively free to move between different parts of a large organisation and watch what ideas of one subdivision can be used in another. Group (internal in relation to the parent company) broker can establish the necessary links between the company units or individual performers to achieve the company's goals in creation and promotion of technologies.

Individual mediators, the so-called technology brokers, are physical persons who can be private entrepreneurs providing services to participants of technology transfer for searching of business partners, investors, or for establishing contacts between individuals, groups or organisations for promotion of innovative ideas through creation of new or use of existing technologies for gaining profit or other benefit.

The process of technology transfer requires carrying out a lot of work that is not typical or is not rational for implementation by the participants of technology transfer. Such work includes: registration of rights for intellectual property objects, development and conclusion of license agreements for transfer of technologies, information services and many others.

At the same time, there are a lot of business entities which are not direct participants of technology transfer, but they are willing to provide business services necessary for technology transfer. Each of such organisations has specific business and mediation in technology transfer is not in their plans. But they are interested in making a profit from rendering business services. Since the appeal to such organisations has random character, these organisations can be attributed to a group of random mediators.

F) Using the methods of technology readiness level

Technology readiness levels (**TRL**) are a method of estimating technology maturity of Critical Technology Elements (CTE) of a program during the acquisition process. They are determined during a Technology Readiness Assessment (TRA) that examines program concepts, technology requirements, and demonstrated technology capabilities. TRL are based on a scale from 1 to 9 with 9 being the most mature technology. The use of TRLs enables consistent, uniform discussions of technical maturity across different types of technology. A comprehensive approach and discussion about TRLs has been published by the European Association of Research and Technology Organisations (EARTO).[1] Extensive criticism of the adoption of TRL scale by the European Union was published in The Innovation Journal.

Technology Readiness Level - COM definition (source: http://onlinepubs.trb.org/Onlinepubs/webinars/160428.pdf)

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Phase	TRL	Description
Basic Research	1	Basic principles and research
	2	Application formulated
	3	Proof of concept
Applied Research	4	Components validated in laboratory environment
	5	Integrated components demonstrated in a laboratory environment
Development	6	Prototype demonstrated in relevant environment
	7	Prototype demonstrated in operational environment
	8	Technology proven in operational environment
Implementation	9	Technology refined and adopted

Table 4: The levels of the technology readiness and their features

How do you measure the maturity of the given technology?
Source: https://cfwebprod.sandia.gov/cfdocs/CompResearch/docs/TRL-Guidance-final.pdf

Basic guideline to carry out any Technology Readiness Assessment (TRA) and defining the maturity of the given technology:

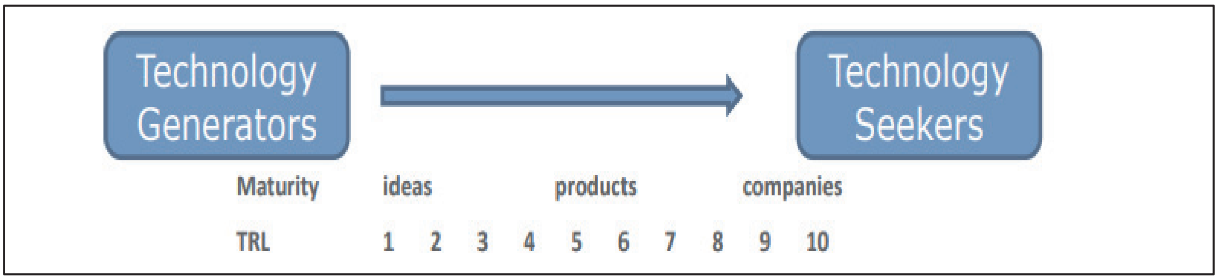

Figure 6: Translation funding is often required to bridge the 'technology readiness gap'
Source:

https://www.lrpv.gov.lv/sites/default/files/media/dokumenti/Konference_2015/PDF/5-1_andonova.pdf

TRL1:
Question
►Is there a fundamental concept, innovation, or scientific principle that is key to the technology under study?

Evidence required
• List and describe the basic principles involved.
• List references (if any) that document the basic principles involved.
• Why is this interesting?

TRL2

Question

►Are there practical applications for this research and/or innovation?

Evidence required

• List examples of potential applications.

• Describe how applications would utilize the basic principles, concepts, or innovations under study.

• List references (if any) that link this research to potential applications.

TRL3

Question A.

►Assuming the basic principles involved are sound, is there an intended application?

Evidence required

• Describe the key functionality of the intended application.

• Why would anyone be interested in this application?

• If a laboratory prototype were created, what would its key elements be?

Question B:

►Have laboratory prototypes been created that show "proof of concept" for key elements of the intended application? These elements are not necessarily integrated.

Evidence required

• Which key elements were demonstrated?

• What metrics were used to show "proof of concept?"

TRL4

Question A

►Has a laboratory prototype been created that integrates all key elements necessary to address a particular problem or application?

Evidence required

• What problem does the prototype address?

• What key elements were integrated?

• Describe how the prototype integrates the key elements and solves the problem.

Question B

►Has a laboratory demonstration been conducted that integrates all key elements necessary to solve a particular problem and shows functional aspects of the prototype operated according to what a customer would expect?

Evidence required

• Describe the demonstration.

• What key elements were part of the demonstration?

• What functionality was demonstrated with the prototype?

• What metrics were used to conclude that the prototype worked as expected?

• How does this demonstration correlate with what a customer of this technology would expect

TRL5

Question A

►Is there an end-user customer for this technology?

Evidence required

• Who is the customer?

Question B

►Is the customer working with the supplier to define functional and performance requirements?

Evidence required

• List and describe functional and performance requirements for the product.

• Describe how these requirements meet the customer's needs.

Question C►Is the supplier working with the customer to define integration and environmental requirements including abnormal or extrema events?

Evidence required

• Describe the integration requirements.

• Describe the plans for integrating the product within the customer's system.

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• Describe the environmental requirements including abnormal or extrema events. What are the expectations for the product after exposure to abnormal environments?

Question D►Has a prototype been built and used to successfully demonstrate required functionality and performance before, during, and after exposure to the customer's environments?

Evidence required

• Describe the demonstration and discuss key elements integrated and included in the prototype.

Question E►Does the demonstration include all functionality and performance metrics the customer expects?

Evidence required

• List and describe the metrics used to conclude that the demonstration was a success.

• How do the metrics correlate with agreed-upon requirements for functionality, performance, and environmental exposure?

TRL6

Question A►Have the supplier and the customer developed a set of requirements for the product?

Evidence required

• Please provide documentation of the requirements.

Question B►Has a prototype been created that is consistent with all of the agreed-upon requirements?

Evidence required

• Describe how the prototype meets form, fit, and function requirements.

• Describe how the prototype satisfies additional expectations/requirements that go beyond form, fit, or function.

Question C►Has the prototype been demonstrated successfully in the customer's required environments?

Evidence required

• Describe the demonstration.

Question D►Do the customer and supplier agree that the demonstration was representative of the customer's needs and that it was successful?

Evidence required

• How was the demonstration representative of the customer's specific needs?

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• What metrics were used to conclude the demonstration was a success?

• How do the metrics correlate with the agreed-upon requirements?

TRL7

Question A►Are the customer and supplier in full agreement that requirements are completely established and in final form?

Evidence required

• Please provide the final set of requirements.

Question B►Has a prototype been integrated within the customer's operational platform and demonstrated to function as expected in appropriate environments?

Evidence required

• Describe the demonstration and how the prototype integrates within the customer's system.

Question C►Are the customer and supplier in agreement that the demonstration was a success?

Evidence required

• List and describe all elements of functionality and performance that were demonstrated.

• What metrics were used to conclude the demonstration was a success?

• How do the metrics correlate with the agreed-upon requirements?

TRL8

Question A►Has a production unit (actual deliverable that is representative of that which can be created with acceptable cost, capacity, and schedule requirements) been created and integrated within the customer's system?

Evidence required

• Describe how this deliverable represents a production unit.

• Describe how the production unit integrates within the customer's system.

Question B►Has a production unit been qualified for final delivery to the customer?

Evidence required

• Describe the approach to qualification. List all tests and demonstrations utilized to qualify the production unit for final delivery.

• Link all elements of the qualification process back to agreed-upon requirements and demonstrate that through this qualification process the production unit is ready for final delivery.

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Question C ▶ Does the customer agree that the production unit is qualified and ready for final delivery?

Evidence required

• Describe the customer's approach to product acceptance.

• How does the customer's approach to product acceptance correlate with agreed-upon requirements?

TRL9

Question ▶ Has the customer accepted the product and placed it in service within their system?

Evidence required

• Describe the successful deployment of the product in terms of the customer's volume and frequency of use.

• What rate of success does the customer have using the product?

The primary purpose of using technology readiness levels is to help management in making decisions concerning the development and transitioning of technology. It should be viewed as one of several tools that are needed to manage the progress of research and development activity within an organization.

<u>Main benefits of using TRLs:</u>

1. **Improved communication**
    • Clearly convey research maturity
    • Identify audiences
2. **Improved outcomes**
    • Ask key questions in a structured framework
    • Inform research in progress with expert assessment
    • Identify steps to advance maturity
    • Transition results to stakeholders

3) Improved research program management

• Establish expectations for research progress

• Review the alignment of projects with program objectives

<u>Limitations of TRLs</u>

1**) Provide a measure of technology maturity only**.

• Do not assess the risk, cost and feasibility of advancing to the next level.

• Should be used in concert with other assessment tools.

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• Poor fit for measuring success of outreach or training, or adoption

2) Risk of oversimplification

• Project value cannot be reduced to a single number.

3) Readiness does not necessarily fit with appropriateness or technology maturity

- A mature product may possess a greater or lesser degree of readiness for use in a particular system context than one of lower maturity
- Numerous factors must be considered, including the relevance of the products' operational environment to the system at hand, as well as the product-system architectural mismatch

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- Successful cases and lessons learnt from technology transfer

MAIN LESSONS LEARNT FROM THIS TRAINING:
Source:

- Jack Fuller, West Virginia University, USA Christopher Hohman, Consultant, USA: An Analysis Of The Techniques Of Technology Transfer The Journal of Applied Business Research – November/December 2010 Volume 26, Number 6
- Elena Andonova(University of Oxford ISIS Enterprise): Technology Transfer Management Key Factors of Success September 14th, 2015, Budapest, Hungary - prezentation

In general, the main question is

A) WHY DO YOU TECHNOLOGY TRANSFER?

The reasons beyond can be complex, but the successful and properly managed technology transfer processess can:

- ❖ create new jobs
- ❖ make money/profit
- ❖ promote the PROs or universities (branding)
- ❖ improve the competetiveness of the enterprises
- ❖ widening and deepening the already existing coopeations between the interested stakeholders or initiating a new networking
- ❖ create local/regional/national wealth
- ❖ a combination of above

In addition to,

B) THE TECHNOLOGY TRANSFER PROCESSESS CAN BE MUTUALLY BENEFICIAL FOR EVERY INTERESTED STAKEHOLDER

Benefits of technology transfer to research organisations, institutions and universities:

- ❖ Additional sources of financing of further research and development activities;

Benefits of technology transfer to industry:

- ❖ Access to unique research results;
- ❖ Shorter innovation cycle of new products;
- ❖ Obtaining of competitive advantage;
- ❖ Obtaining of research results which are dependent on the use of special
- ❖ Research infrastructure, capacities and know-how.

Benefits of technology transfer to society:

- ❖ Improved structure of financing of research and higher education;
- ❖ Higher standard of living and quality of life;
- ❖ Concentration of financial and knowledge assets in the region;
- ❖ Better attractiveness and competitiveness of the region.

Hill (2004) stressed that the credibility of a technology proposition appears to depend upon five requirements:

- ❖ A global, growing market

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- The potential of the technology to disrupt the market
- A strong management team
- Strong intellectual property rights
- A clear business model through which revenue and profit generated.

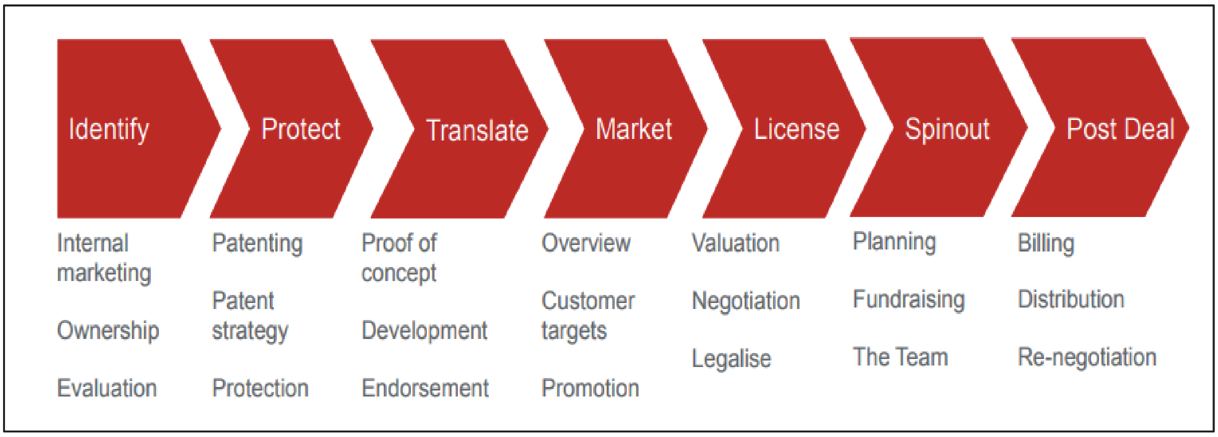

Figure 7. : Typical technology transfer process

Source:
https://www.lrpv.gov.lv/sites/default/files/media/dokumenti/Konference_2015/PDF/5-1_andonova.pdf

IMPORTANT

- **Supports technology transfer from initial invention disclosure through to commercialisation and post-deal support**

- **Understand the competition**
  - Who are the strong/weak innovators?
  - Who are the new comers?
  - Who was there first with the broad/fundamental IP?
  - Who is partnering with who?

- **Understand the technology**
  - Get detailed insight into the state of the art
  - What are the current/past technology focuses?
  - What will be the features of tomorrow's products?

How can you overcome the difficulties and challenges arising from the complexity of the technology transfer processes and make your technology transfer successfull

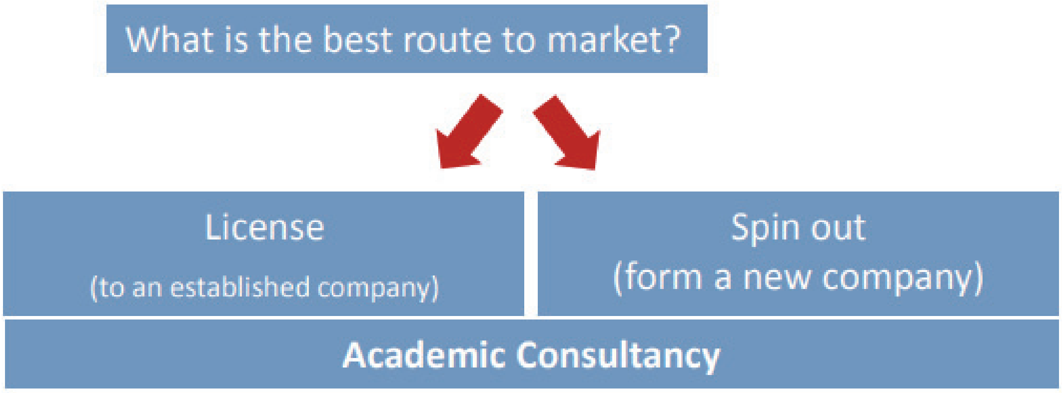

Figure 8.: From IP strategy to marketing strategy

Source:
https://www.lrpv.gov.lv/sites/default/files/media/dokumenti/Konference_2015/PDF/5-1_andonova.pdf

C) BUILDING RELATIONSHIPS WHICH FOSTER TECHNOLOGY TRANSFERS

Alliances between the interested stakeholders may be most useful at the cutting edge of the learning agenda, to access and internalize technologies and know-how that are embedded, largely tacit, uncodified, and thus difficult to access via contractual approaches that do not involve a close collaboration between the partners

D) **GOVERNMENT SPONSORED PROGRAMS TO FOSTER TECHNOLOGY TRANSFER**

Since direct business partnerships and reciprocal technology transfer agreements between universities and businesses are often unrealistic, universities and firms might wish to consider investigating government operated programs to assist them with their technology transfer efforts. Several government programs were created with technology transfer in mind.

E) TECHNOLOGY INCUBATORS

If firms find that no government sponsored initiatives can help them in their quest for technology transfer, they may want to seek out assistance from technology incubators.

Many services are offered by a technology incubator. These services cover most of the basic needs to either establish a firm with the technologies discovered through collaboration or simply market an innovation at an existing company. Services include:

- marketing and public relations strategy assistance,
- information about funding sources,
- directories of professional services (i.e. legal services),
- office space,
- internet access,
- mentoring, etc (Sobol and Newel, 2003).

Any firm or group of entrepreneurs, who wish to partake in the services of a technology incubator, must be admitted into it. To be admitted to an incubator, the party in question must create a

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detailed business plan and submit it to the technology incubator. The plan must include information such as: reasons the firm/product is commercially viable, the business concept, a financial plan, and how the technology will create jobs for the area. They also must express interest in working in collaboration with academics in the university through the technology incubator. If a business plan is accepted, the technology incubator usually receives a small amount of equity in the firm or product in exchange for access to the services offered by the incubator (Sobol and Newell, 2003)

F) ENSURING THAT TECHNOLOGY TRANSFER OFFICES TO BE EFFECTIVE

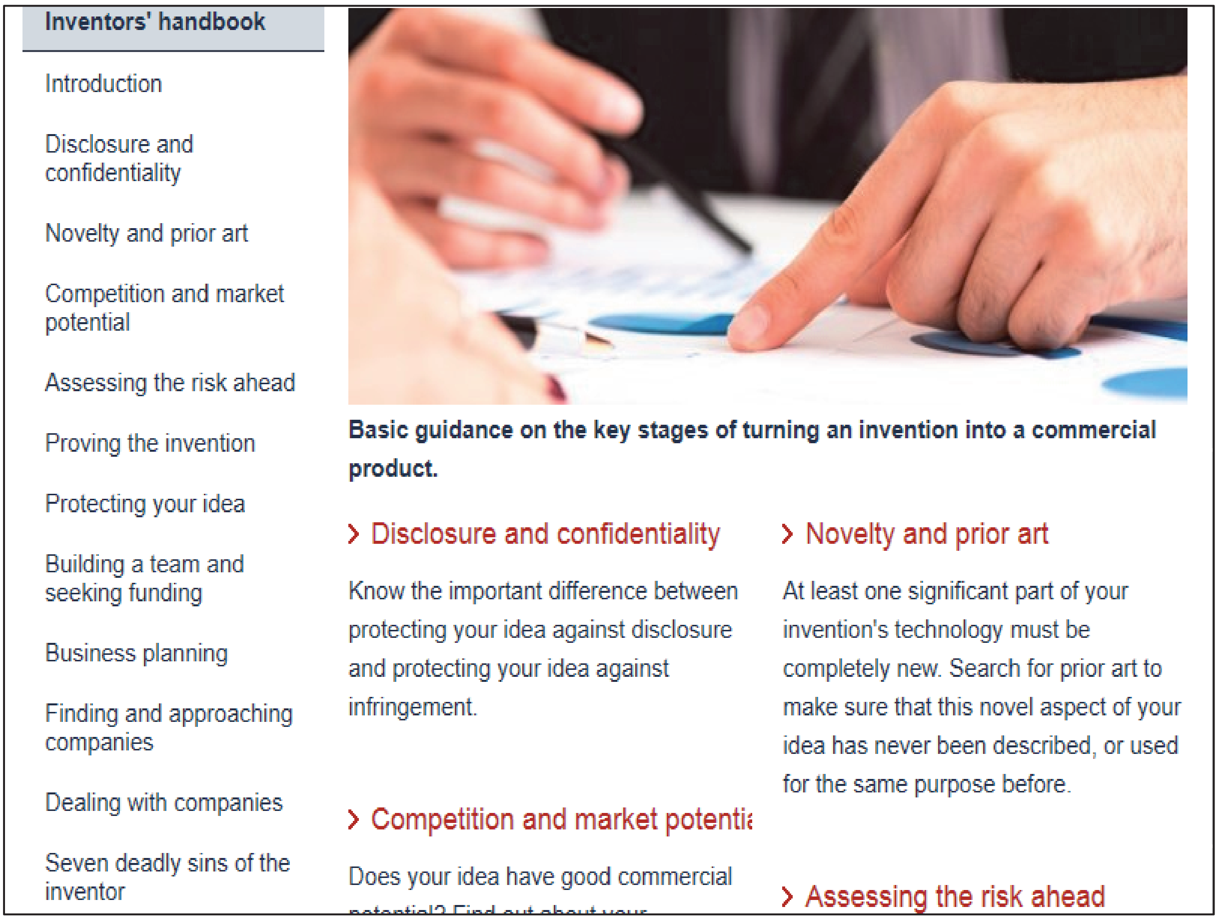
Technology incubators are great resources to facilitate technology transfer. However, they are not found at many universities. Therefore, firms may wish to use a university‟s Technology Transfer Office (TTO) to aid in technology transfer when technology incubators are absent. TTO‟s are commonplace at most major universities. **TTO‟s are designed to facilitate the collaboration between firms and academics employed by a university by acting as a liaison. However, if they are not properly maintained and utilized, they will fail to serve their purpose (Siegal, Waldham, Atwater, and Link, 2004).**

The first measure to ensure that a TTO is effective is that it is given the necessary budget to meet its needs. When staffing TTO‟s, workers who bring certain skill sets to the table may help to make the TTO more effective. TTO offices also can become more effective in creating collaborations by sponsoring events such as affiliations, consortia, and conferences.

Finally:

Inventors' handbook
Basic guidance on the key stages of turning an invention into a commercial product.

Source:
https://www.epo.org/learning-events/materials/inventors-handbook.html



TWO SUCCESSFUL NETWORK AND MODELL IN THE FIELD OF TECHNOLOGY TRANSFER

A) Steinbeis Danube Transfer Center

Sources:

- http://irspm2015.com/index.php/irspm/IRSPM2015/paper/viewFile/1479/499
- http://www.steinbeis-impact.com "The Steinbeis Network – A brief overview"
- Katarína Szegényová, Daniel Ács, Štefan Ilko, Barbora Gero, Robert Gohla, Daniela Chiran: Training of Trainers in Technology Transfer. Train the Trainers Handbook, 1st edition 2014 | Steinbeis-Edition, Stuttgart ISBN 978-3-943356-10-6

During the last years the Steinbeis Network has become synonymous with the successful transfer of tangible, market-based knowledge and technology.
Managed by entrepreneurs, Steinbeis Centres build solid, steady bridges between science, academia, trade and industry – always focused on how everyone involved in the transfer will actually benefit.

The Steinbeis Network was founded in 1971 as a non-profit foundation. It comprises i) centralised brand "Steinbeis" with an organisational and legal framework and ii) decentralised Steinbeis Enterprises and subsidiary companies as well as cooperation and project partners worldwide. The decentralised structure of **Steinbeis Enterprises** means that each of the enterprises as a unit in the network is headed up by the individual manager, who is in charge of what is called either transfer centre, a consulting centre, a research or innovation centre, a transfer institute or simply a GmbH

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(German limited liability company). Managers of each enterprise, the majority of which are professors at knowledge and technology sources, see themselves as problem solvers at the disposal of trade and industry. On behalf and in cooperation with their client company from industry – they arrive at comprehensive, customer-oriented solutions to each problem. Steinbeis' success is rooted in the added value the network gives to each project and challenge its customers face. Currently, the network involves almost 1 000 Steinbeis Enterprises serving approximately to 10 000 customers per year covering more than 50 countries.

The network of transfer centres established by Steinbeis expanding throughout Germany and the world, contributes to the entire spectrum of current technology and management know-how from a single source. The established interdisciplinary teams craft customised solutions for specific challenges in a broad range of subjects.

How does it work?

During its existence, Steinbeis has generated various sources of knowledge and technological innovation. These have been connected into the network involving higher education institutions, universities, research facilities and businesses, thanks to which Steinbeis strengthen effective cooperation between science and academia, but also between businesses in order to ensure the practical use of scientific findings.

The whole process of knowledge and technology transfer begins when a customer presents his/her challenge. Regardless how specialised the issue may be, the network's experts from specific field invent a fitting solution in order to overcome the challenge. Within this process, the Steinbeis Network with its units (Steinbeis Enterprises) is using the potential of research facilities, particularly at universities and brings professional tailor-made solutions based on scientific findings which can be applied in business. Decentralised structure of Steinbeis Enterprises means that the directors of each enterprise act autonomously and independently and their work keeps them in direct, confidential contact with their customers.

The solutions brought to customers and partners can be flexibly matched to structural and technological developments, as well as market demands. The transfer of know-how is ensured primarily through the Steinbeis Enterprises which are continually developing and thus, strengthen the transfer potential of the whole network. These units are organised as a "company in a company".

The main mission of this network is to foster effective and efficient cooperation between the world of science and academia on one hand, and trade and business on the other. Covering a wide range of technologies, customers plug into expertise and skills throughout each and every project. Competitive knowledge and technology transfer is the interface, the linchpin that connects pre-competitive academia and science with the market's demand for research results in business, as well as practical applications of those results. Pre-competitive research must receive state support and subsidies; the actual transfer however, on the other hand, benefits business by translating research results into marketable products.

Support for the Danube Region

In order to support the knowledge and technology transfer in the Danube Region, Steinbeis is establishing a network of transfer centres as a pilot study for strengthening the economic development in this region. These transfer or competence centres are being established at selected universities in the Danube

Region, starting with some local networks coming up to regional and macroregional network with central management. This network will form the **Danube Transfer Centres** (DTCs) which will help to support the regional development and innovations and will foster the application of technology

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transfer in the Danube Region. Additionally, DTCs help to enhance and streamline the technologies in SMEs.

The main mission of DTC is:

- To promote innovation;
- To enhance research;
- To facilitate competitiveness in an efficient manner.

The overall aim of DTC is to foster the competitiveness of the industry in the Danube Region by supporting innovation and technology transfer. This will help in filling the gap between research and innovation what is one of the main roles of knowledge and technology transfer. This will be achieved by:

- Creating new products and services;
- Advancing knowledge;
- Fostering inter-regional cooperation.

Services provided by DTC include:

- Identifying technology needs of industry, particularly of SMEs (innovation audits);
- Identifying marketable technologies and service offers from the universities and research institutes (technology scouting);
- Fostering an active dialogue between industry and science;
- Organising an efficient knowledge and technology transfer from universities to enterprises;
- Initiating joint research projects between industry and academia;
- Advisory and support services for accessing European research and technology transfer programmes;
- Assistance in preparing European projects;
- Developing technology oriented partnerships at regional, national &European level;
- Trainings (management, technology transfer, etc.).

The cooperation partners of DTCs are located in:

- Germany / Baden-Württemberg – Steinbeis Innovation gGmbH with its departments Steinbeis-Donau-Zentrum and Steinbeis-Europa-Zentrum;
- Slovakia – Technical University in Bratislava and Slovak Agricultural University in Nitra;
- Romania – Technical University of Cluj-Napoca, Babes-Bolyai University Cluj-Napoca, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, University of Medicine and Pharmacy Cluj-Napoca;
- Serbia – Technical University in Novi Sad.

DTCs implemented in selected universities in the macro-region have become a flagship project of the Danube Strategy in the priority area "Competitiveness and Clustering" which can be transferred to all Danube countries. DTCs are linking existing stakeholders and networks in order to create synergies among existing projects and to prepare a Joint Action Plan for innovation and technology transfer in the Danube Region for the period 2014 – 2020.

Cooperation with DTCs in individual projects allows businesses to enhance their competitiveness and innovation potential. Entrepreneurs may benefit from the utilisation of existing knowledge and technology transfer network and its experts, from professional skills and competences of transfer centres, from knowledge based scientific services, from the utilisation of existing infrastructure at universities and from the cooperation at all stages of the value added chain.

On the other hand, universities may benefit from DTC services by getting access to demand-driven projects, as well as to the knowledge about themarket. Additionally, participation in DTC network helps to increase the reputation of university in regional economy, to increase income thanks to fees for

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using its research infrastructure, to generate new research activities and/or to enhance the equipment by investments in the context of transfer projects.
This initiative received a start-up funding by the Ministry of State of Baden-Württemberg. The overall aim of this pilot initiative is to submit several project proposals within structural funds, Horizon 2020, etc. These proposals will assure the financing of the annual DTC running costs in order to ensure the sustainability of the initiative and to find additional partners willing to join the network and to establish new DTCs in other Danube countries.

B) Technology Innovation International (TII)

Sources:

- http://www.tii.org/en/about-us/tii-in-brief
- https://blogtii.wordpress.com/

TII a global online community offering expert skills and services which are available to assist universities, RTOs, companies and regions to commercialize their inventions and new technologies or to put in place programmes and schemes which aim to maximize the ROI of the research developed in their region. Thanks to its international chapters in China and Korea, TII also offers its partners and members the opportunity to internationalize their research commercialization efforts (both inward and outward technology transfer).
Thanks to its international chapters in China and Korea, TII also offers its partners and members the opportunity to **internationalize** their research commercialization efforts (both inward and outward technology transfer.

TII members include innovation and technology consultancies, technology brokerages and intellectual asset advisors, university and research centre transfer offices, regional development agencies and chambers of commerce, science parks, innovation centres and incubators, contract research organizations and engineering consultants, government ministries and agencies and sectoral professional organizations. This is TII's wealth and strength: all of its members are promoting or providing high quality research commercialization services, with the ultimate aim of developing the knowledge economy and boosting the wealth creation process.

TII is an international research commercialization hub where you can find a community of experts and a portfolio of services for:

- Assisting your client companies to access new technologies, markets and funding
- Assisting your research teams with commercialization and exploitation issues
- Training your research teams on commercialization and exploitation issues
- Setting up/consolidating a knowledge transfer office / incubator / acceleration programme / regional innovation ecosystem / entrepreneurship awareness programme
- Internationalizing your research commercialization efforts (inward and outward technology transfer)
- Developing international collaborative projects (e.g. H2020)

The TII community of experts is showcased in the My Commercialization Expert database.
You can search for an expert according to the kind of skill you require (e.g. internationalization, IPR protection & advice, investor readiness) and by sector of activity (e.g. renewables, security, healthcare). You are able to select the profiles of the experts that interest you (you have access also

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to their CV) and send them an introductory email. If you work with the expert on an assignment, you have the possibility to give him/her a satisfaction rating in the database on a scale of 1 to 5.

TII experts are available to carry out in-house training on research exploitation / commercialization issues for your research teams.

This is particularly important if they are working on Horizon 2020 or other collaborative projects where exploitation issues must be carefully considered in anticipation of the development of new research results. You can ask the TII secretariat to design you a tailor-made training programme and organize its delivery or you can identify the trainers of your choice by consulting the My Commercialization Expert database and clicking on the skill “Research exploitation training”.

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PART III.

A) FUNGUSCHAIN – MUSHROOM RESIDUE TRANSFORMATION

Bio-based Industries Consortium

(Study case I.)

Sources:
http://biconsortium.eu/sites/biconsortium.eu/files/downloads/BIC_Success_Stories_20170117-light.pdf
www.funguschain.eu

Introduction:

The **Bio-based Industries Consortium (BIC)** is a non-profit organisation set up in Brussels in 2012. BIC represents the private sector in a **public-private partnership (PPP)** with the EU, represented by the European Commission, known as the **Bio-based Industries Joint Undertaking (BBI JU)**, established in June 2014 as one of the pillars of the European Commission Bioeconomy Strategy **.**

The BBI JU is an instrument to support industrial research and innovation, to overcome the innovation 'valley of death', by bridging the gap from research to the marketplace. It encourages partnership with the private sector to fund and bring together the resources needed to address the challenges involved in commercialising major society-changing new technologies.

BIC members cover the entire bio-based value chain and consist of large industries, small and medium-sized enterprises (SMEs), regional clusters, European trade associations, and European Technology Platforms. Any interested stakeholders along the bio-based value chain may apply for membership.

The Bio-based Industries Joint Undertaking is dedicated to **transforming renewable, natural resources into innovative bio-based products**.

In view of the move towards a post-petroleum society, the European strategy "Innovating for Sustainable Growth: A Bioeconomy for Europe (2012)" calls for a bioeconomy as a key element for smart and green growth in Europe. The strategy aims to integrate biomass-producing and processing sectors in order to reconcile food security, natural resource scarcity and environmental objectives with the use of biomass for industrial and energy purposes.
To make this happen the European Commission (EC) and the Biobased Industries Consortium (BIC) joined forces in the Bio-Based Industries Joint Undertaking (BBI JU) to keep investments in Europe and to deploy and create new markets for sustainable bio-based products such as bio-chemicals, materials and fuels. **Innovative technologies and advanced biorefineries are at the heart of the bio-based economy concept, transforming biomass and wastes into green everyday products**. De-risking this

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emerging but fragmented industrial sector, together with supporting the high costs for demonstration and deployment activities, are key drivers for this public-private intervention.

Current and future impacts of the BBI JU Since 2014

BBI JU has substantially contributed to building the European bio-based economy sector

- True innovation: after the first 3 years, already 65 projects - including 20 demos and 6 flagships are running with a total of 729 participants from 30 countries for a total grant of € 414 million public funding and € 2.15 billion of private contribution announced by beneficiaries.
- High mobilisation of SMEs: 36% of current beneficiaries are SMEs (the Horizon 2020 target for e.g. the Societal Challenges being 20%). This level of participation results in a 29% share of BBI funding. SMEs provide valuable support to large industrial players as technology developers in tight cooperation with Research & Technology Organizations (RTOs). Bioreactor design, process optimisation, new biocatalysts for biomass processing, are some examples of areas where SMEs are deeply involved.
- Leveraging public funding by at least factor 4. Already today, for every euro of public funding BBI JU expects to leverage € 4,4 of private financial contributions: in the first 3 years, bio-based industries have reported € 192 million in-kind operational project contributions and € 1.95 billion of additional activities, which is well above the promised investments.

Bridging the gap between research and market: expected outputs by 2020 (from projects launched so far) are well above expectations

- 82 new or optimised bio-based value chains: new or multi-feedstock, improved process technologies, new products or improved supply chain management.
- 46 new bio-based chemical building blocks based on biomass from European origin: replacing fossilbased feedstock, improved environmental, economic and/or product performance.
- 106 new bio-based materials such as breakthrough chemicals, fuels, fertilisers, fibres, plastics, bioactive ingredients and proteins.
- 47 new bio-based consumer products based on bio-based chemicals.
- 146 new cross-sector interconnections proving that BBI JU is organizing partners along the value chains: food & feed additives; agriculture; energy; forestry; packaging; health-, home & personal care; paper & pulp; automotive; pharmaceutical; textiles; construction; and the aquatic sector.
- 36 cooperation projects through cross-industry clusters, creating new ecosystems by connecting parties that have never collaborated before.

BBI JU projects excel on both science and innovation, creating new economic activities.

BBI JU strategic ambitions for the bio-based economy by 2030

- Reindustrialise Europe by creating a rural infrastructure for biomass production, mobilisation and processing in biorefineries, thus regenerating underdeveloped and/or abandoned regions
- Diversify & grow farmers' revenues
- Create 700.000 jobs on all levels of which 80% in rural and currently underdeveloped areas
- Increase biomass supply in Europe by 20% by increasing productivity and sustainable mobilisation

- Boost the mobilisation and valorisation of 25% of unused sources (by-products and biowaste), pursuing 'zero-waste' bio-based operations with subsequent closure of the biocycles
- Replace 30% of fossil-based chemicals & materials production in Europe
- Meet 6% of Europe's transport energy demand by sustainable advanced biofuels
- Support the European market for bio-based fibres and polymers such as viscose, carbon fibres, nanocellulose derivatives and bioplastics to grow rapidly
- Reduce EU dependency on imports of fossil-based raw materials, protein, phosphate and potash
- Reduce greenhouse gas emissions (GHG) of new BBI JU bio-based products on average by at least 50% compared to their fossil alternatives

"Funguschain is a highly integrated project with a unique consortium specialising in various elements across a range of value chains. It brings together leading scientists and companies, who from the project outset have worked closely together to make this challenging project a success. Funguschain will provide an important example of a new way of working in the bio-based economy," Dr Bart van der Burg, Director of Innovation at BDS.

PROJECT DETAILS
Type of project: BBI-Demo
Start date: November 2016
Duration: 4 years
Total cost: €8 million
Industry investment: €2.3 million
H2020 funding: €5.7 million
Headquarters: Amsterdam, the Netherlands
Website: www.funguschain.eu

ABOUT THE PROJECT
Funguschain will use novel cascading processes to extract highvalue molecules from fungal residue to meet end-user needs in the food, cleaning and plastics sectors.

PROJECT AIMS:
The European mushroom farming industry generates over 60,000 tons of agri-residues each week. Funguschain aims to transform this waste into bio-based additives, bioplasticisers and biopolymers using innovative new procedures. The project will demonstrate the industrial viability of building a new biorefinery which uses cost-effective extraction technologies and transforms more than 65% of the mushroom waste into valuable additives.

EXPECTED RESULTS

- Make use of new cascading processes in a new biorefinery to extract high-value molecules from fungal residues.
- Use any remaining residues for composting or biogas synthesis.
- Define, demonstrate and validate five new product types including food supplements, cleaning products, thermoplastic masterbatches, plasticisers and industrial films.
- Improve the environmental performance and cost efficiency of resulting products.
- Boost innovation in agricultural waste management and establish circular economy business models.

CONSORTIUM

A unique consortium coordinated by BioDetection Systems B.V., The Netherlands (BDS), which consists of 16 partners from 10 different European countries (Belgium, Croatia, Germany, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, United Kingdom – Wales), including research institutes and 12 different companies that are leaders in biobased economies.

PROJECT PARTNERS

DID YOU KNOW THAT EACH WEEK MORE THAN 60.000 TONS OF MUSHROOM BYPRODUCTS ARE GENERATED IN EUROPE?

Valorisation of mushroom agrowastes to obtain high value products

Using innovative extraction processes, the project will generate additives that will be industrially validated and incorporated into products including food supplements, industrial packaging and cleaning products.

The project also aims to develop a new and more sustainable approach for the treatment of mushroom by products and create new business opportunities for industries operating within the European biotechnology economy.

The cascading approach

Funguschain project is a new concept of biorefinery which will be created to valorize outcomes with a cascading approach, following these steps:

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- **Microwave-assisted extraction**

A fast and reliable extraction technique based on improvement in extraction kinetics provided by heating induced by microwave radiation.

Results will be molecules such as antimicrobials, antioxidants or polyols which will be applied in further processes for the cleaning, food and plastic sectors.

- **Pressurised hot-water extraction**

A powerful extraction technique using high pressures to maintain aqueous solvents in liquid state at high temperatures.

Results will be biocative proteins and polysaccharides that can be directly used as food supplements with enhanced texturizing and prebiotic propierties.

- **Saccharification fermentation**

A deconstruction methodology of the biomass into a sugar platform, which constitutes the starting point for the production of fermented biopolyesters.

The biopolyesters obtained from treated biopolyesters will be used to formulate new bioplastic blends. Biopolyesters will be produced using the sugar platform to formulate novel bioplastic blends in compounding facilities for the plastic sector.

- **Anaerobic digestion**

Remaining biomass will be dedicated to generate compost and biogas by anaerobic digestion.

The result will be compost and biogas, which is produced by the breakdown of biodegradable waste inside a landfill due to chemical reactions and microbes, or as digested gas, produced inside an anaerobic digester.

The Funguschain approach will bring innovative green compounds for the cleaning, food and plastic sector

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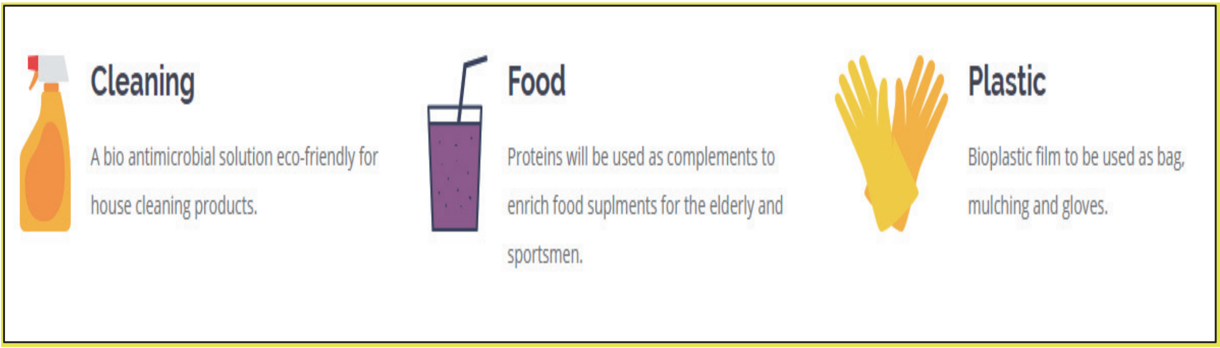
Demonstrators and future applications

These high value molecules from the fungal residue will be applied to a wide range of end-user products like:



The Welsh Government – H2020 Unit selected Funguschain project as a successful story. They interviewed our project partner Neem Biotech about their role in the project and Dr. Michael Graz of Neem Biotech Ltd. said: "*Neem is very pleased to be involved in this high calibre consortium. This is a great opportunity for the consortium partners to be able to build capacity together and to develop innovative technology that can both contribute to better stewardship of natural resources by society and build the pipelines of our respective companies*".

B) BIOFOREVER – CONVERSION OF WOODY BIOMASS

Bio-based Industries Consortium

Study case II.

Sources:
http://biconsortium.eu/sites/biconsortium.eu/files/downloads/BIC_Success_Stories_20170117-light.pdf
www.bioforever.org

Type of project: BBI-Demo
Start date: September 2016
Duration: 3 years
Total cost: €16 million
Industry investment: €6 million
Headquarters: Heerlen, the Netherlands
Website: www.bioforever.org

ABOUT THE PROJECT

Bioforever will demonstrate the conversion of woody biomass to value-added chemical building blocks like butanol, ethanol and 2,5-furandicarboxylic acid (FDCA) on an industrial scale.

PROJECT AIMS

The BIOFOREVER project objective is the technical and economical demonstration of 5 different value chains from feedstock to final product. Within this framework, several conversion technologies will be demonstrated up to pre-industrial scale for several types of feedstock while commercialization routes for the most promising value chains will be delivered.

Woody biomass, including waste wood will be converted to lignin, (nano-) cellulose and (hemi-) cellulosic sugars and further converted to lignin derivatives and chemicals. Feedstocks will be benchmarked with crop residues and energy crops.

A number of pre-treatment and conversion technologies will be demonstrated, as well as routes for commercialising the most promising value chains. The project will establish optimal feedstock, biorefinery technology, end-product and market combinations to offer competitive value-added products for the European bioeconomy.

EXPECTED RESULTS

Establish conversion routes to transform woody biomass into intermediates (such as cellulose, C5/C6 sugars, lignin and humins) and further transform these intermediates into six biobased building blocks (such as carbon binders, butanol, resin acid, enzymes and FDCA).

Demonstrate five lignocellulosic (LC) value chains at preindustrial scale for the selected final products. Develop three pathways to exploit industrial side-streams using four different cascading biorefinery concepts.

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Generate competitive bio-based products which match or outperform existing fossil-based products in terms of cost and product performance.

Achieve up to 85% reductions in CO_2 emissions compared to fossil-based value chains.
Create 1,200 direct jobs and 6,000-7,500 indirect jobs in the agricultural /forestry sector by sourcing European biomass.

BIOFOREVER consortium partners:
- API Europe, Greece
- Avantium Chemicals BV, Netherlands
- Bioprocess Pilot Facility BV, Netherlands
- Borregaard AS, Norway
- Bio Refinery Development BV, Netherlands
- DSM, Netherlands
- Elkem Carbon AS, Norway
- Green Biologics Ltd, UK
- MetGen Oy, Finland
- Nova Institute, Germany
- Novasep Process SAS, France
- Phytowelt, Green Technologies GmbH, Germany
- Port of Rotterdam, Netherlands
- SUEZ Groupe, France

Project co-funded by European Union funds (ERDF, IPA) and by the Hungarian State
Project website: http://www.interreg-danube.eu/made-in-danube

REFERENCES

- https://www.steinbeis-europa.de/files/d3.4handbook_training_for_smes.pdf
- http://ijbel.com/wp-content/uploads/2014/06/Critical-Success-Factors-Csfs-On-Technology-Transfer-Effectiveness-In-Manufacturing-Industry-A-Critical-Review-Farizah-Binti-Mamat-alias-Mohd-Nor-Shashazrina-Binti-Roslan.pdf (International Journal of Business, Economics and Law 2012, Vol. 1 ISSN 2289-1552)
- ERIA and OECD (2014), http://www.eria.org/Key_Report_FY2012_No.8_chapter_5.pdf
- http://tto.boun.edu.tr/files/1383812118_An%20overview%20of%20TT%20and%20TT%20Models.pdf
- http://www.jatit.org/volumes/Vol78No1/12Vol78No1.pdf
- http://www.wipo.int/export/sites/www/sme/en/newsletter/2011/attachments/apax_tech_transfer.pdf
- ON THE ROAD TO INDUSTRY 4.0: TECHNOLOGY TRANSFER IN THE SME SECTOR http://www.its-owl.de/fileadmin/PDF/Informationsmaterialien/2017-Technology_Transfer_web.pdf
- Technology Transfer Barriers and Challenges Faced by R&D Organisations Adam Mazurkiewicz*, Beata Poteralska Institute for Sustainable Technologies – National Research Institute, K. Pulaskiego 6/10, 26-600 Radom, Poland Procedia Engineering 182 (2017) 457 – 465 https://ac.els-cdn.com/S1877705817312705/1-s2.0-S1877705817312705-main.pdf?_tid=d46e6b10-b7f0-11e7-bbad-00000aab0f02&acdnat=1508763244_e0066c89fc11abc087de22d93947ecb0
- http://www.oecd.org/sti/sci-tech/35428635.pdf
- P. Tsybulov, Y. Lashyna, S. Shukayev, R. Gohla, D. Chiran: Technology Transfer in the Field of Renewable Energy Sources Training for Researchers – Handbook 1st edition 2014 | Steinbeis-Edition, Stuttgart ISBN 978-3-95663-014-9 https://ec.europa.eu/taxation_customs/eu-training/general-overview/intellectual-property-rights-elearning-course_en
- WIPO: Successful Technology Licensing Publication No. 903E 2015 Edition ISBN 978-92-805-2633-2 http://www.wipo.int/edocs/pubdocs/en/licensing/903/wipo_pub_903.pdf
- http://ijbel.com/wp-content/uploads/2014/06/Critical-Success-Factors-Csfs-On-Technology-Transfer-Effectiveness-In-Manufacturing-Industry-A-Critical-Review-Farizah-Binti-Mamat-alias-Mohd-Nor-Shashazrina-Binti-Roslan.pdf (International Journal of Business, Economics and Law 2012, Vol. 1 ISSN 2289-1552 2012)
- What is Intellectual Property, WIPO Publication No. 450(E) ISBN 978-92-805-1555-0 http://www.wipo.int/edocs/pubdocs/en/intproperty/450/wipo_pub_450.pdf
- http://www.steinbeis-impact.com "The Steinbeis Network – A brief overview"
- Katarína Szegényová, Daniel Ács, Štefan Ilko, Barbora Gero, Robert Gohla, Daniela Chiran: Training of Trainers in Technology Transfer. Train the Trainers Handbook, 1st edition 2014 | Steinbeis-Edition, Stuttgart ISBN 978-3-943356-10-6
- https://www.epo.org/learning-events/materials/inventors-handbook.html
- http://irspm2015.com/index.php/irspm/IRSPM2015/paper/viewFile/1479/499
- http://www.eurotex.org/
- https://www.lrpv.gov.lv/sites/default/files/media/dokumenti/Konference_2015/PDF/5-1_andonova.pdf

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- http://biconsortium.eu/sites/biconsortium.eu/files/downloads/BIC_Success_Stories_20170117-light.pdf
- www.funguschain.eu

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