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# “Transfer Technology – methodology for top management of university”

Intellectual Output IO6

University of Hradec Králové

TECHNICAL UNIVERSITY OF KOŠICE

UNIVERSIDAD DE GRANADA

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# Introduction

This document has been created as part of the joint project **Technology Transfer Together** (acronym: TEchTransfer, project number: 2020-1-CZ01-KA203-078313) between the three project partners – University of Hradec Kralove (as a coordinator), University of Granada and Technical University of Kosice – with the overall aim to improve knowledge and share experiences in the area of academic spin-off creation.

The document looks at the overall perception and understanding of technology transfer in university environment, spin-offs, describes the key considerations related to spin-off creation at university, motivation and management, provides an analysis of the data obtained from the partner universities and introduces a methodology for spin-off creation. The document also looks at some of the key motivational mechanisms to foster entrepreneurial thinking within the academic environment and contributes to spin-off creation. There is an innovative approach to the methodology for top management of the university: Rector, Vice-Rector, at the first time is the technology transfer solved at the top management level of three international universities and the institutional cooperation project envisages relevant activities between all three partners that provide valuable opportunity to share their expertise in the field of transfer knowledge and technology transfer and methodology of setting up spin-offs and foster the development of innovative joint educational modules of intellectual property and education of knowledge and technology transfer. And that is thanks to involvement in the top management of all three partners, at the level of the Rector's Office. The aim of intellectual outputs is to create Methodology for the successful spin-off setting in an academic area. Aim is to identify critical points in the whole process of setting spin-off companies and to describe the process in the holistic approach.

# The role of university in the field of Technology Transfer

Technology and knowledge transfer is a set of activities and processes that leads to the costing of knowledge outcomes of universities and other research organizations on the market. Technology and knowledge transfer is not limited to results of research and development (R&D) but includes other outputs of universities that can be commercialized in the form of providing various professional services by selling intellectual outputs to industry. Generally speaking, transfer knowledge is very important for the university, for students and especially for researchers including early stage researchers such as Ph.D. fellows that should know about the possibilities of bringing the intellectual outputs to the industry. However, there are various problems associated with this topic which must be effectively solved in order to achieve its full potential since this topic is less mature and developed at universities compared to R&D.

In addition to education and research, the university also has a so-called third role, which is the service of society, its direct social action. The university reflects current social developments and contributes significantly to the dissemination of the latest scientific knowledge and values in many different ways. The goal is to be in close and mutually open society-wide contact

at the local, national and international level. The basic task is the transfer of the knowledge and technologies in the form of studies, analyses, patents or licenses, the establishment of spin-off companies, the provision of professional services, consultations and research in key areas. This has a direct consequence on employment, development of industry and services through innovation, cultural potential and social care capacities. The university strategically develops lifelong education, actively organizes events for the general public, especially in the field of popularizing science and research, technology transfer and also culture. University employees enter the public debate, for example, by appearing in the media, writing articles and comments intended for the public, or creating academic websites. Equally important is their involvement in consultation groups, expert panels, non-governmental and non-profit institutions and civil society in general, which not only shape public opinion, but also influence the actions of the public and state administration.

Experts in management and economics agree about the importance of innovation and the ability to transfer technological innovation originated not only in science, research and development, but also innovation arising from practice or innovation which arose from thinking about things "in a different way" to the business sphere. Technology and knowledge transfer represents a key capability that has a major impact on overall economic growth, GDP growth, value-added employment growth and the overall rise in society. There is a consensus among experts that knowledge is growing in importance for economic growth and that the role of innovation and the ability to use new knowledge and innovate will play an increasingly important role in the economic development of countries and regions in the future.

Changes in labor market requirements are a natural part of a company's development. It is estimated that 35% of current jobs may be held by computers in the next 20 years (OECD, 2018). Some jobs will naturally disappear and will be replaced by new ones. The technological revolution is stimulated by the sense of improving human lives and it requires strategic management not only at the system level but also for each individual. The boundaries between the work performed by humans and those left to machines or algorithms are rapidly shifting. Based on production trends and monitoring the growth of the economy, the global labor market is likely to undergo a major transformation in the next few years. If this transformation is well managed, it can lead to economic growth, job creation, and an overall improvement in the quality of life for society as a whole. As already mentioned, in order to increase the added value of products and services, a transformation into a manufacturing sector is necessary, in which it is possible to produce products or services with high added value.

A very important part of this new manufacturing sector in the future is especially start-up companies and spin-off companies, which start from practically zero. For successful market penetration, it is crucial for them to enter the market often with a new, unique solution, which no one has yet tried to solve a specific problem. For this reason, the segment of start-up companies is desirable for the development of a healthy economy and should be supported not only at the national level but also at the regional one.

Some subgroups of start-ups are provided with special support in their efforts on improving competitiveness and growth. Some start-ups might evolve at a high pace resulting into fast-growing companies (so-called gazelles) or "born global" (new companies that

are internationalizing very quickly). In particular, innovative companies have moved interest to academic spin-offs companies. It is estimated that their impact on improving the competitiveness of the national economy is particularly high (see, e.g., Shane (2004).

New academic companies change into a knowledge society. However, there are still new academic companies additionally supported by developments in the university field related to the concept of knowledge company. In a knowledge-based society, the role of the "classical" university is closely connected with the question of the commercialization of knowledge. This commercialization also includes academic companies. The latter focuses on three tasks: two traditional tasks – research and teaching and a third task emanating from the entrepreneurial nature of the university namely knowledge evaluation (Etzkowitz, 1998).

In Europe, third role for universities regards the successful implementation of innovation in the market. Therefore, the American legalisation "The Bayh Dole Act" is considered as a benchmark for the commercialization efforts of the universities and support of licenses of research results. Universities see licenses as their best commercialization opportunities, while the establishment of spin-off companies is attributed to a more secondary priority.

Experts and scientists usually consider creating their own business structures in the form of "spin-offs" supported by licenses. Creating adequate framework conditions for commercialization of knowledge, whether it is a license or a company, remains one of the key issues in both positions' questions. Answering this question under adequate framework conditions is therefore very relevant, both from a theoretical and a practical point of view.

# Technology Transfer

Technology transfer may be defined as a complex process of transfer (or application) of scientific knowledge, inventions, discoveries and knowledge acquired by research and development activities in the public sphere into economic and social practice in order to commercially evaluate them. The main stages of this process are the protection of intellectual property and its subsequent commercialization.

The World Intellectual Property Organization (WIPO) refers to the process by which knowledge embodied in academic innovation and discovery is transferred from the laboratory to industry, and in the course of that knowledge is transformed into an industry-desired form. However, WIPO do not adhere strictly to this definition and consider any migration of students and researchers between academic and industrial practice and the publication of research results as technology transfer. Technology transfer is also defined as the process of moving innovation from the laboratory to industry.

Technology transfer is also perceived as an exchange of information, materials or intellectual property rights, with the participation of the state, academic organizations and industry. The purpose of the exchange of information, materials and intellectual property rights is to facilitate further research and the commercialization of its results.

In summary, technology transfer can be defined from two perspectives. From a broader point of view, it can be defined as the transfer of research and development results and knowledge into practice. The publication of new knowledge to the open public can also be such a transfer. From a narrower point of view, technology transfer can be defined as the successful application of technology by one entity (such as a research and academic institution) so that this technology meets the needs of other entities (such as companies, end users of technology, etc.).

Such technology transfer involves not only transfer between organizations, but also transfer between different industries. Technology transfer is thus one of the tools contributing to strengthening competitiveness, regional development and raising the economic level of society. It is through technology transfer that inventions, processes and technologies are applied in various areas of real life.

### Types of Technology Transfer

Technology transfer is not universally defined around the world, but with regards to various forms of technology transfer and various actors participating in technology transfer process the technology transfer can be broken down to two types:

- Vertical technology transfer,
- Horizontal technology transfer.

Vertical technology transfer means that the technology moves from the creator or the provider of the technology towards the recipient of the technology, whereas the technology provider is a university or other scientific institution, and the recipient is a business company. A typical example of vertical technology transfer could be technology from the field of electrical engineering developed by researchers of the university. Following the filing of a patent application by the university protecting such technology, the business undertaking buys the production license and then manufactures this technology. Then as agreed in a license agreement, the business undertaking pays the university the agreed fees for using university's patent in the production of new technology.

Horizontal technology transfer can be understood as the transfer of technology between institutions on the same level. This could be technology transfer between two universities, or technology transfer between two business undertakings. In this scenario, one party is always the inventor of technology and thus also the provider of technology. Another party is always a buyer of technology and as such a technology user.

Although in terms of the sequence of individual phases, technology transfer can also be distinguished into two types:

- Linear technology transfer,
- Direct technology transfer.

Linear technology transfer repreents the transfer of already achieved technologies (research and development results) into practice, consisting of three standard main phases. These are identification and assessment of the research result, protection of this result and its subsequent commercialization.

Direct technology transfer is characterized by the creation of technology on the basis of demand raised by the party from the market, without further or accompanying dissemination of technology by the university. Direct technology transfer can be understood as sponsored and joint research, providing the professional consultations by the university or the exchange of university researchers with the business undertakings.

# Knowledge Management

Knowledge management is the process of creating a certain environment in which individuals working together in groups effectively realize chosen goals (Koontz, 2017). According to Chung (1987): „Management is the process of planning, organizing, directing and controlling organizational activities aimed at achieving organizational goals." Robins (2002) describes it as „a field of study that is concerned with determining the procedures to best achieve an organization's objective". Knowledge management is then a process of systematic and active management and formation of the organization's knowledge, which deals with both the state and movement of knowledge. The state is presented by the expertise of people, and the movement by ways of sharing knowledge. According to Woolf (1990), knowledge is organized information that can be used to solve problems. Wiig (1993) defines knowledge as follows: „Knowledge includes truths and beliefs, perspectives and concepts, judgments and expectations, methodologies and know-how." Knowledge can be define as follows: „Knowledge is information that is organized and analyzed, to make it comprehensible and usable for problem solving or decision making." We can determine different types of knowledge into explicit implicit and unformulated (tacit), and they are individually defined as follows: Explicit knowledge: *„Formalized or documented knowledge that is usually well structured and easily transferable."* Implicit knowledge: *„Knowledge that is stored in the heads of workers but can be converted into explicit form at any time."* Unformulated knowledge: *„Knowledge hidden in heads of individual employees. It is not easy or even impossible to convert it into an explicit form and formalize or document it."*

Knowledge management is defined according to Macintosh (1996) as follows: „Knowledge management includes the identification and analysis of available and required knowledge and the subsequent planning and control of actions aimed at the development of knowledge assets." All this in order to achieve corporate goals." Hujňák (1999) defined this term as follows: „Knowledge management represents the strategic application of an organization's intellectual capital. The starting point is the recognized experience and knowledge of the organization's employees, relevant information sources coming from inside and outside the organization and from the identification of the influence of knowledge on increasing the organization's performance." Liebowitz (2003) created the following definition: „Knowledge management is the process of creating added value in a company from organizational intangible assets. Knowledge management is concerned with the ways in which knowledge can best be used internally and externally." Knowledge management can be define as follows: „Knowledge management focuses on systematic approaches to finding, understanding, and using knowledge to create value." Knowledge management is a process of several follow-up activities to improve the worker's understanding of a specific area of his

work. Specifically, this process includes finding, selecting, organizing, distilling and presenting information so that the worker develops. Bureš (2007) recommends looking at knowledge management from multiple perspectives, for example: a conceptual, process, managerial or technological perspective. Knowledge management is a relatively young concept that was originally applied in the management of business processes. Recently, however, it has become more important in the context of managing highly specialized knowledge leading to innovative solutions. Technology transfer as a related issue has developed very dynamically in the Czech environment in the last four years. This is mainly due to the construction of technology transfer centers (TT). However, the production of R&D outputs in recent years in the Czech Republic shows the need to go back again and more deeply to support the management of the creation of a number of applicable outputs, and not self-serving outputs. The term knowledge worker is not specifically and clearly defined in the available literature. It is only a matter of defining who such a worker is and his/her possible characteristics. Today, knowledge workers make up approximately two-thirds of workers in developed economies. Knowledge makers are those who have a management or organizational role within the company for one specific area. They are therefore experts on questions related to the given area and on topics within their functional and branch departments.

## Results of creative activity

The aim of research and development is always new knowledge, but generally, the results of creative activity other than research and experimental development (R&D) can also be protected. These are produced by creative and systematic work to increase the level of knowledge, including knowledge of humanity, culture, and society, and to propose new ways of applying available knowledge.

R&D is therefore typically characterized by the need to meet five basic criteria:

- it must contain an element of novelty,
- it must be creative,
- it must contain an element of uncertainty,
- it must be systematic,
- it must be transferable and/or reproducible.

Not all results of creative activity have to meet the conditions of R&D. What is and is not considered R&D can be demonstrated, for example, in the field of software. The software development component can be classified as R&D only if it leads to advances in computer software. The following examples illustrate the concept of R&D in computer programs according to:

- development of new operating systems and languages,
- design and implementation of new search engines based on original technologies,
- effort to resolve conflicts within hardware or software, based on the process of system or network transformation,

- creating new or more efficient algorithms based on new techniques,
- creating new and original coding or security techniques.

The examples of computer software activities to be excluded from R&D are as follows:

- software development of business applications and information systems using the well-known methods and existing software tools,
- adding user functionality to the existing application programs (including basic data input functionality),
- development of web pages or software using the existing tools.

Software may or may not be the result of R&D, but it can be copyrighted regardless of it. The design of an "ordinary" website does not fall under R&D as it does not advance the field. Again, however, it may be protected by industrial design and other reserved rights.

| **R&D results** | **Results of scientific research activities** | **Area of creative activity** | **Intended object of protection** | **The appropriate method of protection** |
|---|---|---|---|---|
| R (if the conditions above are met) | Software | Information technologies | Source code | Copyright |
| Not R&D | Web page | Webdesign | Graphical display of the website | Industrial law |
| J | Research article (peer-reviewed in a research journal) | Science in its broad sense | Form of expression of the professional topic | Copyright |

*Table 1: An illustration of the concept of R&D results and outputs of creative activity*

Focusing only on R&D may lead to the omission of the results of creative activity that can be protected.

With copyright, protection arises immediately and applies to works of authorship defined as follows:

- literary work,
- other work of art – dramatic, choreographic, mime, film, music, visual, photographic, sculptural, graphic, pictorial, or cartographic,
- research study,
- a computer program, a photograph, and a work expressed by a process similar to photography, which are original in the sense that they are the author's intellectual creation,
- a collection of independent works (magazine, etc.),

- a database which is the author's intellectual creation by way of selection or arrangement of the content, the components of which are systematically or methodically arranged and individually made available electronically or by other means.

Nevertheless, the main importance of technology transfer is due to the application for the establishment of intellectual property protection on the issue of industrial law.

| **Type of protection** | **Protection period** | **Extension of protection** | **Terms and conditions of protection** | **Cannot be protected** |
|---|---|---|---|---|
| Patent | usually up to 4 years | up to 20x1 year | The inventions which are novel in the world are the result of inventive activity, i.e., if they are not obvious to an expert, and are capable of industrial application. | Discoveries, scientific theories, and mathematical methods, aesthetic creations, plans, rules, and methods of performing an intellectual activity, playing games or conducting business, as well as computer programs and the mere giving of information. |
| Utility model | 4 years | 2x3 years | The novel technical solutions, go beyond mere technical skills and are industrially applicable – in particular equipment, wiring, products, machines, tools, chemical compounds. | Discoveries, scientific theories, mathematical methods, mere external modifications of products, plans, rules and methods of carrying out the intellectual activity, computer programs, the mere presentation of information, technical solutions which are contrary to general interests, in particular to the principles of humanity and public morality, plant varieties and animal breeds, as well as biological reproductive materials, methods of production or working activities (protected by patents). |

| | | | | |
|---|---|---|---|---|
| Industrial design | 5 years | 4x5 years | The appearance of the product or its parts, consisting in particular of the lines, contours, colours, shape, structure, or material of the product itself or its decoration if it is of an individual nature (if the overall impression it gives to the informed user differs from the overall impression given to such user by an industrial design which was made available to the public before the date of filling out the application or before the date of priority). | Technical and design solution, the transfer of a known external modification of a product to a product of another kind, or a modification produced by enlarging or reducing the well-known external modification of the product, the substitution of material for the external modification of the product, architectural design of the building (can be protected by copyright), external modification of the product, detectable only with special attention, colour, unless used in conjunction with the shape, outline or drawing, functional principles or material composition. |
| Topography of semiconductor products | 15 years | | The topographies of semiconductor products which are the result of the creative activity of the originator and which are not common in the semiconductor industry. | |
| Plant varieties and animal breeds | 25 up to 30 years | | In the case of a new variety, the variety which is different from the existing varieties and if it shows stability. | |
| Trademark | 10 years | unrestricted x10 years | A label capable of graphic representation, in particular words, including personal names, colours, drawings, letters, numerals, the shape of the product or its packaging, if the label is capable of distinguishing the products or services of one person from another. | |

| | | | | |
|---|---|---|---|---|
| Business company | unrestricted | | The name under which the entrepreneur is registered in the Commercial Register and under which s/he is obliged to perform legal acts. | |
| Designation of origin | unrestricted | | If the quality or characteristics of the labeled goods are exclusively or predominantly due to the specific geographical environment with its characteristic natural and human factors and if the production, processing, and preparation of such goods take place in the designated territory. | |
| Geographical indication | unrestricted | | The goods originating in that territory if those goods have a certain quality, reputation, or other characteristics attributable to that geographical origin and if the production or processing or preparation of such goods takes place in the designated territory. | |

*Table 2: An overview of the institutes of industrial law*

## The Office of Technology Transfer

The Office of Technology Transfer (hereinafter also "TTO") "means a specialized workplace created for the purpose of university-wide support of technology transfer activities, including comprehensive assistance in choosing and ensuring a suitable form of protection of industrial property objects. These specialized workplaces can provide a wide range of services, cooperate with local and foreign companies and initiate and support the transfer of technology, knowledge and know-how from the university to the companies. A knowledge management workplace can be defined as "a legal person (own or contractual), department or branch of the applicant,

which provides for the beneficiary the process of technology transfer, protection of intellectual property and evaluation of its usability, administrative assurance of its marketability, assurance of legal protection of intellectual property ownership, agreeing on specific contractual terms with the user of intellectual property, ensuring legal service when concluding a contract that ensures the protection of intellectual property and carrying out all the specified activities necessary for the entire commercialization process". The services of the knowledge management workplace can be provided internally or externally. The core of the main content of these centers is therefore the interception of the process of identifying research knowledge that could be used in practice. Subsequently, such an application with commercial potential is verified and a business plan is developed.

Changes in organizational schemes at public research institutions is an implication and further necessary development of human resources.

The performance of technology transfer centers is determined by the sensitive decision and support of top management. From an organizational point of view, the centers are mostly made up of the so-called core part of their employees, i.e., those who are stable and permanent, or a fixed part of the center (legal and financial management, IP and commercialization managers). The second part of the staff is made up of technological scouts, which are workers at individual faculties who monitor the situation directly in the research teams and thus provide them with first information and at the same time mediate daily contact between the faculty and the workplace of the office or technology transfer center. At the same time the flow of information and stimuli does not flow in one direction, but it is very beneficial for all parties involved when the flow of information is carried out in both directions.

## Strengths and weaknesses of the current state of Technology Transfer in the university environment

In specific connection to technology transfer, or the existence of a technology transfer office at the university, it is necessary to state the strengths and weaknesses of the current state of technology transfer in the university environment. The strengths:

- significant and high-quality R&D results in individual university and academic institutions,
- availability of erudite persons in the field of intellectual property protection and in the field of commercialization,
- professional support in communication with companies,
- ensuring the demand for a „tailor-made" service for the given institution and its subsequent implementation,
- creation and current establishment of intellectual property protection rules and their subsequent commercialization,
- fundraising for scientific teams, especially in the area of Proof of Concept.

Technology transfer and patent activity also have certain barriers. Weaknesses therefore often include:

- insufficient marketing support,
- employee qualifications – there is no field of study on the domestic market yet,
- sometimes little time flexibility and reliability of delivery of scientific teams,
- ineffective motivation of scientific teams to generate R&D results with application potential,
- problem in penetrating foreign markets with R&D results,
- long approval procedures,
- insufficient and non-transparent incentive system aimed primarily at research results,
- missing system support of the TT unit,
- too frequent changes in the system, legislation and regulations,
- evaluation system and its incentives for knowledge transfer,
- lack of funds for Proof of Concept activities and the process of supporting technology transfer,
- missing budget items for expenses associated with the start of technology transfer,
- reluctance, concerns and lack of motivation of scientific workers for commercialization,
- concerns about the administrative burden on scientific workers.

On the basis of the aforementioned and at the same time on the basis of the studied literature, it is clear that the transfer of technology is increasing and in recent years by the highest executive offices and institutions, such as the Ministry of Education, Youth and Sports, the Ministry of Industry and Trade, Office of the Government, Technology Agency or others is more supported. A number of financial support programs are listed, and it is clear that for greater and better anchoring of technology transfer at local academic and university institutions, it is necessary to create an effective model of motivation for scientific academic workers in the field of technology transfer. In the distribution of funds obtained from commercialization, there is always only one motivational model, especially the financial one, which is always unified for the entire given university or research institution without a deeper distinction into individual fields of study.

The related transfer of knowledge is a priority of many government programs and is mentioned in connection with building the competitiveness of individual industries. How it is perceived from the level of the university and how the university can influence its success in this area is a much less researched question. The first steps have already been taken, universities are beginning to take an interest in what disrupts the "operationally" smooth flow of transfer activities in many markets, for example the USA, the UK and the Czech Republic, areas of difficulty have been identified, which include:

a) limited ability of universities to identify the target company for a given technology,

b) limited ability of universities in the event of expressed interest from the beneficiary to "complete" the outputs so that they correspond to the beneficiary's local requirements,

c) slowness and inflexibility of universities in formulating agreements.

It can be summarized that the areas of difficulty – a) targeting, b) outputs (= product) and c) contractual assurance – fall into the category of marketing or marketing activities.

Here we present the possibility of solving the targeting issue. Positioning is the act of proposing (Kotler and Keller 2006), what an organization (here a university). Identifying a suitable and attractive target market is important for every entity that monitors the effectiveness of its marketing activities. This premise also applies to universities. The first key step, from which any other marketing activity subsequently develops, is the identification of a suitable and attractive target market. If the target market is chosen, the university faces a decision regarding its own position in the chosen target market.

Important issue:

(i) offers and at the same time the proposal

(ii) unique image that the university wants to capture in the minds of key representatives of the chosen target market. It should be noted here that the university and its representatives are usually perceived as poor communicators of their own results, which has the logical consequence that the target markets for technology transfer know very little about the current results of scientific research. It must be emphasized that this is not an easy task, as the university management must create and put into practice usually a set of strategies designed to elicit positive responses in the target market. Which is a very complex issue if we realize that the university management must also consider what is acceptable for the university. There are certainly differences in the possible research spectrums of research goals common to universities and the commercial sphere or the state sector.

Within these spectrums of research objectives, we can range from:

- basic creation of knowledge up to the development of tradable services and products or
- pure basic research to targeted applied research or
- open research with publicly available results up to research.

The most frequently reported positive characteristics related to the advanced research skills and knowledge of academic staff. Rigorous and unbiased results due to their independence from industry have been cited as strengths of academic research.

# Tools for top management for successful Technology Transfer

The university's top management has several options and tools to support and stimulate the results of technology transfer, from soft skills that include effective leadership, motivation to the analytical tools, for example, network analysis. Here are the main ones.

## Motivation

Motivation and remuneration of workers are among the important factors of support and development of human activities, which historically attract extraordinary attention. Today, it is already a sophisticated scientific methodology and human resource management strategy. Nowadays, every organization or institution has at its disposal quite a lot of options for rewarding and motivating its employees. Positively directed motivation reinforces achievement, which can promote positive expectations and self-confidence. Motivation factors can generally be divided according to the literature review into three basic groups, namely individual assumptions, work factors/conditions and working environment conditions. These three basic groups of factors are very closely related and strongly influence the motivation of individuals. Individual prerequisites include: the abilities of each employee consisting of his knowledge and skills, his morals, activity and imagination, commitment and family background. Furthermore, interests, attitudes towards oneself and towards work, towards the work situation and the need for safety and social needs, and last but not least, the need for self-realization and the level of motivation. Shaheen et al. (2013) state that within the theoretical framework for employee motivation there is a need to support the internal factors of individual employees through academic policy, or create adequate conditions. Work factors or conditions are created by each institution as a background for its employees and are the same for all employees – technological conditions, workplace equipment, management style, work organization and work evaluation method, employee benefits, career advancement opportunities, material monetary and non-monetary reward, rational (content) and emotional (experiential) communication. This fact contradicts the needs and the specific position of "knowledge makers". We mention this connection because the originators are usually knowledge makers. The characteristics of the working environment include, in particular, the immediate working environment, co-workers and superiors, the overall organizational climate and workplace relations, a wider system of requirements and control of their fulfillment, individual requirements, care of working conditions by the employer, appreciation of work done, fairness and compliance with conditions without exception. It is ideal to keep these three variables, which affect motivational processes in the organization, in balance. If one of these three components, which influence and determine the performance and motivation of each employee, is lower than at its optimum, the employee will show lower work performance. However, it is true that motivation is very important and it is necessary to pay constant attention to it from the point of view of the management of each institution and the management. The opposite of motivation can be over motivation,

i.e., motivation itself reaches a higher than optimal line, and paradoxically becomes the cause of low performance. Currently known motivational systems that are well-usable or applicable within the knowledge economy can be divided into four areas:

- Individual workers are responsible for the fulfillment of assigned tasks, which they have defined for their competences.
- Individual goals must be a challenge and should inspire performance, provided they ensure the return of financial resources that were used to motivate employees.
- The goals of each institution must be clearly specified so that, based on such a specification, it is clear what performances need to be achieved and how they will be evaluated after they are achieved.
- Ideally, joint definition of goals, on which everyone works, from employees to their top management.

Motivational systems, which are mostly based on financial rewards, are limited to a certain extent, or limited, given that there is no firm link between employee engagement, their outcome for the institution and financial reward. If the financial evaluation increases, it loses its effectiveness and does not adequately motivate further commitment and initiative for the company. Fisher (2005) states that employees who have a very high income and have reached a state of well-being in their own way are in the so-called comfort zone. These employees will not increase their efforts with the increase of possible additional financial remuneration, but it will be necessary to further motivate them in other forms. These are mostly people who find their own personal realization in their work, the development of their own personality, the possibility of societal application and recognition, the possibility to develop and apply their talent and also a source of positive emotions. There is a need to build employee motivation for loyalty to the institution. This cannot be forced against their convictions, but they themselves must be understood and to some extent satisfied.

Overall, it can be concluded that the originator is motivated by many factors, among which they primarily include: career growth, personal success, recognition, the meaningfulness of the assigned work, reward in the form of financial remuneration, the application of one's own ideas within the scope of possible societal significance, ensuring finance for the institution where the originator in question works, and the possibility to use quality laboratory equipment. The sum of these factors motivates the originator in generating effective and interesting R&D results. The originator needs financial support from his direct superior, the head of the department and, last but not least, the dean of the given faculty. Retrospectively, assuming that the result is applied on the market, then the funds flow back to the given workplace up to the originator himself incl. the newly acquired proper prestige, which, according to experience, is always appreciated by the top management of the university, as it also increases its prestige within the framework of improving the quality of social life. One of the tasks of the dean of the faculty is to obtain funds from the university management for further high-quality infrastructure equipment in the individual departments of his faculty in order to continue to develop the creative work and initiatives of scientific and academic staff.

## Network analysis

The aim of this chapter is to use network analysis to provide university managers with an insight into the possibilities of identifying and shaping the university's potential for technology transfer using network analysis, which in itself is a technology worthy of transfer into everyday managerial life. In this chapter we will introduce (i) key concepts from network theory, (ii) a brief insight into the actual network theory and the basic concepts within the network theory used and subsequently (iii) we will guide the reader through the basic results of the network analysis that we implemented at UHK in the area of R&D and TT activities. We will progress from an overall view of UHK to details. The analysis is based on data that we obtained from the internal systems of UHK, i.e., it is the so-called archive data (Wasserman and Faust 1994). This data was not inherently relational. This was standard information related to individual scientific workers. The original data source obtained in this way contained 1810 clearly identified scientific activities active in the field of R&D and TT. For each individual record from the above-mentioned 1810 research projects, data was obtained for the following monitored variables (1) the project manager, (2) the location of the project manager, (3) the faculty where the project manager works, (4) the department, (5) type of R&D activity.

Network theory and key concepts Network theory (Barabási and Pósfai 2016), (S.P. Borgatti and Halgin 2011) is a new but already quite formally defined scientific discipline of learning about nature, society and phenomena occurring in these systems. The theoretical basis of network theory consists of three scientific disciplines: (i) Discrete Mathematics, (ii) Linear Algebra and (iii) Statistics (Jackson 2008).

### Visualization of basic descriptive statistics for the overall UHK network (centrality measures)

We will work with four descriptive statistics (metrics), i.e., degree, closeness, betweenness and eigenvector centrality (Newman 2018), (Freeman 1978). Degree, or in the terminology of graph theory, the degree of a vertex is really just capturing the connection of a node with its surroundings. Closeness, which is best translated as proximity, expresses how easily we reach or connect with other nodes. Alternatively, it can also be expressed as „How far we are on average from others". Betweenness, sometimes translated as intermediateness, describes the extent to which a node can act as an intermediary between other nodes or how much it can connect them together. Let's emphasize that this is a very different concept from degree and closeness. Betweenness does not deal at all with how close or far I am to whom I am, but rather describes a fact that can be expressed with the statement „I am as important as how many other individuals I can bring together". The logic is somewhat similar with degree, but there is a fundamental difference in that, in addition to the number of connections I have with others, I am also interested in how influential those others are, i.e., how many similar connections they have. The phrase that probably best describes this fact is: „not what you know, but who you know". This analysis allowed us to organize the university network in such a way that it is clear that the observed network is not made up of a single component.

Network analysis of UHK was made as a part of publication Marešová, P., Bureš, V., Štemberková, R., Matulová, P., Krejcar, O., Toman, J. Škodová Parmová, D., (2020) Od výzkumu po využívání v praxi: Vše kolem transferu znalostí a technologií ISBN 978-80-7435-816-6.

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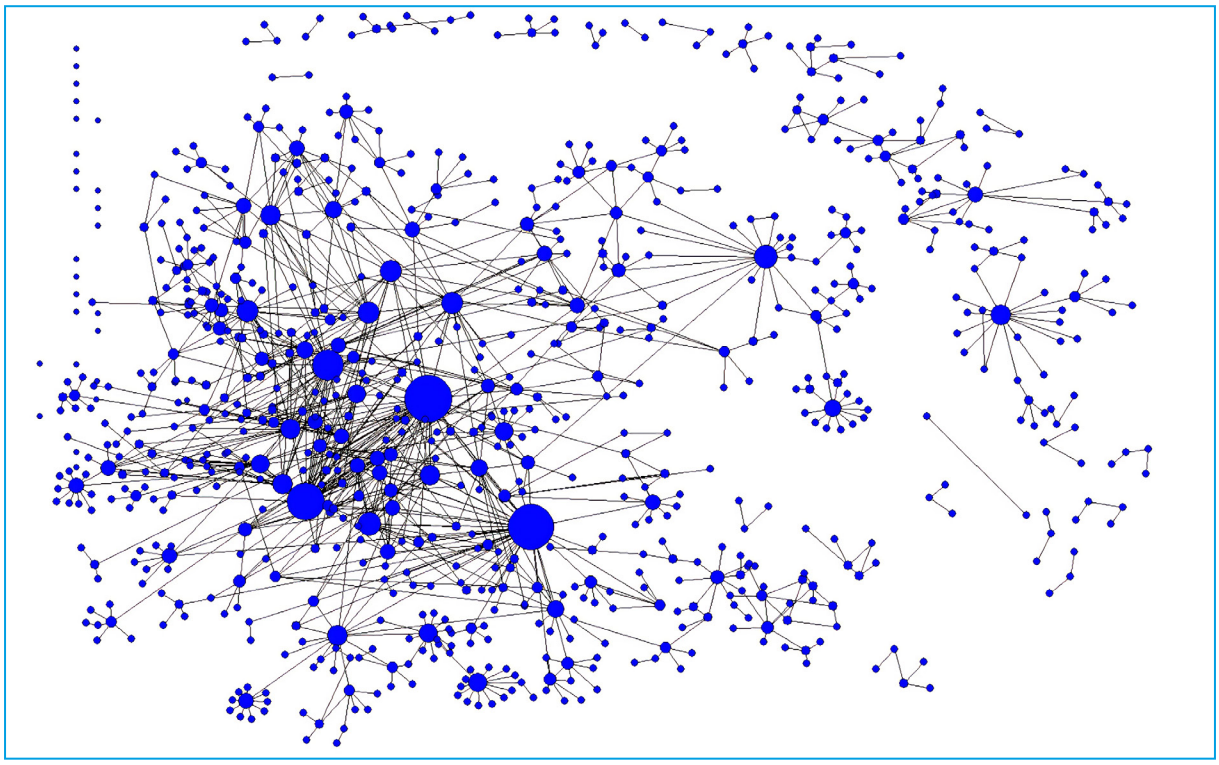


*Figure 1: Visualization of selected descriptive statistics (degree centrality) of the UHK network*

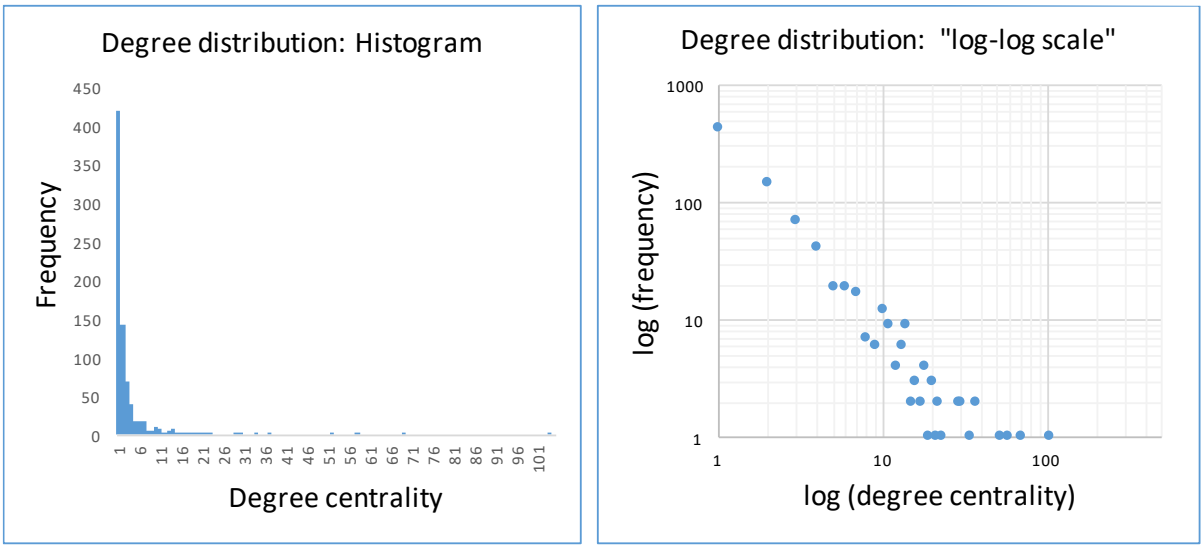



*Figure 2: Distribution of value „degree centrality"*

Additional information provided by the visualization of the university network, which is represented by the size of the individual points of the network, is information about the connection of individual scientists with their immediate surroundings. So we visualize the degree centrality values. With regard to the total number of nodes (812), this graph may

seem a bit uninformative. For that reason, we add to Figure 1 a graph, see Figure 2, showing the distribution of degree centrality values, i.e., a histogram. It is clear from the histogram that there are more than 400 nodes with degree centrality equal to 1 or less, i.e., more than 50% of active actors participate in at most one R&D project. Unfortunately, thanks to the scale, it is very vaguely visible that there are scientists who have more than a few dozen participations during the observed period.

The specific example (measured at UHK) we will use here is the result of the detection of components in the UHK network and its surroundings. Where individual nodes of the network also represent individual scientists and edges indicating the scientist's participation in a research project. However, for now let's turn our attention to the network as a whole. We see that the UHK network in 2019 is not connected. It consists of more than three dozen components with the number of nodes greater than 1.

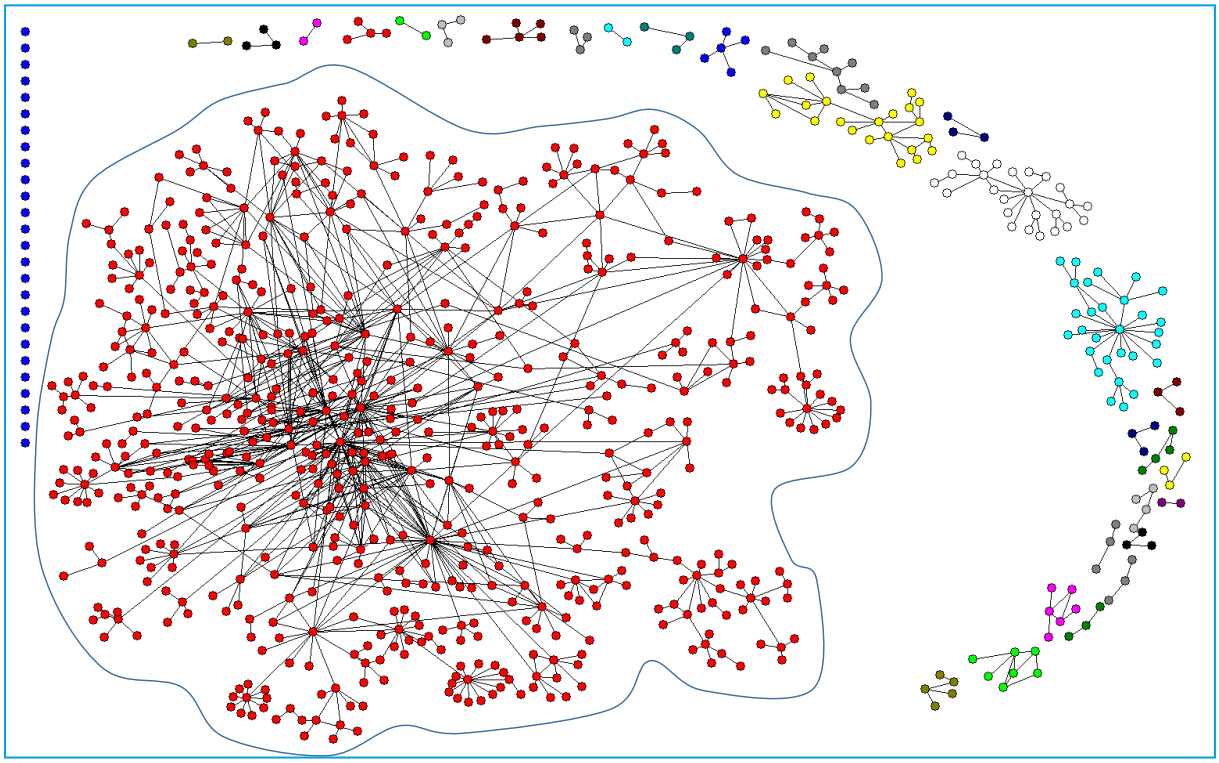


*Figure 3: Map of components detected in the UHK structure*

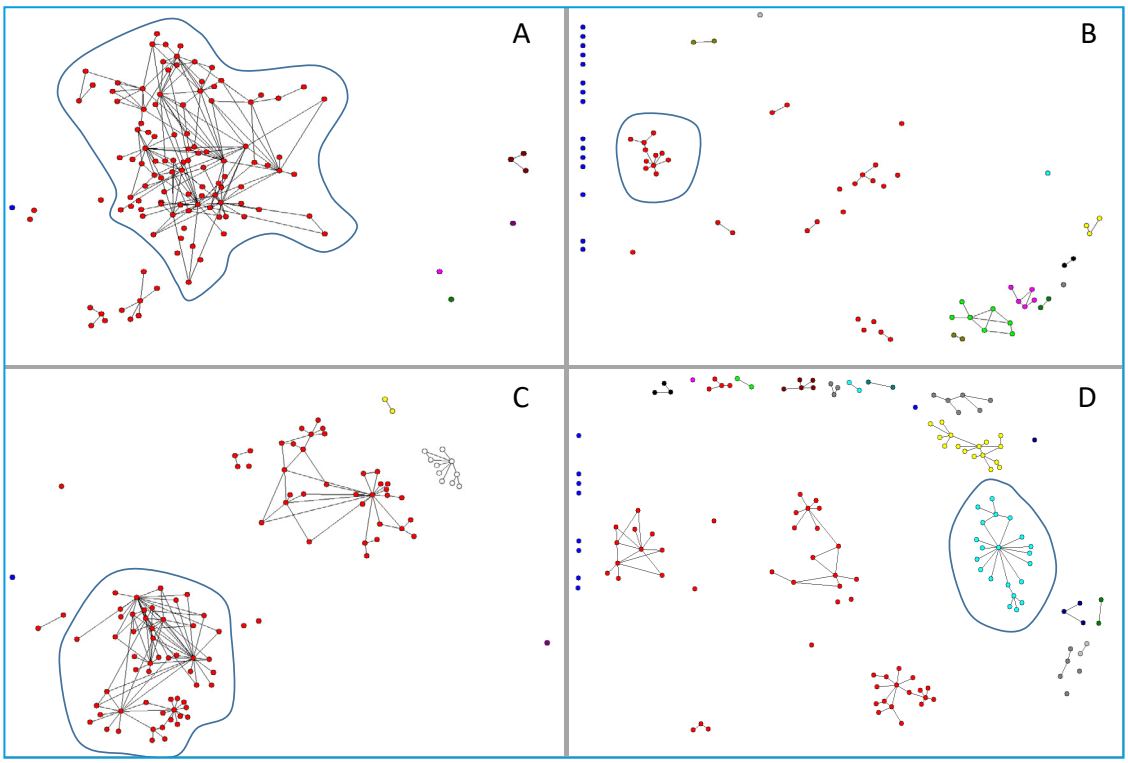



*Figure 4: Map of components detected in the structure of individual UHK faculties*

The largest component, which occupies most of Figure 3, is made up of 615 nodes, i.e., it includes 75.7% of all active researchers working at UHK in the monitored period. The row of blue nodes on the left edge of the image represents individually working researchers and, together with the other color-coded components, represents 24.5% of active researchers working at UHK in the monitored period. If we focus on a greater degree of detail, i.e., at the level of individual faculties, we can observe in Figure 4 obvious differences in the network structure of individual faculties of UHK and its surroundings. In faculties A and C, we observe the presence of major components around which there are several smaller ones. In faculties B and C, on the other hand, we see the existence of a larger number of smaller isolated components, where the main component is a group of scientists not exceeding a total of 15 actors.

Network theory (Barabási and Pósfai 2016), (S.P. Borgatti and Halgin 2011) is a new but already quite formally defined scientific discipline of learning about nature, society and phenomena occurring in these systems. The theoretical basis of network theory consists of three scientific disciplines: (i) Discrete Mathematics, (ii) Linear Algebra and (iii) Statistics (Jackson 2008).

Networks as such are quite complex structures. By studying networks, we have the opportunity to penetrate into the patterns of arrangement of even very complex structures and the related properties of these structures. One of the most basic breakdowns of the level of knowledge of such complex structures is possible from the point of view of different types of patterns and network arrangements. If we proceed from the macro-view to details, then the following four levels of description of network structures are offered, which differ precisely by the degree of complexity reduction, i.e., (Jackson 2008): global pattern of networks; here we begin

to recognize the individual characteristics of the individual vertices or actors of the network (age, gender, religion, nationality and many others), which make it possible to explain the basic segregation or integration mechanisms within the network. This leads us to the concepts of:

(i) Homophily, which population characteristic is probably best described by the saying a free translation of the title of the article that introduces this entire area of human knowledge – „Birds of a feather flock together" Philemon Holland, 1600 or „strong ties".

(ii) Local network patterns; where within local patterns we have the opportunity to observe how clusters of actors (nodes) group together and form cliques. The metric used in this level is the so-called clustering coefficient.

(iii) And finally position in networks; when we observe how a specific peak is connected to its surroundings. We use here a very wide range of metrics, which we call centralities, each of which individually is more or less useful in capturing local phenomena related to the neighborhood of the monitored node. We typically work with degree, closeness, betweenness, eigenvector centrality, but also more recently page rank, decay or diffusion centrality.

Another possible and very often used division of network structures is carried out from the point of view of their dynamics, and at a basic level we recognize:

- statistical networks,
- dynamic networks.

Statistical networks are usually defined as networks with a given fixed number of actors and a variable number of relationships between these actors. Today, the classic representatives of this category of models are the Erdős – Renyi, Watts and Strogatz or Jackson and Rogers model, which are often referred to as "links-by-links", which reflects the fact that the number of nodes is fixed and the number of connections between nodes changes, i.e., the number of edges (Barabási and Pósfai 2016).

Dynamic networks already work with a growing (generally variable) number of actors and related models that have the word growth in the name. These include models of citation networks, web networks, scientific networks, community networks and many others, which are sometimes modeled as uniformly randomly distributed growing (Growing and Uniformly random) network models, other times different levels of preferences (Preferential attachment model) or combinations that are introduced into the models of these two mentioned concepts, which are often referred to as hybrid. Typical representatives of these concepts are, for example, the Stochastis Block model, Exponential Random Growth Model (ERGM), Statistical Exponential random Growth Model (SERGM) or Subgraph Generation Model (SUMG), which is usually based on the original Erdős – Renyi model, which they supplement with the aim of better describing reality (Newman 2018), (Jackson 2008).

Practical example of using the network analyses:

*The commercialization, technology transfer and transfer of knowledge in general are among the strategic priorities of UHK. Part of UKH's vision is long-term support for the effective transfer of research and development results into practice with the aim of gaining a strong and stable position in the field of commercial cooperation not only within the region, but also at the national level. Based on the analyses the management of the university can conclude that there is a high risk for UHK and it is the fact that a large number of high-quality scientific outputs that have commercial potential are produced by a relatively small number of scientists, this finding is supported by several analyses and is also reflected in the teams and projects appearing within the supported Proof of Concept projects. The management of UHK must focus on this situation and on the elimination of the risks associated with it in its activities. Because there is a real risk that the development of technology transfer will laps when key employees leave. The top management is aware of this fact and will systematically monitor this area as part of the technology transfer development strategy and try to ensure the expansion of this core network.*

*TTO's weak point is its limited capacity, negotiations with companies clearly require cooperation with external experts.*

**The aim of this chapter is not to carry out a complete analysis of one of the participating universities of the project consortium, but to show a network analysis as a suitable tool for top management in the field of technology transfer, as it provides relatively clear data on important links between researchers and points to those links that have great potential for the development of technology transfer. This tool will enable top management to successfully manage and support the development of technology transfer at universities.**

## Teamwork

Teamwork is based on the assumption that the whole is more than the sum of the individual parts. It thus includes the skills to work in a team context to ensure the team has an acceptable shared picture of the situation and can perform tasks effectively (for example coordination or cooperation and conflict resolution). However, teamwork includes, for example, understanding one's own role with the team, coordinating tasks, considering and helping others, or negotiating and resolving conflicts.

**Successful teams in technology transfer meet the basic prerequisites of teamwork. For many investors, how the team is composed is very important, sometimes even more than the technology itself. Without a good team, financing a spin-off is almost impossible. The composition of the team cannot be underestimated, therefore we present this tool as one of the key for the successful management of technology transfer at universities.**

There are a number of theories about team roles.

Mathieu et al. (2015) defines several roles in his work, which include:

- organizer (this is the one who set structure of what the team does),

- executor (willingly takes over work and performs actions),
- challenger (pushes the team to explore all aspects of the situation),
- innovator (regularly generates new and creative ideas, strategies),
- team builder (helps to create norms, supports decisions and maintains a positive work atmosphere),
- connector (creates bridges between team members and connects the team with other entities).

Coordination of tasks within the team and with other entities is crucial for the functioning of the team. Each task must have a clear and specific goal, a set deadline and must be achievable. The task is then assigned to an employee who is responsible for completing it and passing on information in the event of a problem. The employee assigned to the task must have sufficient skills and authority to complete the task. The coordination of tasks then takes place in several lines. At the highest level, it is about communication with the strategic elements of the organization and whether it is in line with the intention. It is also necessary to coordinate tasks within one project or tasks with the same goal. Related to this is the need to coordinate tasks between individual teams, which differs in the need for communication between team managers or their coordinators. The last coordination is the coordination of the task itself and its current state (Owen et al., 2009). Another important aspect in a team is also the ability to be replaceable. The team must be able to at least represent each team member to some extent. For cooperation and the team, it is also important to always have a member who is able to at least partially help a colleague to solve (Ramaswamy et al., 2017). When it comes to conflict resolution and discussion, the team leader must ensure that all team members follow the basic rules of communication. The application of the above aspects of teamwork in the field of technology transfer can be negotiation. In important negotiations, the negotiator is usually not alone, but a group of people who usually form a well-coordinated team. In this team, everyone has a predetermined role. These roles differ somewhat for individual institutions and types of actions, but in principle five basic ones can be mentioned:

- leader,
- analyst,
- lawyer,
- recorder,
- „libero".

Negotiations are usually led by the team leader, who from time to time gives the floor to his colleagues. The names of the individual roles sufficiently specify these roles, perhaps only the term "libero" is worth explaining. He is a member of the team who has no permanent role – his task is to carefully monitor the behavior of the other party, alert others to surprising findings, or directly enter into negotiations in situations where the course of negotiations requires it. It is important to take detailed minutes of each meeting, with the help of which it is possible to analyze the progress of the negotiations in retrospect. A prerequisite for every negotiation

is a basic negotiating position, i.e., a basic idea of the price and structure of the transaction. At the same time, the negotiating team should also have absolutely precisely defined limits that they must not exceed during negotiations.

## Leadership

The connection between technology transfer and people management is the subject of interest for experts from different areas that are intertwined with each other. An example can be the study published by Smilor and Matthews (2004), who, within the analysis of several American universities, identified the basic pulling forces that lead universities to be part of economic development and to be more involved in the commercialization of individual technologies. Their benchmark study focused on the role of people management and describing the ways in which this activity helps in commercialization activities. As part of closing the research circle, they finally showed how technology transfer helps economic development in their region. Thus, people management is as important as other activities in the field of technology transfer. As mentioned above, technology transfer is not a job for individuals. Both leadership and supervision imply the need to possess and develop the skills to manage, monitor and support a team in order to accomplish the tasks set objectives. Leading people is about creating and maintaining the ability to interact and manage, which seem to be key elements to define a leader. One of the most accepted definitions of leadership is the approach of Kotter (1996), who considers the basis of process management and leadership, i.e., managing processes associated with planning, financing, human and material resources, monitoring implementation and evaluation, as well as problem solving and re-planning if necessary. A distinctive feature of leadership is the focus on the ability to lead others in the desired direction, motivate them and keep them motivated, and even inspire them to develop their skills. The basic leadership characteristics that every capable leader should follow are based on delegation, communication, authority, proper use of feedback, honesty and positive motivation. Delegation consists in giving employees the opportunity to express their opinions, participate in decision-making, and at the same time give them responsibility. The employee feels important in such management and at the same time the manager has confidence in him. This adds considerable motivation and increases efficiency. For any leader to be effective and have a positive atmosphere in the workplace, he must be fair to all his subordinates. He should treat every employee equally in the event of a conflict or problem, listen to all sides and be able to admit his own mistakes. It also has a very negative effect if the leader allows the worker to try to succumb. The last „duty" of a leader should be motivation. A manager should create a pleasant work environment that is optimistic and energetic. It can help a leader to develop the strengths of his subordinates, to be himself effective and positive, and the goals he sets are high but always realistic.

## Decision making

Decision-making is a key activity in technology transfer. One of the first decision-making problems is, for example, choosing how new knowledge or technology will be commercialized and how intellectual property protection will be implemented. Belinko et al. (2004), for example, offers a scheme by which this can be decided. The scheme is based on a choice of scale of transfer from broad-spectrum dissemination (technical publications, scientific

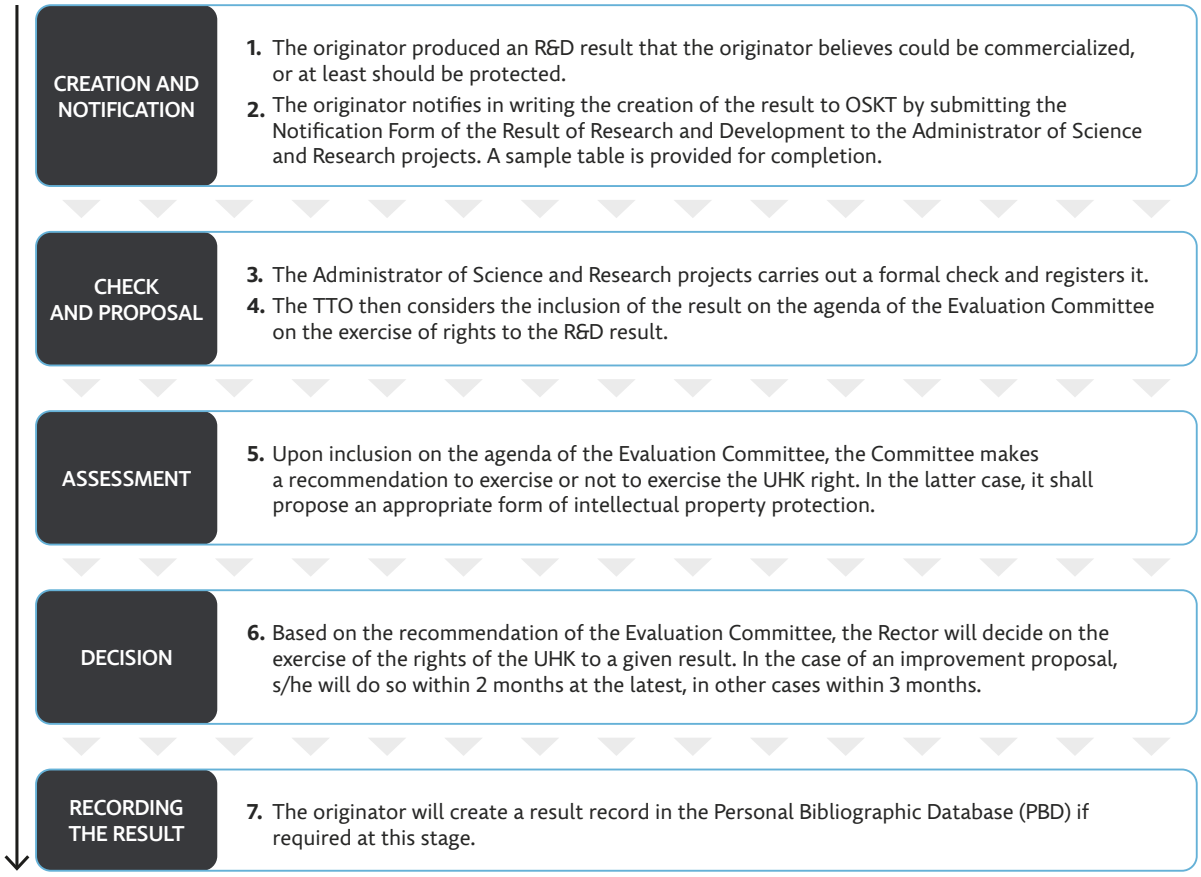
contributions) through the sale of certified materials and services to exclusive licenses and the creation of new organizations. Each case is then evaluated on the basis of various criteria, such as goal, justification, investor, benefits, application, market competition, etc. The individual criteria are scored and the result is a score value that can be used as part of quantitative decision support. It is clear from this description that the decision-making process for technology transfer should include several basic steps. Different approaches can be found in the professional literature. For the purposes of this monograph, the general steps are highlighted, which can certainly be used in various instances for individual decision-making processes associated with technology transfer: 1. Identification of the decision; 2. Collection of information; 3. Identification of alternatives; 4. Determination of decision criteria; 5. Weighing the evidence (critical thinking); 6. Choice of alternatives; 7. Implementation of measures; 8. Control of the effectiveness of the decision. Several problems may arise in the decision-making process. The first pitfall is connected with the amount of available information. These can be either too many or too few. If there is a lot of information about a problem, it can lead to confusion or misunderstanding. An important part of the decision problem can then be inadvertently omitted due to information overload. On the other hand, with little information, we can know in advance that an appropriate decision cannot be made because we do not have all the necessary aspects that influence or determine the decision and its consequences (Garg, 2017). Another problem in decision-making can be the inability to understand the nature of the problem. This is especially the case when we do not determine the cause of the problem or all the aspects that are affected by this situation. Even if we take all the steps correctly, get all the relevant information and take all the criteria into account, the result of the decision may not have the expected effect. Therefore, it is important to objectively evaluate the expected result and analyze its effectiveness after the decision has been made (Hargraves et al., 2019). It is also very important to take the specifics of a particular case into account. If there is a decision problem that needs to be solved as soon as possible, a different approach should be taken compared to a problem that can be solved in a long-term perspective. Consideration should also be given to what might result from a potential bad decision, whether it is just a delay in the deadline or a slight increase in cost. In the case of technology transfer, these are problems that can be accepted in some cases.

# The process of Knowledge and Technology Transfer at university – best practice

It is necessary to establish a clear and transparent process for originators in the academic environment. It is advisable to visualize this process and introduce it into the common processes that are applied at the university. For clarity, it is useful to describe the process in a structured way so that it is clear what the university employee is expected to do to become an originator of employee work. The Science and Knowledge Transfer Office (OSKT) and the Technology Transfer Office (TTO) are particularly helpful in this matter. The different stakeholders involved in this process (e.g., the OSKT, the Dean of the Faculty, the head of the originator's department, etc.) may have slightly different responsibilities at each university or their tasks may be arranged in a slightly modified order. The following stakeholders are involved in this whole process:

- Originator – a natural person in an employment or other similar employment relationship with the university who has participated in the creation of the object of the industrial property.
- OSKT – a coordinator of the whole process (ensuring the protection of the intellectual property and the implementation of all identified activities necessary for the commercialization process).
- The Intellectual Property Evaluation Committee (hereafter referred to as the "Evaluation Committee"), assesses the quality of the notified result and recommends exercising or denying the rights to the result. It also proposes the appropriate form of intellectual property protection.
- Commercialization Board – among other things, assesses the applied results, whether or not they should be commercialized.
- Rector – decides whether the university will exercise the rights to the result.

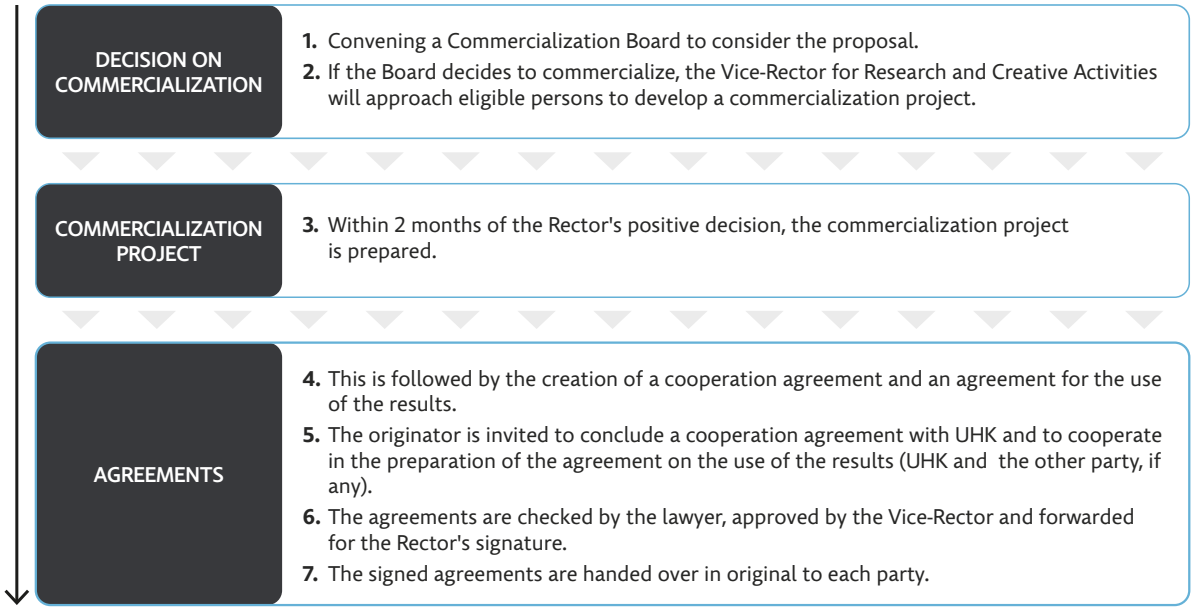
## The proces of Technology Transfer in five stages




This step does not end the whole process, but in fact, it is only just becoming more realistic, as the result is officially taken under the administration of the university and the chosen forms of protection need to be written up in compliance with formal criteria and filed with the relevant industrial property office (patent, utility or industrial design, or trademark) or registered in the Personal Bibliographic Database – PBD (software, functional sample or

prototype, etc.). In this step, the result is further implemented and refined can be submitted to the Commercialization Board (hereinafter referred to as the "Board") for consideration whether or not to commercialize the result.

The steps are as follows:




In the case of exercising the right of the UHK to the R&D result, the originator is entitled to a one-off remuneration according to Rector's Decree 17/2020. The remuneration shall be divided among any co-inventors according to the share of the originator stated in the R&D result notification. The decision of the Rector of the UHK to grant the remuneration for the exercise of the UHK right to the R&D result is preceded by the approval of the Vice-Rector for Science and Creative Activities. The reward will be paid as part of the salary. Its amount depends on the type of result, the share, the point value in a given year, and, in general, on the internal regulation of the Criteria for the Evaluation of Research Work at the relevant faculty.

The process itself is described point by point and summarised below:

1. Once an employee has achieved a research and development result that s/he believes may be commercializable, or at least should be protected (so as not to alienate an idea that may be transferable in the future),
2. s/he must notify the TTO in writing of the creation of such a result by submitting a fully completed form entitled "Notification of the R&D Result" ("Notification").

   The employee has a duty to the employer to notify this and becomes the originator of the result.

## Spin-off – definition, development, support

If we are to talk about effective technology transfer and its setting at the university, it is necessary to talk about spin-off and spin-out. A brief overview and characteristics are given in this methodology. IO3 deals more with this topic. An output that is also part of the project.

One of the most important parts when carrying out transfer tasks consists of determining how can we obtain profit from the product. Obtaining profit is quite important since it allows the creation of new job positions and allows the researchers to carry out more research on their expertise topic or even open new lines of investigation. In order to achieve these economic goals, it is important to know how we can commercialize the resulting products of the research. In addition to making the product profitable, an appropriate marketing campaign allows the researcher to make the product available to the public. This is very important if the results of the research are to be exploited and bring benefits to society. The creation of a spin-off also allows the population to associate the product with a company and makes the consumer-vendor relationship more stable and profitable. Commercialization of research results has become increasingly important for universities worldwide. These can be available to other entities to obtain financial benefits. The goal of commercialization is the practical implementation of the developed research result to meet the requirements of modern markets and the needs of business and industry. As such, the product of this commercialization is the transformation of knowledge and intellectual property into new products, technologies, services, and organizational solutions.

There are many ways to commercialize a research result. The establishment of a spin-off company is one of them. The concept of the spin-off is mostly associated with universities or other research institutions that carry out research and development. Spin-offs are established for the purpose of transferring the results of their research into the market. Although the decision to commercialize such research results through the establishment of a spin-off depends on the capabilities of an individual university or research institution.

Spin-offs are simply businesses (in most cases spin-offs are businesses, though they can have other legal forms) that use the research results of universities for the purpose of their commercialization. However, this mechanism is more often used in cases, where the successful commercialization of a research result is not certain and where it provides a possibility of involving an inventor or researcher in the commercialization process.

The literature dealing with the issue of spin-offs provides several definitions, each focusing on a different aspect of this concept. Therefore, it is very difficult to find a clear and uniform definition of a spin-off. However, it can be agreed that the term spin-off is not limited only to companies established at universities or research institutions, but also to companies established in the environment of business firms. However, the focus of this chapter is mainly on university spin-offs.

According to the Cambridge dictionary, spin-off is a new business created by separating part of a parent organisation. Merriam-Webster defines spin-off as the distribution by a business to its stockholders of particular assets and especially of stock of another company and also as the new company created by such a distribution.

According to the economic encyclopaedia Euroekonom, spin-offs are organisational units, companies that are created based on the separation of a certain activity or group of people from the primary organisation. A university can also be such a primary organisation. At the same time, however, it is true that the primary organisation generally maintains a dominant influence

on the activities of the newly founded organisation. Spin-offs, which are set aside at a university or a research and development organisation of the state sector, are created for the purpose of commercialising the results of research and development.

The Slovak Center of Scientific and Technical Information (www.cvtisr.sk/en.html?page_id=58) understands spin-off as a business legal entity established for the purpose of using and developing the intellectual property of the university up to the form of a product or service applicable in the market. Intellectual property (mostly the result of research) is provided to the company through a license agreement or sale. The university may or may not own a property share in the spin-off, the company, on the other hand, may agree with the university on the use of its laboratories or the provision of services. The innovators (researchers) of the relevant intellectual property usually also participate in the company's activities.

A spin-off usually refers to a separate company established in order to bring a technology or other invention developed by a parent organisation to the market. A conventional spin-off company can be created through the separation from a parent organisation which contributes with its financial, human and intellectual capital. The mission of such spin-off is mainly to further develop and commercialise the technology created at and assigned by the parent organisation. Together with the relevant intangible asset, the parent organisation also transfers the obligations and risks associated with the commercialisation of the intellectual property to the new legal entity. However, a spin-off can also be a company established, usually by a person external to the parent organisation, with a view of exploiting the intangible asset licensed by the parent organisation.

From these definitions, it follows that a spin-off company is a commercial company founded by a parent organization in order to simplify the commercialization of its research results. In most cases, the organisation establishes a spin-off company together with its employees, Ph.D. students or students who participated in the research, or external researchers who participated as inventors of such research results. A spin-off can also perform various activities depending on the intellectual property rights made available to it by the parent organization. Most spin-off companies cooperate with the parent organizations from which they were created. The cooperation may have a form of a search for business partners for the purpose of producing a product prototype, or the granting of a license for the production and sale of products in order to resolve the protection of intellectual property unless the necessary protection for the markets to which the products are to be introduced has been ensured. The task of the spin-off company is to ensure business activities associated with the granting of a license and the search for partners who would be interested in it, or even the production and sale of products themselves.

Types of spin-off companies

**1. Spin-off company with the participation of a research organization and another entity**

This type of spin-off company envisages the participation of a research organization that has a majority or minority stake in the newly formed company. The purpose of this form is mainly the association of capital, often intangible (research results), by the research organization and monetary by the investor or investors. Both employees of the research organization

and persons from the investor or other technology companies (e.g., an experienced CEO) tend to be involved in the company. The advantage of this solution is the division of risk and control over the emerging entity, as well as the financial and business know-how acquired through cooperation with a private entity.

**2. Spin-off company with 100% ownership of a research organization**

In terms of legal requirements, this is a more flexible form of setting up a company to be an extended arm of a research organization. However, it always depends on the setting of internal rules that determine what is necessary to take such a step. It is possible to establish this type of company without the actual entry of the investor. He will enter it later, when the company "proves". The advantage of this variant is the absolute control of the research organization over the emerging company.

**3. Spin-off company without the participation of a research organization**

In the last type of newly established company, the research organization has no share at all, but can be founded, for example, by its employees. The establishment takes place in cooperation or with the knowledge of the research organization and is accompanied by mutual agreements between the emerging company and the research organization. The reason for the non-participation of a research organization in a spin-off company may be the reluctance of the research organization due to the risk of investment, administrative complexity or the effort to motivate employees by participating in the emerging spin-off company. The advantage of this variant is its low risk for the research organization. The option with the participation of an external investor is advantageous for the research organization mainly due to financial support and a better starting position on the market in relation to competitors. The disadvantage is, of course, a certain dilution of shares and thus decision-making rights and the consequent limited influence on the management of the new company. For example, an investor may exchange key positions (CEO, CFO, etc.) for which, for example, the university may not have suitable candidates.

Establishing a company without the participation of a research organization has the advantage that the business risks and administrative burden do not lie with the research organization itself. The risk may be a potential conflict of interest between the research organization and the interests of the employees who founded the new company.

| | **Spin-off** | **Start-up** |
|---|---|---|
| Origin (Created by) | University | Outside University |
| Technology/IP | Owned by University | Developed and owned by start-up or licensed to start-up by University |
| Managed by | University Staff | Outside University |

*Table 3: Spin-off vs Start-up, Source: WIPO*

## Fab Lab as an effective tool for Technology Transfer

Fab Lab from the English Fabrication Laboratory is an open high-tech workshop for the public (usually for registered members paying contributions to the running of the workshop) and a training center in the field of modern technology. The purpose of Fab Lab is to make otherwise very expensive machines and technologies available to early stage scientists, companies, students, etc., and to provide them with appropriate training and education for mastering given technologies. Fab Lab provides tools, space to create, machine operator training, technical support, and educational events for brokers (individuals using technology and creative thinking to create).

Fab Lab is usually based on the principles of sharing know-how, open-source. In addition, modern European Fab Labs strive for maximum urban independence, in-house production, and ecological thinking with maximum waste reduction.

The purpose of Fab Lab is to connect students, universities, companies, and other workshops.

Fab Lab provides an environment for student projects, and beginning entrepreneurs and seeks to bring the university and private spheres closer together. Sharing know-how between universities, workshops, and other entities is also a prerequisite.

Fab Lab should better prepare students for the job market, which is now closely linked to modern technologies (such as 3D printing, IoT, robotics, automation, drones, digitization, and other related areas) and connect more the student sphere and the practical requirements of today's companies. Another goal is to support students in the opportunity to start their own companies and provide the necessary support for starting their own start-up. Thanks to the available technologies, students can implement their ideas without major initial investments. **It seems that role of Fab Labs in the spin-off support chain is significant.**

## Proof of Concept as an effective tool for Technology Transfer

Proof of Concept is a very important step in the whole process of founding spin-off companies and has a key initiating role.

Proof of Concept, also known as proof of principle, is a realization of a certain method or idea in order to demonstrate its feasibility, or a demonstration in principle with the aim of verifying that some concept or theory has practical potential. A Proof of Concept is usually small and may or may not be complete. (definition by Wikipedia)

Proof of Concept activities: these are such activities performed with a result of research and development, leading to a practical, at least partial verification of the contribution and practical function of the result of the research and development, or which lead to an increase in the quality and therefore also in the value of the information on the result of research and development. This is usually the production of a functional sample, or its partial development, verification of some production principles and possibilities of production, implementation of certified and independent measurements and tests, testing functional sample in practice or simulated operation. Proof of Concept (PoC) is finding out if a product is feasible and if it has any hope of entering the market. There are several key questions that

need to be answered. Is your idea practical? Does it really bring unique value to the target group? Will users really want to use your product or service? For what price? Proof of Concept is one of the basic components of the Lean Start-up approach – a methodology that all developers should follow for start-ups to get the idea to a successful start.

Why do university need a Proof of Concept? The main purpose of implementing Proof of Concept is to verify that the product concept has a real chance of surviving in the market. The PoC's output is basically "yes" or "no," which is why many entrepreneurs are reluctant to embark on it, fearing that their beloved product idea might end before it even begins.

You can have a fascinating spin-off idea in your head and your colleagues and acquaintances can appreciate it and considered it as important and valuable. But if you avoid that key PoC "looking in the mirror", you can never be sure that your idea for the app is technically feasible and will be well received by the market. In 2019, UHK succeeded in applying for financial support from the Technology Agency of the Czech Republic in the GAMA 2 project to support increasing application potential of research and development results – Proof of Concept, which aims to support systems of transfer of new knowledge funded by public funds in research organizations and their successful application in practice.

An example of best practice is the GAMA project. Thanks to the GAMA 2 project (Running by Technology Agency of the Czech Republic), a unified system of commercialization was set up at UHK, and thanks to the implementation of this project, the processes associated with the selection of PoC projects with high potential for practical application were initiated. Thanks to the project, the staff of the Science and Knowledge Transfer Office of the UHK had the opportunity to set up optimized intellectual property protection processes in the first year. As part of the implementation of the GAMA 2 project, the potential of technical solutions at all UHK workplaces was captured in 2020. The potential of commercially applicable science and research outputs within the entire UHK was thus very effectively activated. Thanks to the GAMA 2 project, a total of 15 sub-projects with significant commercial potential were supported at UHK. In the coming years, in which we expect the final results of the outputs of sub-projects, it is planned to apply the results at the international level.

Proof of Concept is a very important step in the whole process of founding spin-off companies and has a key initiating role.

Based on experience at UHK there are determined four stage of Proof of Concept.

## Key stages of Proof of Concept

| Stage | Question |
|---|---|
| **I.**<br>Demonstration of the need | • Is there demand driven by market? Why? Before start thinking about the details of your solution, first invest time and energy in a thorough examination of the specific problems of the target group or its various segments.<br>• Identify the problem to be solved. Identify the group of people which is affected by this problem. Define the trouble people face and honestly think about whether this is really something you need to come up with a new solution.<br>Methods:<br>• Literature research<br>• Multi-criteria analysis<br>• Questionnaires<br>• In-depth interviews<br>• Statistic evaluation: Advanced statistical methods and Excel and SPSS<br>• Case study |
| **II.**<br>Connect issues and solutions | • Brainstorm with team about possible approaches to solve the problems you identified in the previous step. When you come up with a new solution for each problem, describe their technological viability, the unique value they have to bring, the cost and time required.<br>• The result of this step should be a list of problems linked to a list of the best solutions, all of which are so feasible and useful that it is worth including them in the final product.<br>Methods:<br>• Get feedback on practical benefits – Commercialization committee<br>• In-depth interviews with stakeholders on the market<br>• TTO´s feedback |

| | |
|---|---|
| **III.**<br>Get feedback on practical benefits | • Go back to your target audience and go through the solutions came up with to make sure they really bring them the value they want.<br>• Is this really an effective solution to the problems? Are your solutions practical, useful and convenient? Test your assumptions properly and try not to be influenced by enthusiasm for solution. If the draft proves useless for your target, take a step back.<br>Methods:<br>• In-depth interviews<br>• Industry committee |
| **IV.**<br>Cover practicals | • Look at solution mainly from the perspective of end users.<br>• Before move on, once again consider the technical feasibility and financial sustainability of the solutions. Think about the skills and capacities that will be needed, the source of income, pricing policy and promotion of the final product. Try to come to terms with all the obstacles before you take the next step.<br>Methods:<br>• In-depth interviews<br>• Industry committee<br>• Prototyping committee<br>• Case study<br>• A synthesis of the findings I.–III. mentioned above<br>• Prepare for prototyping |

*Table 4: Key stages of Proof of Concept*

In seed phase of development, the start-up company is usually already legal founded (in the Czech Republic it is usually a s.r.o. form), and the main topic is the introduction of a product, service or technology to the market. The development of technological devices occurred at this stage for prototype production or technology verification. It is formalized description of the innovation. This phase is characterized by teamwork, by developing prototypes, entering the market, looking for support mechanisms such as accelerators, technology parks and incubators, and by finding investors whose capital is needed for further business start-ups. For most start-ups, this is the stage highly uncertain and also where a large number of start-ups fail. In this phase, as a rule, there is the first investment (the so-called seed capital). These

are the funds necessary for the start-up company and product launch. Main capital providers at this level are Venture Capital funds, private investors or groups may also appear. In Europe, these are usually investments from 250,000 up to millions of EUR. The concept of Venture Capital is in the Czech environment more broadly understood as a medium to long-term capital invested in the form of capital entry into the company. For the investment the fund acquires a share in the company's share capital and jointly together with financial resources, he also provides professional assistance to the company (principle of so-called "smart money"). Most valuable for cooperation with the investor is his experience with company development, financial advice, and contacts in the business. The investment itself often may be less important than valuable investor advice and help in creating a business plan, including relevant contacts and active contribution in acquiring new customers. Venture Capital is usually allocated to small companies with exceptional growth potential or companies which have grown rapidly and appear poised to continue in expansion. Although it can be risky for investors who invest funds, the potential for above-average returns is attractive. For new companies or businesses that have a limited operating history (up to two years), financing with Venture Capital is becoming increasingly popular – even essential – as a source for raising capital, especially if they do not have access to capital markets, bank loans or other debt instruments. The main disadvantage is that investors usually acquire capital in the company and therefore have a major say in the management of the company. Another method of financing in this part of the development is crowdfunding. This method of financing is becoming more and more popular and widespread. This is a method of financing in which a greater number of individuals contribute a smaller amount to the target amount. This is what happens on crowdfunding servers (aggregators) that allow you to search for supported projects and invest in them. In practice, we can encounter two types of crowdfunding financing: in the form of a share in the supported company, the right will be in the future share in the profit, or especially for smaller projects is possible to choose a variant in which it is possible to choose a project and based on financial support to receive compensation in the form of a service or product. Crowdfunding platforms include in the world, for example, Kickstarter or Indiegogo, several can also be found in the Czech Republic, such as Fundlift, Penězdroj, Startovač, HitHit, Kick.me and more. It is also possible to use bank financing for the seed phase instruments, banking investments, and loans. Many banks are targeting directly to the financing of start-ups, so it is appropriate to use specialized offers.

A feasibility study, sometimes also referred to as a technical-economic study, is a document that describes the investment plan in summary and from all implementation-relevant points of view. Its purpose is to evaluate all implementation alternatives and assess the feasibility of a given investment project, as well as to provide all the basis for the investment decision itself. In principle, the feasibility study should be as comprehensive and coherent a description of the project as possible. For this reason, it is logically one of the main information sources for project evaluation, whatever the structure of the criteria is. At a general level, the content of the feasibility study can be defined using the following thematic blocks:

- technical and technological solutions,
- project organization and management, including personnel solutions,

- questions of demand for the service and product and its supply, substitutes for the service or product provided, product, price, promotion, distribution, etc.,
- effect on the environment,
- other essential characteristics of the project and its surroundings (legal solution, political support, ...),
- financial plan (analysis) of the project,
- analysis of socio-economic benefits and costs of the project (qualitative assessment, quantitative assessment, CEA, CBA),
- risk management (analysis and solution of risk).

In most cases, the feasibility study is required as part of the annex to the application for support from EU structural funds through individual operational programs. But there is no need to perceive it only as a mandatory supplement. The feasibility study contains systematically arranged information needed for the overall evaluation of the project. It summarily describes the investment plan from all points of view relevant to implementation. It has the task of evaluating various alternatives, assessing the feasibility of a given investment project and providing the basis for a decision. It is a tool for assessing project proposals, especially from an economic and technical point of view. The goal of the feasibility study is therefore to verify whether the best possible option has been chosen, whether the necessary financial resources for the implementation of the project have been well estimated, whether the long-term sustainability of the investment has been demonstrated and risks have been identified.

The feasibility study should evaluate the project in the following areas based on various criteria:

- technical solution of the project,
- market analysis,
- financial analysis,
- economic analysis,
- analysis of the project's impact on the environment,
- analysis of the impact of the project on human resources and relevant target groups.

Each analytical result should contain possible risks and, if possible, also a proposal for their elimination or reduction. Processing the study is based on the data of the already processed project or business plan and other information sources (technical project, construction and project documentation, EIA study, and others). The feasibility study requires the involvement of experts from the fields of law, the environment, economics, financial analysis, marketing, quality management, and others depending on the focus of the project. One of the basic conditions for selecting projects for grant allocation is the condition that the study must be prepared at a professional level and must contain all the required information and parts, including annexes and additions. The scope of the study is not mandatory.

The feasibility study is a tool for justifying the project proposal, especially from an economic and technical point of view.

Its aim is to verify whether:

- the best possible option was selected,
- the necessary funds for the implementation of the project were accurately estimated,
- the long-term sustainability of the investment has been demonstrated,
- risks have been identified.

In some cases, even before a full-scale feasibility study is developed, it is appropriate to develop a preliminary feasibility study. A preliminary feasibility study differs from a feasibility study by the level of detail and provides only framework data at lower costs and in a shorter time frame, or focuses only on a certain area. Rather, it has the character of an ideological intention, which is very valuable for the framework formation of the basic direction of the project, and its creation will save a lot of effort in creating a full-fledged study.

## The feasibility study as an effective tool for Technology Transfer

A research project is a scientific endeavor to answer a research question. Research projects may include:

- Case series
- Case control study
- Cohort study
- Randomized, controlled trial
- Survey
- Secondary data analysis such as decision analysis, cost effectiveness analysis or meta-analysis.

From a feasibility study perspective, the goal of risk management is to increase the project's chance of success. It is important to eliminate those risks that threaten the success of the project and can lead to the financial instability of the company. Risk analysis should not be taken as just another section of feasibility study. It should consider the risks in all parts of this study, from the beginning of project preparation until the final decision on its acceptance or rejection. Identification of risk factors is demanding and mostly takes place on the basis of knowledge, experience, and intuition of workers participating in the project. Workers' experiences with others projects implemented in the past are of great importance. For long-term investment projects that are financially demanding, the risk area is particularly important.

**The 3 parts of feasibility study:**

- Technology Considerations
- Product or Service Marketplace
- Identification of Specific Market.

**Types of feasibility studies:**

- Technical feasibility

- Economic feasibility
- Operational feasibility
- Legal feasibility
- Schedule feasibility
- Project scope
- Current analysis
- Requirements.

A very suitable form for verifying the feasibility is the Proof of Concept. See more information in the following chapter.

A feasibility study helps to answer the following questions:

- Is the project feasible?
- Can it be done? Should we proceed with the proposed project idea?
- Does it make sense?
- Should we proceed with the proposed project idea?

A feasibility study should be conducted to determine the viability of an idea BEFORE proceeding with the development of a business.

This activity takes place during the project initiation phase and is conducted before the project is implemented.

The study needs inputs from many professional disciplines from various areas of the study.

Feasibility studies can **identify the logistical, financial, and market challenges of a proposed project** by evaluating: what is the estimated fund of the project, when the potential business will offer a return on investment, the market for the proposed product or service.

Proof of Concept activities: these are activities carried out with a result of UHK research and development, which lead to practical, at least partial, verification of the contribution and practical function of the result of research and development, or which lead to an increase in the quality and thus also the value of the information about the given result of research and development. This usually involves the production of a functional sample, or its partial development, verification of some production principles and possibilities of production, the performance of certified and independent measurements and tests, and testing functional samples in practice or simulated operation.

## Education as an effective tool for Technology Transfer

Appropriate and sufficient education is a very important pillar for the development of technology transfer. It is appropriate that each academic level has an adequate educational course in this area. It is especially important to focus on young researchers or Ph.D. students. Furthermore, it is appropriate to include less formal education formats in the educational curriculum, for example a summer school focused on technology transfer.

A participant who completes the technology transfer course should gain knowledge, skills and competencies that will give him/her a clear understanding of the university intellectual property protection options, commercialization opportunities, knowledge of internal process setups, and the ability to decide what type and how s/he prefers to protect in terms of intellectual property.

Specifically, s/he will acquire the following knowledge:

- after completing the course, the student will have an overview of the possibilities of financing the creation of R&D outputs from public and private sources,
- s/he will be able to distinguish aspects of the types of protection of the R&D output, and in addition s/he will gain knowledge of the requirements for the output,
- s/he will know the different forms of intellectual property protection,
- during the course, the student will gain knowledge of the process of commercialization of the R&D output from various forms of cooperation with the private sphere to aspects of establishing a spin-off company,
- s/he will be familiar with the process of technology transfer at home university,
- s/he will know possible forms of commercialization, possible options for establishing a company and creating business plans, the necessary steps that lead to this,
- s/he will know the possible business models that could be considered for their product,
- s/he will gain an overview of the basic methods of valuation of the R&D output (or company) in relation to its market potential as a guidance for choosing a suitable option for transfer and commercialization.
- S/he will acquire the following skills and competencies:
- s/he will be able to distinguish and decide on the potential type of legal protection of intellectual property,
- s/he will be able to deal with the basic legal documents relating to the establishment and operation of different legal forms of business,
- s/he will be able to develop a business plan,
- s/he will be able to evaluate an investment based on the use of relevant methods,
- s/he will be able to complete an application for IP, as well as to address competent persons at UHK for further solution of the given question,
- s/he will be able to clearly present the essence of their innovative project, discuss the risks of the selected form of IP and commercialization options,
- s/he will be able to detect and deal with the project weaknesses, strengths, opportunities and risks.

# Fundamental pillar for Technology Transfer

Based on the joint work of the working group, which is the part of the project and preparing effective methodology for the setting of technology transfer at the university, the following points were highlighted:

## Five fundamental pillars

1. Preparation of an environment to ensure education at all levels (students, Ph.D. students, young researchers, experienced and senior researchers) in the field of technology transfer, intellectual property protection and spin-off establishment.
2. Building a network of external experts who can effectively evaluate the potential of R&D results at UHK and will further be able to effectively help with commercialization (it is not possible to ensure it in-house, it is necessary to build a network of external experts).
3. Supporting the replace ability of key personnel following R&D results with commercial potential.
4. To ensure the solid need analyses of regional as well as national companies, through external entities.
5. Digitization of the whole process of announcing research results.

## Action plan

- University have to prepare comprehensive education in the field of intellectual property for students, doctoral students and researchers. In this way, education in the field of intellectual property will be achieved, a university will ensure a quality educational base for doctoral students, researchers and academics. A university will prepare education in the form of a flexible course in this area, which will be available to all the above-mentioned target groups. This course will be differentiated according to several knowledge levels and will thus suit different research groups according to the degree of expected involvement of workers in the application and commercialization of R&D results.
- Intensification of cooperation with the private as well as the public sector in research and development activities of an expanded volume of contract research and applied research, incl. higher applicability of its outputs in the form of commercialization.
- A university will provide professional advice in the field of legislation and financing of spin-off companies.
- A university (possible through an external entity) will scan company's needs in its region and then will follow by an analysis of areas suitable for cooperation.
- A university will establish cooperation with min. two companies that have an international scope, identify their needs and propose an action plan to involve a university in solving these needs.

- A university will have to map all potential areas at individual faculties for the development of Proof of Concept projects.
- The TTO will have employees who are well experienced and skilled in the areas of intellectual property protection. It will ensure their regular professional education.
- The TTO will establish cooperation with experts who know key companies, have an established network of valid contacts and are able to mediate a quick and effective evaluation of the Proof of Concept projects at UHK, in the next phase leading negotiations with the company regarding terms application of R&D results. These experts will not be employed in-house, but will be hired for specific cases of implementation of R&D results, especially where is seen and expected a real potential and impact in the commercial sphere.
- Top management have to support the sale of intellectual property licenses – actively participate in the communication between industry commerce and academia.
- The TTO will have to map intellectual property at a university and have to evaluate licensing potential. TTO will involve also external experts in the field in this process.
- High priority has the involvement of social and humanity sciences in the field of knowledge transfer with the support of multidisciplinary connections, especially the humanities in connection with IT.
- The TTO, in cooperation with external experts, will ensure regular evaluation of the Proof of Concept potential.
- The TTO will map areas suitable for cooperation with companies and prepare a clear, updated catalogue of services that UHK can offer to the commercial sector within the framework of R&D.
- The TTO will monitor research directions, obtain information from relevant entities on the market.
- With regular contributions and information in various media and other channels, UHK ensures the visibility and promotion of UHK research results.
- A university will organize min. once a year events as "Business meets Science" or "Transfer Days", which will primarily be aimed at regional companies. This concept lays the foundations for joint activities, knowledge transfer and joint research projects between companies and university. These events will be designed and implemented in close cooperation with local business networks. These concepts will be applied as part of the conference of Hradec Economic Days HED.
- The TTO fully digitizes the entire process of announcing research results.
- The TTO selects suitable areas for multidisciplinary linking of humanities and IT disciplines.

## Indicators

***"If you can't measure it, you can't manage it."***

***Peter Ferdinand Drucker**, an Austrian-American management consultant, educator, and author, whose writings contributed to the philosophical and practical foundations of the modern business corporation.*

- The number of researchers, including B.Sc., M.Sc., Ph.D. students, who successfully complete a professional course focused on technology transfer and are able to answer key questions related to the area of technology transfer and commercialization after passing it
- The number of newly established collaborations with national and international companies
- The number of organized "Business meets Science" or "Transfer Days" concepts
- The number of submitted projects focused on research and development of new products, production processes and services, thanks to which companies will establish themselves in new (especially foreign) markets
- The number of successfully obtained Proof of Concept grants
- Volume of contract research
- The number of successfully sold licenses
- The number of newly established spin-offs
- The number of research projects involving not only senior researchers, but also young researchers and students
- The number of outputs in the media that present a university as a driver of innovation in the region, which will increase the visibility of UHK research results
- Creation of an updated catalogue of a university services and research for companies
- The number of research tasks in which key UHK employees participate in cooperation with young researchers
- The numbers of newly engaged researchers
- The number of entrepreneurs involved, as mentors or experts for evaluating the opportunity of market application of start-up projects
- Number of cross-sectoral projects that use synergistic effects and multidisciplinary projects

# Conclusion

Technology and knowledge transfer knowledge is a set of activities and processes that lead to the costing of knowledge outcomes of universities and other research organizations on the market. These are mainly results of research and development (R&D); however, the transfer of knowledge includes other outputs of universities that can be commercialized in the form of providing various professional services by selling intellectual outputs to industry. Based on need analysis which was made among all three partners, transfer of knowledge is very

important and each researcher and also students, especially Ph.D. students, should know about the possibilities of bringing the intellectual outputs to the industry. With this topic come various problems and tasks which must be effectively solved.

The document looks at the overall perception and understanding of technology transfer in university environment, spin-offs, describes the key considerations related to spin-off creation at university, motivation and management, provides an analysis of the data obtained from the partner universities and introduces a methodology for spin-off creation. The document also looks at some of the key motivational mechanisms to foster entrepreneurial thinking within the academic environment and contributes to spin-off creation. The main keys were identified the following ones:

- Motivation
- Network analysis
- Teamwork
- Leadership
- Decision making
- The process of knowledge and technology transfer at university – best practice
- Spin-off – definition, development, support
- Fab Lab as an effective tool for technology transfer
- Proof of Concept as an effective tool for technology transfer
- Key stages of Proof of Concept
- Proof of Concept as an effective tool for technology transfer
- The feasibility study as an effective tool for technology transfer

Based on the findings of all top management members of the participating universities, the following recommendations were summarized for successful technology transfer:

- improve the management of academic spin-off companies at the management level,
- set up technology transfer center – partly in house and partly external experts for specific task,
- use analytical tools for better understanding internal connection in cross-sectoral university research,
- set up technology transfer course according to academic level,
- set up summer school as non-formal education in the field of technology transfer,
- make motivation for the researchers to participate in technology transfer,
- set up budget for Proof of Concept,
- built solid need analyses on Proof of Concept,
- universities must show appreciation of their work and their business risk,

- establish at the university level the rules, which include all aspects of academic spin-off firms such as conflict of interest regulation,
- different way for licensing and for spin-off – recognition at the beginning of whole process,
- building Fab Lab as a part of the university environment,
- access to innovation incubator for 12 months free for promising project ideas,
- build independent research unit driven by industry demand,
- ensure cooperation between industry and academia,
- improve academic mobility from research center to cooperate with Fab Lab and research unit,
- improve the distribution of revenue from sold licenses and increase value assets in spin-off companies, incentives for setting up spin-off companies, better respect to the faculty in the distribution (e.g., laboratory equipment),
- demonstrate to the faculties' staff that spin-off companies also bring benefits to them.

In the ongoing process of globalization, human capital is undoubtedly gaining importance as a source of innovation and intangible intellectual property (IP). Knowledge management is part of the development of human resources and the development of their tacit knowledge in particular. Research institutes and universities are an important basis for unique IP, where these subjects are almost existentially dependent on the effective development of people and the management of related resource processes. In addition, interaction with the commercial world is constantly gaining importance as a tool for increasing the competitiveness of individual regions. At the top management level of universities, its representatives have the opportunity to use several tools and thus support effective technology transfer. The aim of the presented document is to present these tools, show examples of good practice and provide practical instructions. The methodology brings the results of the working group, which consists of members of the university top management – the three project partners – University of Hradec Kralove (as a coordinator), University of Granada and Technical University of Kosice – with the overall aim to improve knowledge and share experiences in the area of academic spin-off creation.

Output includes the defined main pillars of effective and successful technology transfer, an action plan, as well as indicators that will make it possible to clearly measure whether the action plan is being fulfilled. The presented methodology is a suitable tool for managing technology transfer and can help university management to manage, evaluate and strengthen the benefits arising from research activity and transform them into commercializable results.

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**Attachment:**

Notification of the R&D Result

| **NOTIFICATION OF THE R&D RESULT** | | |
|---|---|---|
| | To be completed by the originator | Explanations of TTO |
| **1. Name of the result** | | |
| **2. Field of the result** | | |
| **3. Originator and co-originators, the share of intellectual contribution of each co-originator** | | |
| **4. Contact person authorized to act for the co-originator** | | |
| **5. Description of the result** | | |
| **6. Description of the research and scientific work carried out on the result, including information on the time and place of achievement of the result** | | |
| **7. Advantages of the result compared to the status quo** | | |
| **8. Disadvantages of the result compared to the status quo** | | |
| **9. Potential use (areas, stakeholders, demand)** | | |
| **10. Method and time of publication of the result** | | |
| **11. Demonstration of novelty** | | |
| **12. Readiness for use (steps to be taken for practical use, description of follow-up research and development)** | | |

| | | |
|---|---|---|
| **13. Proposed method of protection or contractual use and features of the new solution to be protected or used** | | |
| **14. Related project (if subsidy or support has been provided)** | | |
| **15. Supporting materials to be attached (texts, drawings, graphs, performance data, reports, agreement between co-originators)** | | |