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TECHNOLOGY TRANSFER MANAGEMENT

Learning Module

Integrating Talent Development into Innovation Ecosystems in Higher Education

586227-EPP-1-2017-1-BG-EPP

INNOTAL

Table of Contents

The module introduces the basics of technology transfer and diffusion. It builds learners' skills to assess real technologies for their commercial potential. It also provides introduction into licensing agreements and the role of Technology Transfer Offices at universities. It is thus intended to develop knowledge and skills for co-creation in innovation.

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Introduction/ Syllabus

AIM OF THE MODULE

The focus on this module is Technology Transfer Management (TTM). The module assists the participants to develop their understanding of, and skills and competencies in, technology transfer management. The module is thus designed to enhance the innovation potential of the participants and the university as a whole.

WHY TECHNOLOGY TRANSFER?

Technology transfer is the process of transferring scientific, intellectual, research and technological outcomes of universities, and know-how related to them, to the society through licensing, or through start-up and academic spin-off activity. Therefore, technology transfer management assists in identifying, productising and disseminating promising research outcomes, university innovation and know-how to the benefit and use of society, forming academic-business partnerships, creating new start-ups and academic spin-offs, and immersing university students in real-life based training and learning. This process is thus a key element in helping universities serve their 'third' mission (next to the traditional two missions of teaching and research), namely to address society and its competitiveness, job creation and growth.

TARGET GROUPS

The target groups of this module are higher education students, teaching staff and research and development staff. The module also invites stakeholders to take part in various exercises performed in the learning process.

OVERALL STRUCTURE AND THE SPECIFIC LEARNING AIMS OF THE MODULE

The Technology Transfer Management module consists of five lectures organised in a constructive manner: the first discusses what technology transfer is, why it is useful and what the Technology Transfer Offices are. This is followed by a lecture on market and risk management, which deepens the understanding of the importance of market orientation of the inventions, of the different ways to assess markets. It also explains how market assessment is part of risk assessment. The third lecture discusses technology management, invention and the impact analysis of inventions. The fourth lecture discusses intellectual property issues. The last, fifth, lecture focuses on licensing and other considerations for commercialisation. Hence, the module prepares the learners for the process of forming a start-up or an academic spin-off, or licensing an invention to an established company.

LECTURE OUTLINE

Lecture 1: Technology Transfer

The aim of this lecture is to develop and increase learners' understanding and competences of the basic building blocks and concepts of Technology Transfer, why to engage in Technology Transfer, what is the role of Technology Transfer Offices, and what are technology transfer strategies, as well as to prepare the learners to apply this knowledge in practise.

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The lecture is divided into the following sections:

- What is Technology Transfer and why to engage in Technology Transfer
- Technology Transfer Offices
- The Technology Transfer process
- Technology Transfer strategies

Lecture 2: Market and Risk Assessment

The aim of this lecture is to develop and increase learners' understanding of the importance of market assessment as part of a successful product launch and risk assessment, and to increase their competence in using different aspects of and tools for market assessment, including market assessment during the product development process, in the technology transfer process and in a classical market assessment.

The lecture is divided into the following sections:

- What is market assessment and why is it needed?
- Markets and operators on markets
- Market assessment process
- Risk analysis

Lecture 3: Technology Management, Evaluation and Impact Analysis

The aim of this lecture is to develop learners' competences in evaluation and impact analysis of inventions in technology transfer. It provides an introductory understanding of how to review possible IP candidates for transfer, readiness and customer fit, and what are the main tools used in the process.

The lecture is divided into the following sections:

- What it is technology management, evaluation and impact analysis
- Definition of the organisation's technology transfer / patent portfolio
- Evaluation of Technology Transfer Readiness
- TRL - Technology Readiness Levels
- CRI - Commercial Readiness Index
- DRL - Demand Readiness Level
- Success factors in Technology Transfer Projects

Lecture 4: Managing Intellectual Property Rights

The aim of this lecture is to develop learners' competences in the area of Intellectual Property Rights. The lecture provides knowledge about what

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Intellectual Property Rights are, how they are formed, who has to protect them, how they are protected, and how they are related to universities and technology transfer. Learners will thus be able to choose the right solutions for the outcomes and to address Intellectual Property issues before, during and after a research project impacting technology transfer.

The lecture is divided into the following sections:

- What are Immaterial Property Rights?
- The Benefit of Intellectual Property Rights
- Forms of Intellectual Property Rights
- Intellectual Property Rights and Openness
- Managing Intellectual Property Rights from the Idea to Invention and Licensing

Lecture 5: Considerations for Commercialisation - Licensing

The aim of this lecture is to develop learners' competences in the area of commercialisation via licensing. The lecture will provide introductory knowledge about advantages and disadvantages of licensing forms, license agreements and negotiations in the technology transfer process.

The lecture is divided into the following sections:

- What is commercialisation – licensing?
- What can be licensed?
- Why license?
- Disadvantages of licensing
- Licensing agreements and negotiating

STRUCTURE OF THE LECTURES

Each lecture is divided into nine parts:

- Introduction to the lecture
- The main content on the topic
- Suggestions on further reading
- Summary of key points
- Case studies/ real world examples
- Assignments and exercises
- Test using multiple choice questions
- Bibliography
- Glossary

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GUIDELINES FOR THE DELIVERY OF THE MODULE

This module can be delivered through blended or virtual training. The preferred option in blended learning as it encourages discussions and workshop activity in exercises. Discussions through practical examples and reflections are suggested besides the lecture content. Use any current topics and literature as adding to training. Use reflection after each part of the lecture.

The following method is suggested for blended learning:

- Pre-assignment task (self-study): getting acquainted with the case study examples of the topic
- Face-to-face sessions:
  - Start with discussing about the case study examples and move on to the theory, continuously encouraging dialogue to increase self-reflection and form a deeper understanding of the topic. The professor/teacher can add more examples from his/her own country, referring to familiar companies (of any size) or current events
  - Exercises: group work using creative, practical and design thinking methods* is advisable for most exercises, as it would allow learners can ask for support if needed and learn from each other. This will prepare them for individual exercises. If possible, try to engage TT office staff, start-ups, researchers or companies in the exercise workshops. You can organize additional workshops on real cases as the most advanced level of exercises.
- Homework
  - Exercises: some of the exercises can be given as homework
  - A test can be performed at the end of the module sessions in class or as homework. Use supportive feedback method.
  - Suggested reading as homework. The learners can also write essays on the topic, using the available literature

The following method is suggested for virtual learning:

Use a virtual learning platform or create such for the module course. It should enable online chats and discussions and delivery of the exercises. The exercises are to be delivered through the learning platform where the teacher can create assignments, upload examples and additional materials on the training platform. The main differences are:

- Pre-assignment task (self-study): can be discussed at the first virtual session.
- Face-to-face sessions to be replaced by virtual sessions while using the same methods. This might require more individual processing of the exercises. Virtual group work is still encouraged, as well as real-life group work whose results the

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students can submit through the platform. Enable voting and chat possibilities. One option is to record the sessions and have all training delivered online, with chats only taking place on the learning platform.

* A guide to design thinking in education for higher education teachers: www.d-think.eu/uploads/1/6/2/1/16214540/dthink_toolkit_en.pdf

MATERIAL ADAPTATION TO THE NEEDS OF PARTNER COUNTRIES

The main adaptations and suggestions are:

- Reflecting on own country's IPR in general, considering whether it is an open or more restricted IP model.
- Reflecting on innovation and technology transfer policies in the country, as well as the particular university's collaboration with stakeholders
- Market assessment methods: considering the possibility to turn a large population into an advantage in technology transfer processes
- Market assessment: reflection on cultural dimensions in inventions in different market areas and how the income level can influence the adaptation of inventions in different countries
- Applied use of information in a creative and practical way are suggested, as they increase knowledge retention

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Technology Transfer

ANNOTATION

This first lecture introduces the basic building blocks and concepts of Technology Transfer (TT). The lecture looks into the motivations to engage in TT within an organisation and among individual researchers. It will familiarise the earner with different methods and mechanisms of transfer. An example of a simplified process overview is also depicted to see how research results turn into industry application via a transfer process. The lecture also makes a brief introduction to the basic two strategies of Technology Transfer (push and pull).

The lecture is divided into the following sections:

- What is Technology Transfer and why to engage in Technology Transfer?
- Technology Transfer offices
- Technology Transfer process
- Technology Transfer strategies

WHAT IS TECHNOLOGY TRANSFER AND WHY TO ENGAGE IN TECHNOLOGY TRANSFER

Technology Transfer (TT; also Transfer of Technology and Technology Commercialisation) is the process and mechanism of transferring accumulated knowledge (research results, skills, technical knowledge, prototypes, inventions, materials, manufacturing methods, trade secrets, etc.) developed by a specific entity, person or organisation that owns or holds it, to another person or organisation. In the process, the scientific and technological developments become accessible and available for further utilisation or commercial development for new products, services, processes, materials, etc. by the receiver. In the case of a technology, an innovation occurs when a successful commercial exploitation follows the creation.

In many universities and public research institutions the commercialisation of public research is a key function. Knowledge and research generated by public research system diffuses through a variety of channels. These channels are also complemented by public-private partnerships, open science initiatives and entrepreneurial channels.

The transfer is usually achieved in two ways - through licensing of intellectual property (patents, trademarks, copyrights, etc.) to established corporations, and the formation of new start-up companies around the technology.

The activities in a TT spectrum can be viewed broad or narrow and include various aspects and functionalities. Technology residing in each of the respective areas can enter an organisation via different mechanisms. In the broad sense, the expanded spectrum of Mechanisms of Transfer can include e.g. the following:

- Scientific publications
- Joint research partnerships and collaborative research and development

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- Contractual research and development
- Consulting (technology transfer via consultancy and expertise)
- Seminars and conferences
- Equipment hire
- Material testing
- Intellectual property rights (IPR) licencing
- Business incubation and the formation of Spin-offs and academic Start-ups

WHY ENGAGE IN TECHNOLOGY TRANSFER?

It is important to understand that organisations engage in technology transfer for several different reasons. The reasons might also be different inside and between an organization's own research departments. The motivations also differ on the individual researcher level.

For the research institution, the reasons for TT can be for example profit making, i.e. earning money from public research, securing return on research investment, obtaining financial and/or research autonomy, or it can be to achieve more impact with research focused on societal challenges, economy, and environment.

The economic interests in technology transfer are usually motivated by either enhancing the economic development by transferring new technologies to local industries or by obtaining financial support from industry to support university programs. Monetary gains can be for example royalties from licenses to university intellectual property or monetary return from equity holdings in start-up / spinout companies formed around university intellectual property. Reasons beyond economic gains can also be significant – examples can be many, such as increasing interaction with the industrial community leading to increased quality of research, obtaining industrial support for university research or gaining support from the central and local governments for university research focused on supporting economic development.

On the other hand, individual scientists engage in commercial activity with a variety of motives. Many do so for reputational and intrinsic reasons. The reasons that motivate researchers to engage in technology transfer and research commercialisation can be broadly divided into 3 categories: financial rewards, reputational/career rewards and intrinsic satisfaction. A policy to encourage commercial engagement should be built on reputational and intrinsic incentives rather than purely focus on creating financial motivations.

The reasons for engaging in TT might include the following:

- Prototyping and development of life-changing innovations
- Making a positive impact on society

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- Supporting research credibility
- Identifying ways to disseminate non-patentable ideas
- Developing academic-corporate alliances with institutions and conducting ground-breaking research projects
- Supporting regional economic growth and new job creation
- Attracting research sponsors
- Finding channels to utilize and nurture the talent of staff, faculty and students
- Helping to give birth to new start- ups via business incubators
- Providing substantial revenue for universities (valid in cases such as MIT or Stanford)

As TT is an activity with two parties involved - the originating and receiving organisations, industry clients' motivations to engage in the process should be understood equally well. From the technology receiver point of view, transfer can be utilised for e.g. acquiring efficiency, business profitability and market share or in an effort to gain a potential competitive advantage. Business and transactor efficiency are among the reasons for the transfer. Product quality, customer satisfaction, and increasing technological competencies are the main reasons for an enterprise to transfer technology.

TECHNOLOGY TRANSFER OFFICES

Technology transfer offices (TTOs) are responsible for technology transfer and other aspects of the commercialisation of research that takes place in public research organisations or universities' research departments. Primarily, the TTOs act as a transmission channel between research and market environments and industrial enterprises. Several ways of function and a spectrum of services are usually available in different universities. The key activities of a TTO generally consist of methods to capture ideas and inventions, evaluate their potential and business viability and to protect, licence or commercialise intellectual property in a variety of ways. In addition, the TTOs have a role in injecting industry and market insight, trends and indications arising from the market and industry into research activities. They also function as advisers to support the top management of research institutions.

Oftentimes, the bulk of activities of Technology Transfer Offices are related to "Technology or R&D Push" based activities. Many offices also integrate or collaborate closely with business incubators to support start-up activities. The main activities of a TTO are to identify and capture inventions, protect and commercialise them.

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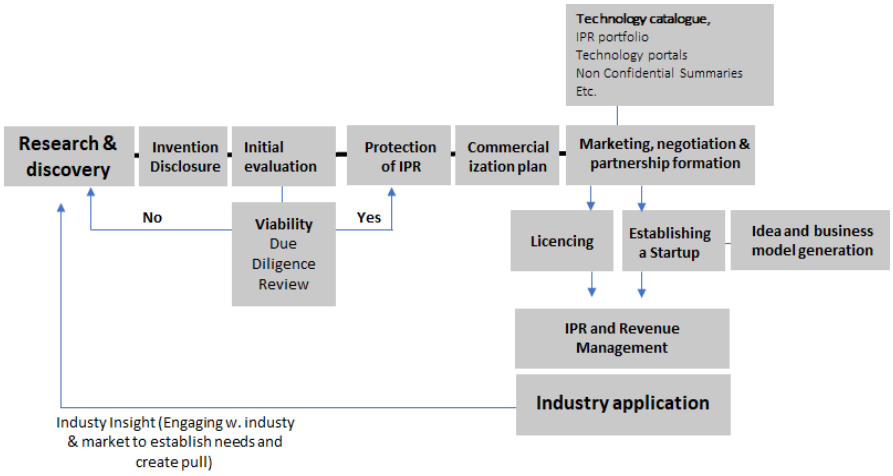
TECHNOLOGY TRANSFER PROCESS

The technology transfer process can be viewed from two angles; the originating research institution and the receiving organisation. There are four basic stages of technology transfer: research and selection, measurement and acquisition, adaptation, and implementation. The technology to be transferred is first investigated and a detailed study is carried out. This study can include multiple dimensions. The market assessment is viewed in detail in Lecture 2 and Technology impact and readiness are covered in Lecture 3.

First, this lecture looks into the basic activities of a transfer process viewed from the Technology Transfer Office point of view. Invention and discovery by the researchers and inventors form the basis for creating transferable IP (Intellectual Property). In the university settings this work is done by the faculty, staff and students. The universities operate various functions and activities depending on the TT goals and maturity level of the process. Next, a brief broad overview of a TT process is introduced. Specific aspects and details on the process are covered in more detail in the following modules.



Invention Disclosure

A technology transfer process usually starts with an invention disclosure that includes a detailed description of a novel invention. The disclosure explains how it is created and how it can be reproduced, who are the inventors, etc. The description also explains the importance of the invention, how it improves on current designs, and what differentiates and distinguishes the invention from other prior art.

Definition: Prior art (state of the art), in most systems of patent law, is constituted by all information that has been made available to the public in any form before a given date that might be relevant to a patent's claims of originality. Prior art means any evidence that the invention is already known.

An in-depth invention disclosure allows the TTO to evaluate if there exists any monetary value in the invention, and to aid in the selection of tools for IP protection and commercialisation. It also establishes a

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formal record of the invention. The innovation closure exists as separate document from possible lab notebooks and other documentation and is often done with a standardised disclosure form.

Preliminary evaluation and assessment

A preliminary viability evaluation is usually undertaken on the basis of the innovation disclosure. The TTO can also meet with the inventor(s) to discuss the details of the invention. The evaluation can include multiple aspects, for example:

- Innovation; novelty and benefit over existing technologies
- Current development status and future development plans
- Resources needed for further development
- Intellectual Property status and prior art, patentability or suitability for other forms of IP protection
- Marketability and market demand of the outcome, product or service
- Potential applications and possible corresponding markets and cooperating partners/customers
- Market size and growth potential
- Competitors, competing products and possible competitive edge over existing solutions and technologies
- Agreements or competing rights to the innovation, possible funding received linked to the invention.

Protection of IP

If the initial evaluation shows potential, the TTO applies for a suitable IP protection. To benefit from the invention, safeguarding of the Intellectual Properties with protection is usually mandatory. The protection for an invention can be achieved with various methods: by applying or registering patents, trademarks, utility models, designs, or non-registered copyright and trade secret. (See Lecture 4 for more details on IP protection.)

Commercialisation plan and Marketing

After the protection of the IP is complete, a plan is formulated for the marketing and commercialisation of the technology. There are multiple routes to commercialise. Organisations usually have existing industrial partners to engage with and often maintain supporting Technology Portals, Catalogues and collected IPR portfolios with non-confidential summaries available on technologies offered.

Licencing and Start-up formation

Two main routes to commercialisation are licencing and spinoffs, i.e. establishing a start-up company. Often the organisation has existing connections with industry and the innovation IP is marketed to already

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established companies. This route benefits from established position in the market and existing resources, experience, distribution channels and similar. If it is not feasible to licence to an already established company, the second route is to create a new start-up around the innovation. Universities often run start-up incubators to support early stage development and offer diverse services e.g. offering co-working spaces or offices, mentoring, idea sparring, access to funding, business consulting.

Commercialisation, development and IP/Revenue management

Successful technology transfer leads to industry adoption and application. From the TTO this also requires a varying degree of transfer management related to the actual transaction to the receiving organisation, depending on the type of technology and mechanism of transmission. IP and revenue management are discussed more in the Technology Management section.

TECHNOLOGY TRANSFER STRATEGIES

A well-defined strategy can be the key factor for successful technology transfer. In this lecture, two main types of TTO strategies (directions) that have been used by national R&D facilities are described. Push and Pull models define TT strategy. The Push model focuses on finding industry applications and destinations for suggested technology transfer. The Pull method focuses on identifying market demands and deeper collaboration with the industry to create a circular model of transfer.

Push and Pull

1. Active - Push Transfer Strategies

An active or 'supply-push' model means that a technology holder or a supplier initiates the

technology transfer and then pushes technology toward the market. Application of this strategy starts by identifying an innovation or an IP from an independent inventor and then marketing it to a manufacturer (i.e. the innovation, associated market needs and business opportunity). The innovation is then transferred from source to destination with a suitable transfer mechanism.

2. Passive - Pull Transfer Strategies

In contrast to the push strategy, a demand-pull transfer strategy is characterised by actively seeking industry insight. This model means that a technology transfer process is initiated by whatever entity is seeking a solution to satisfy demand. The buyer or user of technology defines the attributes of technology to create demand. Companies' capability to articulate their technological needs are important for demand-pull technology transfer. A passive strategy, or a response to a 'pull effect', requires information circulation and also understanding the customer or user needs. The process starts by identifying one or more market needs or requirements. After this, a manufacturer (destination) is

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made aware of the market need. A solution is then sought to address this need (source). The innovation is then transferred with an appropriate transfer mechanism from the source to the destination.

Pull model of Technology Transfer challenges the traditional view

The traditional understanding of Technology Transfer - "Supply-Push" - is often described as assuming that prioritisation, development and evaluation of technology portfolios allows us to identify potential technology applications, and, by applying suitable protection mechanisms and marketing potential, buyers of the technology can be found. The "demand-pull" approach challenges the settled logic of starting technology transfer work with the categorisation and prioritisation of technology and IPR portfolios, and the development emphasis on technology catalogues and portals. Instead, the approach suggests to start with the industry and market needs by conducting a categorisation and prioritisation of product/process improvement needs. The approach also puts emphasis on a deeper engagement and co-creation with the industry. The outcome, unlike generating technology portfolios, aims to develop industry/market needs catalogues, articulated in a form that the scientific community is able to understand. Defining specific industry challenges helps inject industry insight and needs into university research, creating a circular model of Technology Transfer. These industry needs can arise from a multitude of motivations, e.g. scientific changes, market and competition, legislation, human inquisitiveness or innovation as company policy.

FURTHER READING

- Lam. A. (2011). What motivates academic scientists to engage in research commercialisation: 'Gold', 'ribbon' or 'puzzle'? Research Policy, 2011, vol. 40, issue 10, 1354-1368.

This paper employs the three concepts of 'gold' (financial rewards), 'ribbon' (reputational/career rewards) and 'puzzle' (intrinsic satisfaction) to examine the extrinsic and intrinsic aspects of scientists' motivation for pursuing commercial activities

- IP Handbook. Concept Foundation, PIPRA, FIOCRUZ and bioDevelopments-Int. Institute. http://www.iphandbook.org/handbook/

Prepared by and for policy-makers, leaders of public and private sector research, tech transfer professionals, licensing executives, and scientists, this online resource offers up-to-date information and strategies for utilising the power of both intellectual property and the public domain.

- Velasco, F. (2017). Re-thinking Technology Transfer. (2 May 2017). https://fvelasco.com/re-thinking-technology-transfer/

The article describes the Pull Model of Technology Transfer. It argues that Technology Transfer should be understood as a circular process, where the focus shall be placed on the "demand" side and the market needs.

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- Grange, L.I. & Buys, Andre. (2012). A review of technology transfer mechanisms. The South African Journal of Industrial Engineering. 13. https://www.researchgate.net/publication/228890533_A_review_of_technology_transfer_mechanisms

SUMMARY OF KEY POINTS

- Technology Transfer is the process of transferring technology from the person or organisation that owns or holds it to another person or organisation. TT occurs along various axes: among universities, from universities to businesses (and vice versa), from large businesses to smaller ones (and vice versa), from governments to businesses (and vice versa), across geopolitical borders, both formally and informally, and both openly and surreptitiously. It includes the flow of any ideas: technical knowledge, data, designs, prototypes, materials, inventions, software, trade secrets from one party to another. In the context of research institutions, it is the process whereby new inventions are created in those institutions' labs and are converted into a product and commercialised.
- Technology Transfer can have many forms
- Reasons for engaging in TT can vary across organisations and individuals
- There are several transfer methods
- Push and Pull models define TT strategy. The Push model focuses on finding industry applications and destinations for suggested technology transfer. The Pull method focuses on identifying market demands and deeper collaboration with the industry to create a circular model of TT.

CASE STUDIES / REAL-WORLD EXAMPLES

- Studies in Technology Transfer

Selected cases from Argentina, China, South Africa and Taiwan Province of China. 2014. UNCTAD Current Studies on Science, Technology and Innovation N.7

https://unctad.org/en/PublicationsLibrary/dtlstict2013d7_en.pdf

- University technology transfer office success factors: a comparative case study

York Anne S. & Ahn, Mark 2012, Int. J. Technology Transfer and Commercialisation, Vol. 11, Nos. 1/2, 2012

https://www.researchgate.net/publication/264820471_University_technology_transfer_office_success_factors_a_comparative_case_study

- Technology without borders: case studies of successful technology transfer

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International Energy Agency; United Nations Energy Programme and Climate Technology Initiative (2001). Technology without borders: case studies of successful technology transfer. Organisation for Economic Cooperation and Development (OECD), Paris.

http://oro.open.ac.uk/56009/1/IEA_Technology_Without_Borders.pdf

- A Technology Transfer Framework: A Case Study from the Energy Sector

JoaoR. Lavoie, Jisun Kim,and TugrulU. Daim - International Journal of Innovation, Management and Technology, Vol. 8, No. 4, August 2017

http://www.ijimt.org/vol8/737-M753.pdf

- Case studies at Laser Interferometer Gravitational-Wave Observatory (LIGO)

https://www.ligo.caltech.edu/mit/page/technology-transfer-case-studies

- A Case Study of Technology Transfer Process in a Government Research Organisation in Sri Lanka Darshana Mudalige, Perera H.S.C (2011)

The purpose of this paper is to identify and discuss the critical elements of a successful technology transfer process of a research organisation by exploring the technology transfer process adopted by a leading government research institute in Sri Lanka.

https://www.researchgate.net/publication/273629620_A_Case_Study_of_Technology_Transfer_Process_in_a_Government_Research_Organisation_in_Sri_Lanka

PROPOSED ASSIGNMENTS AND EXERCISES

Start by structuring your understanding by drawing a mind map on the topic of Technology Transfer activities.

Further exercises:

- How can TT benefit your organisation and what motivation does your organisation have? Define why is your organisation engaging (or planning to engage) in TT activities?
- Do different departments share a common perspective or hold a different view on the definition of TT and the objectives of TT activities? Map out different views and identify shared and different aspects and motivations in your organisation. How can you integrate possible differing views in TT definition, activities or objectives?

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ASSESSMENT

Multiple choice test	
Question 1: The main tasks of a Technology Transfer Office are:	
Answer 1	Identifying inventions
Answer 2	Protecting innovations
Answer 3	Commercialising inventions
Answer 4	None of the above
Answer 5	Producing inventions
Correct answer(s)	1,2,3,
Question 2: Technology transfer can be used to transfer	
Answer 1	Research results
Answer 2	Skills
Answer 3	Technical knowledge
Answer 4	Prototypes
Answer 5	Inventions
Correct answer(s)	All 1-5
Question 3: The emphasis on these two specific activities differentiate the Pull model of Technology Transfer from the Push model:	
Answer 1	Creating Technology Catalogues
Answer 2	Developing IPR portfolios
Answer 3	Identifying industry / Market needs
Answer 4	Co-creation with enterprises
Answer 5	Establishing new start-ups
Correct answer(s)	3, 4
Question 4: Mechanisms of Transfer can include e.g. the following:	
Answer 1	Seminars and conferences
Answer 2	IPR licensing
Answer 3	Scientific publications
Answer 4	Consulting
Answer 5	Joint research
Correct answer(s)	All (1-5)

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Question 5: What a technology transfer process starts with?	
Answer 1	Research definition
Answer 2	Portfolio review
Answer 3	Foreground definition
Answer 4	Invention disclosure
Answer 5	Copyright definition
Correct answer(s)	4

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GLOSSARY

Technology Transfer	Technology Transfer (also Transfer of Technology and Technology Commercialisation) is the process and mechanism of transferring accumulated knowledge (research results, skills, technical knowledge, prototypes, inventions, materials, manufacturing methods, trade secrets, etc.) developed by a specific entity, person or organisation that owns or holds it, to another person or organisation. As a result, the transferred scientific and technological developments become accessible and available for further utilisation or commercial development for new products, services, processes, materials, etc. by the receiver.
Technology Transfer Office	Technology transfer offices (TTOs) are responsible for technology transfer and other aspects of the commercialisation of

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	research that takes place in public research organisations or universities' research departments. Primarily, the TTOs act as transmission channels between research and market environments and industrial enterprises. Several different ways of functioning and spectrums of services are available at different universities.
Invention Disclosure	A technology transfer process usually starts with an invention disclosure that includes a detailed description of a novel invention. The disclosure explains how it is created and how it can be reproduced, who are the inventors, etc. The description also explains the importance of the invention, how it improves on current designs, and what differentiates and distinguishes the invention from other prior art.
Push model	Push strategy model focuses on finding industry applications and destinations for suggested technology transfer
Pull model	Pull strategy model focuses on identifying market demands and deeper collaboration with the industry to create a circular model of transfer.

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Market and Risk Assessment

ANNOTATION

One of the biggest risks of any product and invention is its inadaptability to markets and to use. Market assessment is a method to identity the need and suitability of an invention and product to markets. Therefore, it is also an important part of risk management. In this lecture you will learn what market assessment is, why is it needed who are the operators on markets, what is the market assessment process during the product development process, in technology transfer process and in a classical market assessment, and what tools you can use for market assessment. The final part of the lecture will observe what risk management is.

The lecture is divided into the following sections:

- What is market assessment and why is it needed?
- Markets and operators on markets
- Market assessment process
- Risk analysis

WHAT IT IS MARKET ASSESSMENT AND WHY IS IT NEEDED?

No matter how great the invention is according to science and the inventor, markets may still reject it and find it undesirable. Market assessment is the basis for the success of a product on markets. It helps to identify and understand market opportunities and the added value of a product. Without market assessment, products are more likely to fail. Therefore, each product, invention, service and technology should be subject to market assessment before its launch. Market assessment is instrumental in detecting and estimating potential risks related to the product's entry on the market.

Such an assessment helps to target the products and activities better to specific markets, assists in planning and implementing product strategies, and through more targeted actions, provides savings to the organisation. It is used for analysing the nature of the markets, detecting and analysing risks on markets, and for evaluating the suitability of products on markets. It provides information for market entry, marketing strategies, business model, and commercialisation strategy of a product. It also defines a product's position and role in the organisation's strategies.

Market assessment helps to identify market barriers, i.e. elements that hinder and block a product's entry to markets. These can be, for instance, legal, political or cultural elements, habits, attitudes, values, needs, existing and competing products and technology, or simply understanding of the product and its benefits. For instance, attitudes towards novelties create barriers but also possibilities. Some consumers adapt to novelties quickly while others wait to observe the user experience acquired by others before they trust the product; some warm up slowly to the product, while others will not adopt it at all.

Market assessment can similarly assist identifying market forces. These are organic forces that continuously change markets and customer behaviour, such as prices, supply and demand, trends and external

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phenomena. Market analysis and assessment also assist in defining the right communication towards the customers, decision makers and other related parties.

MARKETS AND OPERATORS ON MARKETS

Markets are where different operators exchange products, services and other solutions against a compensation. Markets can be local, regional, national and international, and they are all connected and influence each other. The core operators on markets are buyers, producers, sellers, distributors, suppliers, traders/brokers, end users, policy makers, and authorities, but also creators and inventors of the product. Universities and researchers can also be market operators. Markets can be business-to-business or business-to-customers. The more complex the buyer-producer chain is, the more complex business analysis and assessment are needed.

Besides operators and the basic nature of markers, there are also market forces and barriers, which are elements that hinder access to markets. All these influence the strategies and actions that the company takes regarding the product.

MARKET ASSESSMENT PROCESS

Market assessment usually begins when the product (tangible or intangible) is ready. However, there are other perspectives on this:

- Market assessment during product development
- Market assessment and technology transfer process
- Classic market assessment

Market assessment during product development

Market assessment can be implemented already during the product development process. For example, user participation in product development and testing helps to eliminate dysfunctionalities of a product, and to see how people use it and what they think of it. The information is used for further product improvement during development. There are plenty of methods to involve users. Besides user testing, one of the most commonly known is co-creation. During co-creation, the users participate in creating the product or a service. In these cases, the legal aspects and the impact of the user participation must be clearly defined. End users can participate in the invention creation process and hence invention assessment process already during the invention development phase.

Market assessment in the technology transfer process

Market assessment in the technology transfer process begins with assessing patentability, that is, technology assessment and evaluation of the invention. At this stage, the invention goes through a detailed process during which the invention's technological potential, novelty and any patent-related issues are carefully screened. If the invention is

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patentable, a patent application is made.

The next evaluation is marketability and commercial opportunities of the invention. This phase uses information from the product disclosure. The aim is also to find the purpose, market need and users of the invention, potential fields of use, and any issues related to patents, such as patent strength and depth, similar, substituting and competing technologies, forms of technology to be used. Based on these, strengths and weaknesses, geographic differences and limitations, right timing potential of the product to markets in relation to trends, and any potential development needs are detected. If ready, the invention will be provided to potential licensees.

A technology transfer office assists with this process in universities.

Classic market assessment

Classic market assessment can be conducted on product concepts and ideas, existing and entering products, but also on inventions during the technology transfer process. Besides the initial stages, it is applied throughout the lifetime of the product.

Different aspects are observed and analysed in market assessment, including the nature, size and conditions of the markets, competitors, replacing and competing products, consumers, consumer segments and behaviour, purchasing power of customers, user orientation, cultural issues, trends, habits and ideologies, the sector, market forces and barriers, risks, opportunities and strengths, environmental and political issues, timing, and the company's own resources and potential. These lead to understanding the market potential, market niche, position and opportunities of a product, review, segmentation and decisions on customers and end users, restrictions and risks related to the product, decisions to take, strategies for market entry and other market activities, and the nature of the messages towards consumers and stakeholders. Market assessment also helps to define the organisation's strategies and understand if and how a product should be modified on a specific market. A product or a service may enjoy high demand in one geographic area, but not in another. It may have to change its form or other elements, such as name, to be approved in specific market areas.

Market analysis can be conducted for business-to-business and business-to-customer products, on different markets (local, national, international to global markets). Research and investigation for market assessment can be both qualitative and quantitative. A variety of tools and methods can be used in market assessment. Herewith we present some of the most common investigation areas:

Customer research

The starting point in consumer research is the consumer's need - the problem to be solved, which the product aims to address. Without a need and consumer-oriented solution to the problem, there are no markets for the product. Different quantitative and qualitative customer

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research methods are used to identify, for instance, consumer categories, demography and segments, habits, ideologies, purchase and consumer behaviour, and consumer needs and geographic variations in consumers, customer satisfaction, reaction on advertisement and branding, customers' ideas on the position of the product or a company among competitors, customer loyalty, and opinions on pricing. Based on the data, consumers can be categorised and segmented to be targeted by specific actions. *User personas* can be used in describing the typical users the product. One should remember that the customer may not always be the end user of the product. Hence, both these groups are subjects of research.

The customer research methods include:

- Surveys - in-person, by telephone, posted questionnaires, online
- Interviews - in-person, phone or virtual
- Focus groups, in a setting or virtual, provide opinions and discuss on open-ended questions on a specific topic
- Observation takes place in location settings and from video data, of which the observer makes notes. Observation focuses on how the subjects behave and use products, and their habits
- Online methods, ranging from online discussion, netnography, data from link clicks, scanner data (e.g. a club card), or social media listening (e.g. times a brand is mentioned).
- Analysing sales data, e.g. sales trends, changes in the interest in a product, etc.
- Physiological measures, e.g. eye movement or emotional response tracking in a laboratory
- Data produced by users and customers, including videos, stories, drawings, probing journals, online reviews, to detect the attitudes, potential needs and ways to use products
- Field trials - testing the product with users in real-life settings. This can be used for concepts and products. Among the methods are e.g. rapid experiments, mystery shopping
- Other methods: e.g. user testing of products during and after development, concept testing during development, co-creation with users during development.

Cultural dimensions

Cultural dimensions are an important part of understanding customers, values, and local laws, conditions and infrastructures. The culture may also influence the adaptation of inventions.

Among the most known cultural frameworks are:

- Geert Hofstede divides cultures into seven dimensions:

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masculinity vs. femininity, low vs. high power distance, individualism vs. collectivism, low vs. high uncertainty avoidance, long-term orientation vs. short-term orientation, and indulgence vs. restraint.

- Inglehart–Welzel cultural map of the world is divided into two axes:
  - x-axis: Survival values versus self-expression values
  - y-axis: Traditional values versus secular-rational values.
- Trompenaars' 7 Cultural Dimensions: universalism vs. particularism, individualism vs. communitarianism, specific vs. diffuse, neutral. vs. emotional, achievement vs. ascription, Sequential time vs. synchronous time, and internal direction vs. outer direction.
- The Lewis model divides countries into linear-active, reactive and multi-active cultures.
- Edward Hall's cultural classification differentiates between high or monochronic cultures, and mono-chronic or multichronic time, high versus low territoriality (need of space), slow vs fast information flow.

Competitor analysis

Competitor analysis is the key to understanding the potential and position of the product and to find its own niche on the market. It should be performed before entering markets and regularly while operating on markets. Issues that can be detected through competitor analysis are competitor identification, classification and market positioning, competitors' offer and promise to customers, promotional and social media activity, marketing strategies, competitor positioning and value, competitors' price, market share, delivery, quality and resources, comparison of competitor's offer versus own offer, but also consumers attitudes, ideas and loyalty towards competitors and awareness of competitors. These will assist to position the product and its offer against competitors' offer and to decide on strategies that can be successfully applied. Different methods can be used to find information. The information can be analysed using e.g. matrices and meters.

The competitors may not always be direct. Indirect competitors from different fields, habits and products also matter. For instance, a preference to drink water instead of soft drinks can be a value-related or health-related choice, and hence water can be a competitor to a soft drink (in addition to other types of soft drinks).

Trend analysis

A trend is a phenomenon in the society with a past, presence and a future. Trend analysis is a forecast method of potential future events and

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movements. Information can be collected and analysed for a long period of time and future events can be predicted based on this information. Although trend development can be followed with a longitudinal study, it is always uncertain. For instance, sudden events may fully change the forecast, such as the COVID-19 pandemic. There are different kind of trends from short-lived crazes (e.g. the toy of a season, such as fidget spinners) to long-lasting megatrends (e.g. the plastic pollution problem). Different methods are used for analysing trends - Delphi, cool-hunting, screening the operational environment, scenario work, road maps, emerging issues, technology scouting wild cards, future's diamonds (R. Popper), and futures wheel.

PESTEL analysis

PESTEL analysis is useful for analysing target markets, and when starting new business in a new region, launching a product, or entering a foreign market. The areas to analyse are Political, Economic, Social, Technological, Environmental and Legal factors (PESTEL). It can be used together with the SWOT analyses and Porter's Five Forces.

P	**POLITICAL**	Government policy, political stability, corruption, foreign trade policy, tax policy, labour law, trade restrictions
E	**ECONOMIC**	Economic growth, interest rates, inflation rates, unemployment rates, exchange rates, disposable incomes
S	**SOCIAL**	Population growth rate, age distribution, career attitude, safety emphasis, health status and consciousness, lifestyle attitudes
T	**TECHNOLOGICAL**	Technology incentives, level of innovation, automatisation, R&D activities, technological change, technological awareness
E	**ENVIRONMENTAL**	Weather, climate, environmental policies, climate change, pressure from NGO's
L	**LEGAL**	Anti-discrimination laws, antitrust laws, employment laws, consumer protection laws

Table of PESTEL analysis summary table by Business-to-you.

SWOT analysis

A SWOT analysis provides a clear picture of an organisation's or product's internal strengths and weakness, as also of external opportunities and threats related to it. It assists in decision making and risk analysis as it shows clearly the functional and non-functional areas of activity or a product. The SWOT themes are organised in a fourfold table as follows:

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STRENGTHS	OPPORTUNITIES
WEAKNESSES	THREATS

RISK ANALYSIS

The information obtained from the market assessment can be used to make a risk analysis. A risk analysis identifies and analyses any potential risks linked to commercial activity, product and markets. It helps in planning and implementing activities for risk prevention, and provides insights about how to act and recover in case of risks. Continuous monitoring and follow-up of risks is part of risk management activities. An organisation should also learn from the risks and exploit this learning in its activities. Risk management should be part of a company's strategy.

Both quantitative and qualitative methods are used for risk analysis and management. Identification, analysis and management processes alone are not enough. A company should also involve the right people into the process and should take into account the potential, events (from natural to man-made), trends and the human factor (consumers and anyone involved in the process), which are the most difficult elements to control.

The phases of risk management are:

- Risk assessment activities

  A set of qualitative and quantitative methods, including for instance, risk maps, data from patenting and market assessment, data from previous and other examples, internal issues related to the company (staff, location…), external issues including stakeholders, social responsibility, and environmental factors and raw materials.

- Risk identification and analysis

  The obtained data is carefully analysed and risks are identified. The risks are categorized according to type, eventuality, size, impact and timing, for instance accentuating the most imminent risks and the risk with most harmful outcomes.

- Risk management plan

  A risk management plan is created based on the results from the risk analysis. It details the activities, resources, monitoring and recommendations regarding risks, including the imminence of risks. The Plan should contain recommendations, guidance and other important elements for the management of risks. It should also point to the need for training and preoperational activities.

- Implementation

  Implementation of risk management takes place in everyday activity of an organisation in different areas of its operations. It

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usually includes risk communication and may include training.

- Monitoring

  Monitoring of risks should be ongoing, with regular evaluation points. Monitoring should lead to risk prevention, activities, changes and learning from risks.

FURTHER READING

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SUMMARY OF KEY POINTS

- Market assessment is needed to ensure the success of a product. Without market assessment, products are more likely to fail.
- Market assessment helps to identify risks and is thus part of risk management
- Market assessment can be applied during the development process, during the technology transfer process, after the product is ready, and it should also be applied at ongoing basis
- Market assessment in technology transfer focuses on the patentability of the invention and on identifying commercial opportunities
- Market assessment is holistic and among the aspects that have to be investigated are products, consumers, markets, competitors, culture, location and climate, but also legal issues.

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CASE STUDIES / REAL-WORLD EXAMPLES

- **Four failed inventions that changed the world**

The following BBC video provides four examples of inventions which failed at the time when they were created but later became extremely important. These tell about the importance of timing, use purpose, user-orientation and presenting and productising the invention to target audiences.

Link: https://www.bbc.co.uk/ideas/videos/four-failed-inventions-that-changed-the-world/p07mdllw

- **How cultural context can change furniture**

IKEA is a globally known furniture and home decoration brand. Its Nordic aesthetics and the functionality of the furniture are appealing and refreshing. Yet, although it has become an icon and a concept, and an object of high desire, cultural adaptation has posed challenges to IKEA. The challenges have not regarded that much the design, but more the houses the furniture should fit and the lifestyle of the consumer markets. Two opposite 'failure' cases of IKEA are Japanese and US markets: the European size furniture was too big for Japanese houses while too small for the US markets. The issue does not only concern what fits into the house, but also about how it matches with the other furniture or even the size of bed linen. Besides furniture size and the overall living culture, the service culture and competitor scenes were different, too. Despite Nordic design being appealing to the Japanese due to its simplified form language, the Japanese have a wide range of companies that operate on the living and lifestyle sector with simplified form language, for example MUJI.

The company adjusted the product offer and services to these target markets, but yet the examples show how important market research and assessment are. Despite being a desired and well-known product, which works as an advantage, the company still faced struggles due to imperfect understanding of local cultures and habits. This highlights the importance of market research and assessment for the invention and for a product in general, as well as for services.

What helped IKEA in the process was its good reputation, high brand awareness and desirable products. It should be remembered that new inventions and products first need to justify their existence, then reassure customers and end users, create positive user experiences, and finally create and maintain brand loyalty, reputation and continuous market need.

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PROPOSED ASSIGNMENTS AND EXERCISES

https://www.academia.edu/5286475/Ikeas_failure_and_success_on_the_Japanese_market_BAMMC-THESIS_BY_ALEXANDRA_STOLBA_Table_of_Contents

Exercise 1: Cultural differences on markets

The aim of this exercise is to screen different markets and consumer behaviour on those markets.

- Select a consumer product which will be the subject of your research. It may be a technological and invention-based product or another kind of product
- Choose three markets which are very different from each other, for example, Argentina, Japan and the UK
- Analyse the cultural aspects affecting the product in each country, using cultural dimensions and Internet search of attitudes, habits and other culture elements. Choose additional elements which are directly linked to the product, for instance, lifestyle and house size issues as on the IKEA case, or attitudes towards what is healthy and what is usually consumed during meals in case of soft drinks.
- Next, analyse each culture using the PESTEL method
- Mark what are the main differences and similarities. What is approved and what is prohibited or not looked at positively?
- Now choose your target market and justify your choice.

Exercise 2: Targeting the market

Use the results from the previous exercise and continue working on them.

- Take the target market you selected in the earlier exercise
- Look deeper into the market and the consumers on those markets. Segment the consumers
- Next, look at your product's competitors and potential and indirect competitors on those markets. Again, remember that indirect competitors may be effecting products in a seemingly completely different category
- Make a SWOT analysis of your product on the market
- Make a fourfold table where you position your product among its competitors. Choose the axis as best serve your purpose
- Think about your selling argument. Write it in one paragraph only.
- Last, make a mood board of your product on the market. A mood board is a collage, a visual presentation that combines

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images, words, other materials and samples to express a particular emotion of feeling. It is useful when identifying brand or product personality on markets.

ASSESSMENT

Multiple choice test	
Question 1: What is not true about market assessment?	
Answer 1	Market assessment is part of risk management
Answer 2	Market assessment is only needed at invention research and market entry phase
Answer 3	Market assessment can involve users
Answer 4	Market assessment should be part of a company's strategy
Correct answer(s)	2
Question 2: What is particular in market assessment of an invention?	
Answer 1	We define market areas to operate on
Answer 2	We carry out consumer research
Answer 3	We define competitors
Answer 4	We define marketability and commercial opportunities for an invention
Answer 5	We involve users in the development process
Correct answer(s)	4
Question 3: Which customer research methods would you use to find as authentic and unbiased information as possible?	
Answer 1	Survey
Answer 2	Interviews
Answer 3	Focus groups
Answer 4	Observation
Answer 5	Physiological methods
Correct answer(s)	4
Question 4: What is the starting point in classic market research and assessment?	

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Answer 1	The invention
Answer 2	The product
Answer 3	The customer's need
Answer 4	A global phenomenon
Answer 5	The company's need
Correct answer(s)	3
Question 5: Which methods would you use for investigating trade restrictions on a specific market?	
Answer 1	SWOT
Answer 2	PESTEL
Answer 3	Cultural methods
Answer 4	Competitor analysis
Answer 5	Customer research
Correct answer(s)	2

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GLOSSARY

Co-creation	In co-creation, users and stakeholders participate together with the developers in the development process of a product, invention or a service. They usually participate in restricted parts of the process, such as e.g. co-creation workshops. The process provides valuable information for development and increases the purposefulness and user-orientation of the outcomes.
Consumer segment	A group of customers with a similar background and interests, e.g. young middle- class families in sub-urban areas.
End user	The final user of a product or a service.
Market barrier	Elements that hinder and block the entry of the product in certain markets. These can be, for instance, legal, political, cultural, or linked to use habits, attitudes, values, needs, as well as existing and competing products and technology.
Market entry	When a product or a company enters the markets for the first time
Market force	There are organic forces that continuously change markets, such as prices, supply and demand, but also trends and external phenomena, which all form an idea of how customers and end-users act on markets.
Stakeholder	Any party that the company deals and operates with. They can be, for instance, clients, policy makers, retailers, suppliers, authorities and financers.
User persona	A fictional character that represents a specific user type or a user group type. A personal description includes, for instance, lifestyle and demographic

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	elements, preferences, pains and gains of the character.

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Technology Management, Evaluation and Impact Analysis

ANNOTATION

The third lecture takes an introductory look into Technology Management with a set of viewpoints: Defining a Technology and Patent Portfolio of an organisation. It also introduces a way to evaluate Technology Management with a set of tools. Technology Transfer Readiness is determined through a set of evaluation methods: Technology Readiness Levels, Commercialisation Readiness Index and Demand Readiness Levels. Lastly, Technology Transfer projects are introduced. This lecture provides an introductory understanding of how to review possible IP candidates for transfer, readiness and customer fit.

The lecture is divided into the following sections:

- What are technology management, evaluation and impact analysis?
- Defining the organisations technology transfer / patent portfolio
- Evaluating Technology Transfer Readiness
- TRL - Technology Readiness Levels
- CRI - Commercial Readiness Index
- DRL - Demand Readiness Level
- Success factors in Technology Transfer Projects.

WHAT ARE TECHNOLOGY MANAGEMENT, EVALUATION AND IMPACT ANALYSIS?

Early stages of Technology Transfer include the identification of appropriate candidate technologies for transfer. To ensure success, determining which research to develop for commercialisation is a critical part of the process. Difficulties in Technology Transfer can arise from not sharing the same culture, goals, modes of operation, time lines and success criteria. Important points to consider about a technology are the ways it fits into the company's current markets, distribution channels and manufacturing capability.

A major challenge is also the lack of practical methods to evaluate Intellectual Property Rights and Novel Technology. TTOs most often encounter this problem in the commercialisation phase. They must manage the different expectations of the inventor and investor, which results in difficulties in mediation. The TTO must keep the industrial partner on board for further development and commercialisation of technology but, as a member of the university body, they are also representing the inventor.

As a result, disagreements about valuations can result in investors being reluctant to commit funds for further exploitation. With an early-stage invention, the commercialisation possibilities and the value of the technology in applications often remain unclear. With early-stage novel technologies, intensive investment and development is often required before transfer or commercialisation is possible. Often, TTOs have limited resources to realize these.

First, the lecture takes a look into defining and organising portfolio

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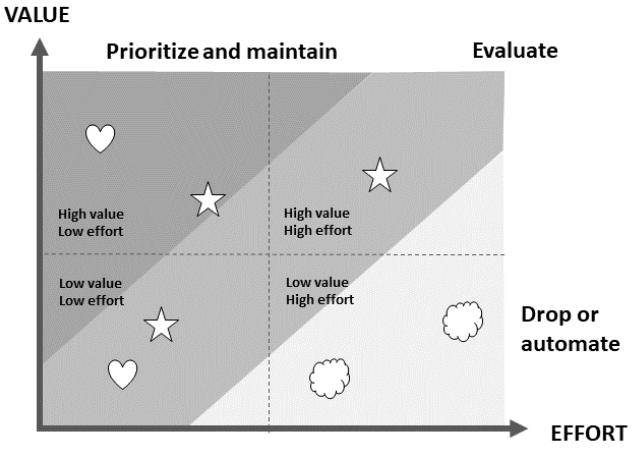
aspects inside the TTO.

Developing frameworks and tools to help assess the likely success of commercialisation efforts is beneficial to both parties of technology transfer.

DEFINING THE ORGANISATIONS TECHNOLOGY TRANSFER / PATENT PORTFOLIO

In the early phases of engaging in TT activities, the organisation's technology transfer portfolio should be audited. A technology audit is a way of assessing IP assets and deciding what should be done with them. An audit also improves the strategic value of the portfolio. It is important to define the potential value and required efforts related to each technology:

- High value: warrants further study and assessment. Actions: license further to new or infringing companies, find new adjacent fields to expand to.
- Low value: Actions: abandon efforts, market passively or automate, possibly develop with low resources. Also note if any fees are related to managing the IPR and decide whether to keep paying the fees or let the registration lapse.



Graph: Portfolio evaluation Matrix

A review of existing portfolio of patents and licenses can be done by using a simple matrix to create a brief evaluation and overview of available IPR assets. This allows for prioritising the portfolio items according to potential value and for directing activities and allocating resources to best suit the potential and resources available. An audit should also be done in conjunction with all new projects to identify what potential IP will be or can be generated and whether it can be protected and commercialised.

As selecting inventions to pursue and integrate into a portfolio can be difficult, information regarding technology business cases is vital. Evaluation should not be undertaken by relying merely on technological details. Also, the actual value and commercial prospects of an early-stage

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and novel technologies are often unknown and negotiation with the investor or receiving organisation are important to find the actual use cases for the technology. This means valuation is often possible only in the context of specific uses.

EVALUATING TECHNOLOGY TRANSFER READINESS

Technology transfers can be complex projects and must often overcome a multitude of technical and organisational challenges. Industry-side evaluation has an aim to select the technology to be transferred in the most appropriate way for the business. Filters to review can include cost, technical competence and suitability criteria. On the receiver side, details on industry or business need, technology readiness, market, innovation costs including marketing are evaluated. From a technical aspect, transferring and implementing the same technology and systems from the originating unit to the receiving unit without any adjustments is not always possible. The receiving unit might not have the required manufacturing and analytical capabilities in place, requiring implementation of new technologies prior to utilisation.

Different methods to manage technology transfer and evaluate Technology Transfer Readiness can be used. Examples include technology reviews, technology space maps and balance sheets, etc. In the context of this lecture, the following stand out as important to understand:

- TRL Technology Readiness Levels
- CRI Commercial Readiness Index
- DRL Demand Readiness Level.

TRL - TECHNOLOGY READINESS LEVELS

TRL originated in the 1970's at the American National Aeronautics and Space Administration (NASA), and began as a means of measuring how far a technology was from being deployed in space. Since then, the process has evolved and is used across a wide range of sectors. TRLs are a globally accepted benchmarking tool for tracking progress and supporting development of a specific technology through the early stages of the technology development chain. They can be used to evaluate the maturity of particular technology and to assess the development status. The tool also supports consistent, uniform discussions of technical maturity across different types of fields and technologies. Examples of the most common uses of TLR at NASA include communication, setting target/success criteria, project planning development, technology selection and portfolio management.

TRL phases:

TRL 1 – basic principles observed

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TRL 2 – technology concept formulated

TRL 3 – experimental proof of concept

TRL 4 – technology validated in laboratory

TRL 5 – technology validated in relevant environment

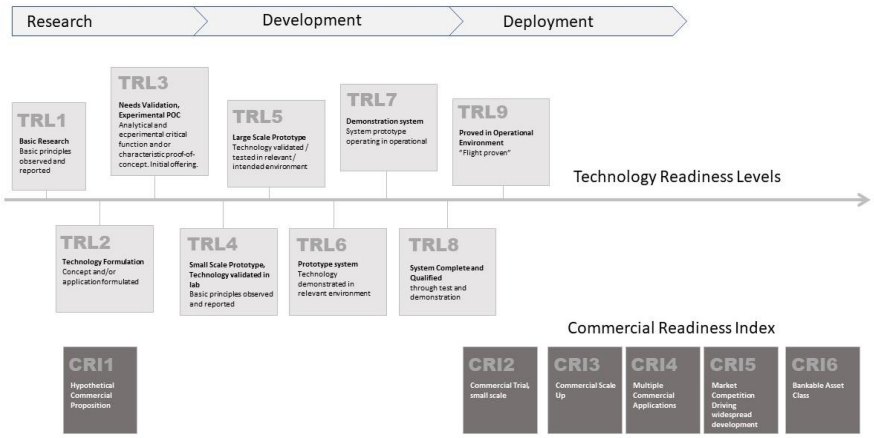
TRL 6 – technology demonstrated in relevant environment

TRL 7 – system prototype demonstration in operational environment

TRL 8 – system complete and qualified

TRL 9 – actual system proven in operational environment

Increasing technology readiness does not mean nearing a successful product. The majority of the technology risk is eliminated when progressing through the TRL stages, but often there remains significant commercial uncertainty even at the demonstration and deployment phase. The TRL can be supplemented with the CRI-model which moves beyond the proof-of-function measured by the TRLs towards an evaluation of commercial readiness.



CRI - COMMERCIAL READINESS INDEX

The CRI framework was developed by the Australian Renewable Energy Agency (ARENA) and aims to complement the Technology Readiness Levels (TRLs) by assessing the commercial maturity of technologies with a six-level indicator. CRI begins once the technology is at the stage where there is research to prove that it is feasible in the field (simultaneous to TRL 2) and extends to when the technology or application is being commercially deployed and has become a bankable

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asset class. The individual levels are described as follows:

CRI 1 Hypothetical Commercial Proposition: technically ready but commercially untested and unproven. The commercial proposition is driven by technology advocates with little or no evidence of verifiable technical or financial data to substantiate claims.

CRI 2 Commercial Trial: small scale, first-of-a-kind project funded by equity and government project support. The commercial proposition is backed by evidence of verifiable data, typically not in the public domain.

CRI 3 Commercial Scale Up occurring, driven by specific policy and emerging debt finance. The commercial proposition is driven by technology proponents and market segment participants. There is publicly discoverable data driving emerging interest from finance and regulatory sectors.

CRI 4 Multiple Commercial Applications becoming evident locally, although still subsidised. Verifiable data on technical and financial performance in the public domain is driving interest from variety of debt and equity sources; however, it still requires government support. Regulatory challenges are being addressed in multiple jurisdictions.

CRI 5 Market Competition driving widespread deployment in the context of long-term policy settings. Competition is emerging across all areas of the supply chain, with commoditisation of key components and financial products occurring.

CRI 6 Bankable Asset Class, driven by the same criteria as other mature technologies. Considered as a "Bankable" grade asset class with known standards and performance expectations. Market and technology risks are not driving investment decisions. Instead, proponent capability, pricing and other typical market forces are driving uptake.

DRL - DEMAND READINESS LEVEL

Often, the TTOs focus just on the TRL scale. Yet the Demand Readiness Level is an additional useful scale to Technology Readiness Level and a tool to hybridize Market Pull and Technology Push approaches. The purpose of DRL is to measure the level of market pull corresponding to the level of technology push. The DRL scale offers a tool to assess the maturity of evolving demands identified by potential innovation actors towards an appropriate stage of conceptualisation of the need in the market. This creates a matching point with scientific research teams that are capable to either propose as solution an existing scientific result through technology transfer process or translate the demand in new R&D projects. The DRL levels are described as follows:

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DRL 1 - Occurrence of feeling "something is missing"

DRL 2 - Identification of specific need

DRL 3 - Identification of the expected functionalities for a new product/service

DRL 4 - Quantification of expected functionalities

DRL 5 - Identification of system capabilities

DRL 6 - Translation of the expected functionalities into needed capabilities to build the response

DRL 7 - Definition of the necessary and sufficient competencies and resources

DRL 8 - Identification of the experts possessing the competencies

DRL 9 - Building the adapted answer to the expressed need in the market.

FURTHER READING

Jagoda, K., Maheshwari, B. & Lonseth, R. (2010). *Key issues in managing technology transfer projects: Experiences from a Canadian SME*. Management Decision. 48. 10.1108/00251741011037747. https://www.researchgate.net/publication/228369799_Key_issues_in_managing_technology_transfer_projects_Experiences_from_a_Canadian_SME

This paper aims to explore and illustrate the technology transfer experiences of a small to medium-sized enterprise using the stage-gate approach to TT as an inquiry lens.

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Article on risk and success factors for transferring technology from one scientific and technological institution to another organisation.

Michael Firgens, M. (2017). *Technology Transfer: What you need for a successful transfer. Biopharma Excellence.* http://www.biopharma-excellence.com/news/2017/4/20/technology-transfer-what-you-need-for-a-successful-transfer

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SUMMARY OF KEY POINTS

- Portfolio analysis helps to direct development efforts. Evaluation needs to be extended to new projects as well.
- Technology transfers can be complex projects that must often overcome a multitude of technical and organisational challenges. Developing frameworks and tools to help assess the likely success of commercialisation efforts is beneficial to both parties in technology transfer. Several tools and frameworks are available to use and integrate when evaluating aspects of readiness, e.g. TRL, CRI, DRL.
- Readiness for transfer can be analysed with several tools and close collaboration with the customer. The TRL, CRI and DRL metrics are overlapping and can be practiced simultaneously. They can be used to measure different maturity aspects of a specific technology.
- Several aspects define a successful TT project. Common themes include sharing and combining knowledge, resources management, collaboration, aligning and managing goals, building trust, persisting and learning. A TT project should always be viewed with profitability and growth as outcomes. The TT initiative should also be analysed in relation to business results, e.g. customer and market expectations. Introduction of new technologies to new market require parallel efforts in market development.

CASE STUDIES / REAL-WORLD EXAMPLES

- **David de Jager (2017)** Commercial Readiness Index Assessment - Using the method as a tool in renewable energy policy design. NEDO / IEA-RETD Workshop http://iea-retd.org/wp-content/uploads/2017/05/170515-RE-CRI-RETD-de-Jager.pdf

This study explores the use of the CRI as a tool to support policy makers to commercialise renewable technologies (RETs)

- **Sune Solberg Hjorth and Alexander Michael Brem (2016)** How to Assess Market Readiness for an Innovative Solution: The Case of Heat Recovery Technologies for SMEs. *Sustainability* 2016,8, 1152; https://www.researchgate.net/publication/309875319_How_to_Assess_Market_Readiness_for_an_Innovative_Solution_The_Case_of_Heat_Recovery_Technologies_for_SMEs
- **Orion Group** Technology transfer: Five rules for success **-** Five rules of thumb for a successful pharmaceutical technology transfer. https://www.orion.fi/en/Orion-group/products-and-services/contract-manufacturing/latest-news/tech-transfer-five-rules-for-success/

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PROPOSED ASSIGNMENTS AND EXERCISES

Structure your understanding of the lecture by drawing a mind map on the topic of technology management.

- Identify success criteria and develop a screening template and a process model outline for your organisation
- Develop a process to audit ongoing projects. How would you do it? How do you identify what project outcomes are wanted and what IP can potentially be protected and transferred (patents, design rights, copyrights, trademarks)?
- Technology Readiness Levels (TRLs) are a way to assess the maturity of particular technology and can be used as a risk management measurement. Familiarize yourself with the TRL method.
- The TRLs can be complemented by using the Commercial Readiness Index and the Demand Readiness Level frameworks. Familiarise yourself with the use and potential application of these in an actual use case in your organisation.

ASSESMENT

Multiple choice test	
Question 1: Utilising the evaluation matrix, dropping an item from a portfolio is advisable for items that are characterised as:	
Answer 1	High Value - High Effort
Answer 2	High Value - Low Effort
Answer 3	Low Value - High Effort
Answer 4	Low Value - Low Effort
Answer 5	All of the above
Correct answer(s)	3
Question 2: TRL is an abbreviation for	
Answer 1	Technology Relocation Letter
Answer 2	Technical Resource Locator
Answer 3	Technology Readiness Level
Answer 4	Technology Ready for Licencing
Answer 5	Technical Reliability Limitation
Correct answer(s)	3
Question 3: Commercial Readiness Index (CRI) is a	

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representation of the	
Answer 1	technical feasibility of a new invention
Answer 2	commercial maturity of a technology
Answer 3	demand for a commercial product or service
Answer 4	commercial potential of a specific market
Answer 5	business viability of a business plan
Correct answer(s)	2
Question 4: The purpose of which framework is to measure the level of market pull corresponding to the level of technology push?	
Answer 1	TRL
Answer 2	DRL
Answer 3	CRI
Answer 4	All of the above
Answer 5	None
Correct answer(s)	2
Question 5: Success factors for technology transfer project include:	
Answer 1	sharing and combining knowledge
Answer 2	good project and resources management
Answer 3	collaboration with all parties
Answer 4	building trust
Answer 5	aligning and managing goals
Correct answer(s)	1,2,3,4,5

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GLOSSARY

Technology Transfer Readiness	Readiness of an invention to be transferred into practise, use, markets, other parties, etc. Technology readiness has different dimensions.
Technology Readiness Levels	Technology Readiness Levels (TRL). TRLs are a globally accepted benchmarking tool for tracking progress and supporting the development of a specific technology through the early stages of the technology development chain. They can be used to evaluate the maturity of particular technology and to assess the development status.
Commercial Readiness Index	The Commercial Readiness Index (CRI) assesses the commercial maturity of technologies with a six-level indicator ranging from Hypothetical to Bankable asset class
Demand Readiness level	DRL - Demand Readiness Level (DRL) is a scale measuring technology readiness and a tool to hybridise Market Pull and Technology Push approaches. The purpose of DRL is to measure the level of market pull corresponding to the level of technology push.

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Managing Intellectual Property Rights

ANNOTATION

Intellectual property rights are an important part of the technology transfer process and the process of transferring the outcomes of research to practical use and to companies. In this lecture you will learn what they are, how they are formed, by whom and how they are protected, and how they are related to universities and technology transfer.

The lecture is divided into the following sections:

- What are Immaterial Property Rights?
- The Benefit of Intellectual Property Rights
- Forms of Intellectual Property Rights
- IPR and Openness
- Managing Intellectual Property Rights from the Idea to Invention and Licensing.

WHAT ARE IMMATERIAL PROPERTY RIGHTS?

Universities produce different outcomes, inventions, innovations and works through their activities, for instance, basic, applied and commissioned research, scientific publications and books, artistic activity, consultation and awards. As these are fruits of someone's work and investment, and as they may lead to impact, innovations, financial gain and business activity, it is important to define the owner of these outcomes. Intellectual property rights (IPRs) processes and agreements assist in this. Therefore, the IPR process is an elemental part of the technology transfer process as well.

IPRs provide legal rights on the results, scientific outcomes, solutions, processes, innovations, inventions, objects, literature, artistic or other works to the creator, protect the creator from any forms of IPR violations and enable return on the investment made by the creator.

The creator of the work can reserve the rights to himself or herself, or provide them to an external body, which is most often done against a compensation. The right to use comprises, for instance, the right to use, reproduce, modify and sell the invention or the outcome. Hence, IPRs contribute to the exchange of information, works and findings for the benefit of society.

THE BENEFITS OF INTELLECTUAL PROPERTY RIGHTS

Intellectual property rights protect the rights of the creator and owner of the work, providing recognition and income to the creator. Among the other benefits, especially for universities, are for instance:

- IPRs harness new information, solutions and research outcomes created in universities for use and exploitation in society, companies, organisations and in the university itself. This may also positively contribute to the reputation of the university.
- IPRs make a positive contribution to development, innovation, invention and research, and exchange of information between

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universities and research bodies, but also other organisations, e.g. companies, thus boosting economic and societal development. This may result, for instance, in increased motivation of universities and researchers for further innovation and research.

- Universities gain income and compensation for the investment in research and intellectual activity. Income may also be harnessed to fund further research.
- IPRs increase the credibility of the university through patents, patent portfolios and patent applications, which may also contribute to receiving funding
- IPRs facilitate technology transfer to different organisations, e.g. to companies, and the establishment of new companies, start-ups and academic spinoffs using the produced information

The beneficiaries are not only companies, but also general public, decision-makers, experts and different professionals.

FORMS OF INTELLECTUAL PROPERTY RIGHTS

There are different forms of intellectual property rights. The form of the work influences the form of the IPR solution to be applied, and hence its duration and geographic coverage. The basic rule is that the creator of the work owns its rights, and these rights can be sold or licensed to another body against compensation.

The creator of the work is called licensor, and the third party the licensor passes the IP to is a licensee. The licensee will purchase the IP rights of the outcome for certain duration of time in a defined geographic location.

The main categories of intellectual property rights are:

Copyright

Copyright refers to the protection of creative, artistic, cultural and literary works, covering for instance, books, poems, lectures, musical works, photography, paintings, visual art, theatre plays, films, choreography and translations (See more on Article 2 of the Berne Convention e.g. at https://www.law.cornell.edu/treaties/berne/2.html), but also technology-based works (e.g. computer programmes). The copyright refers to the work itself and its expression, but not to the ideas. For instance, a certain painting of flowers can be protected, but not the general idea of a painting with flowers. Therefore, copyright provides recognition of a specific work and financial gain to its creator, and restricts any third party from copying, using, multiplying or modifying it without the author's permission.

The copyright is created when the work is created and remains valid usually for 70 years after the death of the author. The recognition of the creator will usually remain even after the copyright expires.

Patent

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A patent can be applied for an invention. In order to be granted a patent, an invention must:

- be new, containing innovative value (not be obvious)
- have an industrial application possibility, hence be technological
- disclose the technical information

Patents protect the work of the inventors from unauthorised exploitation (producing, modifying, using, selling, commercialising, importing) of the invention by the third parties. A holder of the IP can license the patent to third parties for certain duration of time and geographic area.

A patent is granted for a limited time, normally for 20 years, for a limited geographic area. A patent is applied separately for each country, though options to apply it for multiple countries at the same time exist as well. One should, however, be prepared that the patenting process is long (e.g. 2,5 years) and applying for patent involves costs. Patents may also be extended after the end of the initial duration, which, too, may be country-specific. Patent application processes vary across countries.

Trade secret

Although trade secrets are not IPR, secrecy and confidentiality apply to them as well. Trade secrets are specific highly confidential solutions that create competitive edge and leverage the brand, thus becoming commercially valuable. Such can be for instance recipes, data, processes or formulas. The added value may be subjective and image-based, like a unique taste, but also concrete, like a client list.

Three qualities characterise trade secrets:

- They must be commercially valuable or provide competitive advantage.
- Secrecy is applied to them. Hence only a restricted group of people is aware of them and special efforts, e.g. confidentiality agreements, are applied to them.
- Due to secrecy, they are not known and accessible.

Any violation, unauthorised acquisition or disclosure of a trade secret without the owner's permission is a punishable action.

Trademark

A trademark is a distinctive sign or symbol unique to a company, organisation or a private person which allows it to be identified and distinguished from others. It is formed of visual, written and multimedia elements, or different combinations of these, which should be different from other trademarks. IPR protection prevents the others from using the owner's trademark. A trademark can be registered and can be extended against a fee.

Registered design

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A design can be protected by design rights (also registered design, design patent). In this case, the creator of the work - the designer - owns the exclusive rights to own designs, which prevents third parties from using or copying the design for any commercial or productive activity. Design rights apply for e.g. industrial and handicraft products, packaging and graphic designs.

The design rights vary by country and they are of a limited duration. Unlike copyrights, it is advisable to apply for a design registration, also called a design patent, as an unregistered design has only a short protection period, while a registered design can be protected through renewals even up to e.g. 25 years (as in Europe). As the practise varies by country, it is advisable to review the data of the own country.

Utility models

Utility models are granted for technical inventions that are commercially exploitable, similarly to patents. Unlike for patents, for utility models:

- The registration process is quick
- The novelty level is less radical than in patents and the novelty is reviewed only on demand
- The protection is limited and it does not cover method or use protection

The utility model is practical for simpler inventions which need to get to the market quickly. The protection period is also shorter, 10 years compared to 20 years of patent protection.

IPR AND OPENNESS

Providing outcomes of a work openly and free promotes sharing, further development and use of solutions. This is one possible option for the creators of the work to choose, except if the work has been commissioned by a third party. The aim of sharing the outcomes and the form of funding of the activity may influence the openness of the outcomes. Sometimes external conditions, the common good, are the main motivators for openly shared solutions. Publishing of research papers can also be considered a form of sharing outcomes openly.

Among the most common open IPR solutions are:

- Copyleft licence is mainly used for software. It provides anyone the right to use, modify, improve and distribute the software under the same license and terms as the original work, including the source code, hence promoting further innovation. There are however limitations for the modified versions and their distribution (read more at https://opensource.org/osd-annotated). The openness of the source and innovativeness is granted also with the requirement that the work should be usable with any product and software, and any form of discrimination of people is prohibited. One example of such copyleft solutions

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is GNU General Public License (https://www.gnu.org/).

- Creative Commons promotes free distribution and use of artistic and other copyright related work. It gives the owner the possibility to set the level of protection to the work and to the forms of its distribution.
- Patent pools are consortiums between two or more organisations or companies that share their own patents between them through licensing and exchange. Normally, patents of mature technologies are shared and they are used for technological and product development in a joint field of activity.

Strong or Weak IPR Protection?

IPR protection can be strong or weak. Both strategies have their benefits and weaknesses:

	Weak IPR protection	Strong IPR protection
Strong points	Innovation is encouraged due to diffusion	Acknowledging the work an the role of the innovator, an returning the investment to researcher promotes researc and development (R&D) Potential increase of innovation and long-term growth
Weak points	Imitators have the power over innovators due to weak IPR protection of original inventions Potential discouragement of investment in research	Innovators are the main beneficiaries Innovation may be restricte due to a narrower circulatio of innovation

Each country should seek for an adequate IPR level matching its own innovation goals and capacity.

Managing IPR in a university is a holistic process and each university should have a strategy and resources for IPR protection and management. The process of managing IPR involves different kinds of people and organisations - from researchers to students, university management, companies, start-ups and spinoffs, staff at technology transfer offices (TTO), IPR and agreement lawyers, and funders of the work.

IPR management is carried out:

- before and during the creation of the work/invention/outcome

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- during IPR protection and licensing of the finished work/invention/outcome
- during the period of sustainability of the IPR protection and licensing of the finished work/invention/outcome, for instance during the process of creating patent portfolios and licenses, including license extensions.

The role of the technology transfer offices in the intellectual property process is essential. TTOs help to license and commercialise the inventions and pass them to academic spin-offs and start-ups, and established companies and organisations. More assistance on the right IPR solution and agreements are provided by the IPR staff and lawyers of the university.

IPR risk management

IPR risk management should be applied throughout the lifetime of the outcome creation process, from the idea search to licensing and portfolio management. It addresses issues such as confidentiality, the novelty of the desired and delivered outcome, disclosure, the background the different parties bring to the project, the ownership of the outcomes including financial incentives, and any future uses and developments of the outcomes, warranties and liabilities.

Patent portfolios

Managing patent portfolios is part of the university's IPR management. A patent portfolio is a collection of all university's patents from emerging to established patents. Managing portfolios covers for instance licensing, maintaining, extending patents and ending patents, and identifying emerging patents from inventions.

IPR before and during the creation of the work/invention/outcome

IPR related outcomes are created during different activities of the university (research, publications, artistic work, consultation, equipment support, etc.) which are carried out individually or in teams. The teams may be internal to the university or they can be national or international multiorganisational teams formed by universities only, or by universities and other organisations. The roles of each organisation must be carefully defined as this will impact IPR.

Another aspect that influences IPR issues is the relationship between the staff (and students) performing the work in universities and in other organisations, and the work agreement for the ownership of the outcomes. In many cases, a university or a company owns the IPR of the outcomes, although the staff members merits recognition of the work. However, there are also contracts that give some rights to researchers.

All the individuals and organisations bring their experiences and knowledge to the project. This is called background information and it may be subject to special IPR agreements signed at the latest at the beginning of the project. Such information may not only be tacit

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accumulated work and subject knowledge, but specific information essential for the delivery of the project. It may also include IPR protected outcomes, trademarks and patents.

From the IPR point of view, these issues create complex situations which will influence the delivery of the project and the ownership of its outcomes. Therefore, they need to be carefully outlined, agreed upon and taken into consideration in the planning phase of the project and finalised as IPR agreements before the work starts or at the beginning of the project. They will also influence the IPR agreements of the project outcomes and any future licensing and patents regarding the project's outcomes.

IPR protection and licensing of the finished work/invention/outcome

Once the work has been concluded and the project has ended, IPR and ownership will be agreed on. Depending on the nature of the work and its novelty and value, the outcomes might be patented or another kind of license might be acquired. The IP of the works which have been ordered by an external body, for example a company, are owned by the party which ordered the work. In addition, the form of financing may also influence the IPR and profitability requirements.

The work team behind the outcomes is granted the IP rights to their work. What comes to inventions and patents, before patenting, innovations must go through a disclosure of invention process in their own universities to evaluate the level of innovation. Based on the results, a patent or another form of IPR protection might be applied for. The patenting process is long.

Once protection on the invention has been received, the university may commercialise the invention and license rights of the invention to third parties against compensation. External bodies can include organisations, new and established companies, academic spinoffs and start-ups. A new start-up or an academic spin-off may also be established. In all these cases, detailed IP and licensing agreements need to be prepared. The role of IPR professionals and the TTO of the university is to assist in IPR acquisition, licensing and commercialisation processes.

FURTHER READING

World Immaterial Property Organisation, WIPO: **www.wipo.com**
Article 2 of the Berne Convention:
https://www.law.cornell.edu/treaties/berne/2.html
Open Source: https://opensource.org/

Creative Commons: https://creativecommons.org/

India; Office of the Controller General of Patents, Designs & Trade Marks: http://www.ipindia.nic.in/

India; Copyright Office. Government of India: http://copyright.gov.in/

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Nepal; Government of Nepal, Ministry of Industry, Department of Industries:
https://iponepal.gov.np

Sri Lanka; National Intellectual Property Office: https://www.nipo.gov.lk/web/index.php?lang=en

The Philippines; Intellectual Property Office of The Philippines: https://www.ipophil.gov.ph/

SUMMARY OF KEY POINTS

- All outcomes of the university work can and should be protected. Intellectual property rights (IPR) provide legal rights to the creator of results, scientific outcomes, solutions, processes, innovations, inventions, objects, literature, artistic or other work. They protect the creator from any forms of IPR violations and return the investment she or he made in the work.
- IP rights of an outcome can be sold or licensed to a third party against compensation. This passes the right to use, modify, reproduce, commercialise, sell and distribute the IP protected outcome is a certain area for certain duration.
- IPR and commercialisation processes make new information and inventions available for the benefit of society, for instance as improved solutions usable by the general public or as inventions that could be commercialised by companies, start-ups and academic spin-offs.
- The nature of the outcome influences which form or protection is applied to it. Forms of IPR protection are for instance, copyrights, patents, utility models, trade secrets, trademarks and registered designs. A different IPR practise is applied to each.
- The IPR process and protection should not be applied only to the outcome of a project. They should be integrated into processes before the start of the project and taken into account in all activities after the end of the project and during the delivery of its outcomes.

CASE STUDIES AND REAL-WORLD EXAMPLES

The following case studies and examples provide different viewpoints to IPR protection in different sectors, types of inventions and other products.

- **Covid-19 and 3D facemasks**

Open publication of inventions and other already or normally IPR protected outcomes is sometimes the best solution. Openness assists spreading information and inventions, and sometimes this is for the greater good. A good example of this is the open publication of 3D printed face masks and other instruments for free use and exploitation by anyone who may need them. This IPR solution assists in the fight

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against the COVID-19 pandemic. Among the 3D organisations publishing are for instance:

https://cults3d.com/en/3d-model/tool/covid-19-coronavirus-cap-protection-ffccse_x12

https://www.3dstep.fi/covid19/

https://www.3dsystems.com/covid-19-response

https://3dprintingcenter.net/covid-19-3d-printing-health-protective-designs/

The main purpose is to contribute to the general welfare and help the world to become normal again. However, such open publishing has potential benefits to the inventors, too, such as free publicity for the 3D organisations and potentially more work in the future, normalising and spreading of 3D technology, potential increased sales of 3D printing machines, and 3D printing machines as crisis response mechanism in the future. All of this may increase the purchase of the machines.

- **15 Patents That Changed the World**

This website provides a collection of case studies of world changing patents, such as the motorised exoskeleton or the 3D printer. The cases clearly demonstrate the dimension of essential invention.

Link:
https://www.popularmechanics.com/technology/design/g20051677/patents-changed-the-world/

- **Case Study Aquafragma: Building up a successful patenting strategy for an EU-funded project (by the European IPR Helpdesk)**

European IPR Helpdesk provides a description of IP in a research project.

Link:
https://www.iprhelpdesk.eu/sites/default/files/newsdocuments/Case-Study-Aquafragma-Building-successful-patenting-strategy.pdf

- **Case studies by European IPR Helpdesk**

A searchable selection of case studies by the European IPR Helpdesk.

Link: http://www.iprhelpdesk.eu/library/case-studies

- **Case Studies on Intellectual Property (IP Advantage): Search Results**

A pool of case studies from around the world, describing patents from multiple sectors, covering a wide range of inventions from breathable shoes to finding Africa's future crop. The case studies are compiled by WIPO (World Intellectual Property Organisation).

Link:
https://www.wipo.int/ipadvantage/en/search.jsp?ins_protection_id=53

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4&focus_id=

- **Building on a Foundation of IP**

A case study of an invention and patenting by Biocon from India. (WIPO). Link: https://www.wipo.int/ipadvantage/en/details.jsp?id=2602

- **What might happen with trademarks**

Three quick cases on trademarks by the Entrepreneur. Article: A Quick Guide to Protecting the Name of Your Business.

Link: https://www.entrepreneur.com/article/345927

PROPOSED ASSIGNMENTS AND EXERCISES

Mind mapping the IPR in a project

You work on a research project on water system protection and you need to define its IPR conditions at the beginning and at the end of the project, and how technology transfer could be implemented.

Take a paper, pens of different colours and post it notes as you will use the mind mapping technique. Mind mapping helps to process and categorise thoughts and things, and to create connections. Pens of different colours help you to differentiate and categorise things further. When you write things first on post it notes, you can move them around and organise them as you wish. Instead of post it notes, you can also use regular size pieces of paper and something to attach them onto a wall or paper.

Before starting to work on the project, name it and define its purpose in a short sentence.

- At the beginning of the project you need to define its IPR conditions. Create a mind map of the project's IPR conditions at its beginning, taking into account the following conditions:
  1. The consortium is international and consists of universities from Asia and Europe. You can freely choose the countries, but you should add your own country as one of the participating countries
  2. Each university brings background to the project, including research information. Two existing patents and two good practices will be brought to the project. The IPR of these two good practices is Creative Commons Share Alike. They are based on a previous project and have been created by an IPR agreement in which only two project partners have been part of. How will these rights be transferred to the current project?
  3. The university teams consist of researchers and other university staff and of students who work as assistants in the project

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4. The project will also use open innovation and co-creation with target groups during research
5. The outcomes must be tangible and may lead to patents, design patents and publications.

You can choose the exact purpose and topic of the project. Once ready with your mind map, keep it.

- Create another mind map of the final outcomes of the project. For each outcome, identify who has been working on it and what is the share of the background information and previous patents which have been used in the work.

  The outcomes should include at least patentable inventions and scientific publications.

- The main invention of the project needs to be transferred to the countries participating in the project. Select what the main innovation is out of the previously mentioned outcomes. Combine the two earlier mind maps and continue working on IPR issues for the selected invention, using the conditions applicable to the two mind maps. What background and foreground (information created during the project) does the invention require? What is the project partners' share in them? Who has exploitation and ownership rights and what kind of rights are those? What should be agreed between the partners in the partner IPR agreement so that the invention can be licensed in your country?

  Use the mind map technique for this purpose again.

- Once the IPR issues related to the invention are clear, start thinking how it could be licensed to local companies, start-ups or academic spin-offs in your country. Make 2 plans which are both maximum circa 1-2 pages long. Alternatively you can make a PowerPoint presentation of the plans.

  The plans should include a brief intro, a description of the invention and the solution and its application including a short resource and IPR plan.

ASSESSMENT

Multiple choice test	
Question 1: What is not correct about patents?	
Answer 1	A patent is always an invention
Answer 2	Patents are not renewed automatically
Answer 3	Technical information disclosure is part of patenting requirements
Answer 4	A patent is automatically valid globally when

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	applied in one country
Answer 5	The patent application process is long
Correct answer(s)	4
Question 2: Which of the following may become IPR protected without registration?	
Answer 1	Trade secret
Answer 2	Design patent/ registered design
Answer 3	Patent
Answer 4	Utility model
Answer 5	Trademark
Correct answer(s)	2
Question 3: What is not true in research work from the IPR protection perspective?	
Answer 1	IPR agreements need to be created for the background information and materials the project team brings into the project.
Answer 2	Confidentiality agreements are created at the end of the project.
Answer 3	Novelty of the research topic and its desired outcomes may create an IPR risk.
Answer 4	Work agreements of the research staff may impact IPR agreements
Answer 5	IPR issues also concern the students taking part in the research project.
Correct answer(s)	2
Question 4: Which form of IPR protection would most likely pass through a Technology Transfer Office?	
Answer 1	Copyright
Answer 2	Design patent/ registered design
Answer 3	Patent

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Answer 4	Utility model
Answer 5	Trademark
Correct answer(s)	3
Question 5: Which IPR approach best promotes diffusion of innovation or an outcome	
Answer 1	Patents
Answer 2	Patent pools
Answer 3	Copyright
Answer 4	Low IPR protection policy
Answer 5	Copyleft license
Correct answer(s)	5

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GLOSSARY

Background	"Background" refers to information, outputs and experience that a party brings to a project, process or work. It is often IPR protected, i.e. the so-called background intellectual property. An agreement should be made on the background and its role during the project in the outcomes, and in the final IPR agreement.
Confidentiality agreement, i.e. non-disclosure agreement	The agreement protects the work and any confidential information related to it. It obliges the parties to not communicate to any external parties any confidential matters related to the work, project, company, organisation or other aspects. The agreement can be concluded, for instance, between an employee and employer, between project parties, between business partners, or with individuals participating in research.
Copyleft	Copyleft is a form of open licensing used for distributing works and programs freely and enabling others to use and modify them. It is most often used for software.
Disclosure	Disclosure means that something (e.g. an outcome, a product, information) is made public and known. In IPR, disclosure has different roles.

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	For instance, non-disclosure agreements are used for keeping specific information confidential. It influences many IPR aspects of outcomes and inventions. For instance, disclosure of information on an invention prevents it from being granted a patent. Yet, technical information of an invention must be disclosed to the public.
Invention	An invention is a novel solution which uses technology and has a clear and essential novelty value. This technology is harnessed to solve specific problems. An invention is eligible for patent application.

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Considerations for Commercialisation - Licensing

ANNOTATION

Technology transfer relies on licensing of intellectual property. After a patent is received or IP protected in another suitable way, the TTO will often partner with the inventor to market the IP/ patent - to find a licensee or even establish a new commercial entity (spin-off) to be the licensee.

The two main routes to commercialisation are licensing to an existing company and forming a spin-off start-up company. As the main function of a university is usually research and teaching, there is seldom direct interest to commercialise the research outcomes inside the university (to build products or services) and therefore it is often beneficial to license out or sell the IP.

Engaging with commercial entities in an early phase of the development process is usually in the university's interest. This is mainly due to the costs of obtaining a patent and of supporting additional research before proceeding to the product development phase.

Licensing offers several benefits to both parties. For enterprises, new innovations offer a possibility to improve market position and gain access to new technology. A good way to negotiate license agreements is to aim for a win-win transaction for all parties. This requires understanding of both side's needs, out-licensing and in-licensing.

The aim of this lecture is to provide an introduction to the basics of commercialisation via licensing and offer some considerations on license agreements. The content by nature is non-exhaustive and encourages self-study into the finer details on the subject matter.

The lecture is divided into the following sections:

- What is commercialisation – licensing?
- What can be licensed?
- Why license?
- Disadvantages of licensing
- Licensing agreements and negotiations

WHAT IS COMMERCIALISATION – LICENSING?

Technology transfer depends on licensing of intellectual property. A license is an agreement or an official permission with a statement of terms that permits an action to do, use or own something.

Patent licensing agreements are contracts in which the patent owner agrees to grant the right to make, reproduce, use, sell, and/or import the claimed invention, within the limits set by the provisions of the contract. Acting without a licensing agreement, the use of said intellectual property would constitute an infringement. This is usually in return for a royalty or other compensation. In a license agreement there is no transfer of ownership as the IP is held by the licensor. Another way to transfer intellectual property rights is to sell them. With an IP assignment, all

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rights to the piece of intellectual property are transferred to the purchasing party. This transaction ends all the obligations for the initial owner (e.g. renewal) and also the ability to use the protected IP (unless specified otherwise in the contract).

There are at least two parties to a license agreement; a Licensor - the owner of the intellectual property who does the out-licensing and a Licensee - the receiver of a license who does the in-licensing.

> *"A licensing agreement is a partnership between an intellectual property rights owner (licensor) and another who is authorised to use such rights (licensee) in exchange for an agreed payment (fee or royalty)". – WIPO*

WHAT CAN BE LICENSED?

Several types of Intangible property can be licensed, whether the IP is registered, unregistered or "soft". Examples of registered IP are patents, utility models, registered trademarks and designs. Unregistered IP examples are copyrights (works of authorship), unregistered trademarks and designs.

Other or 'soft' intellectual property includes know-how, trade secrets and confidential information. Examples in the soft IP category would be e.g. expertise, skilled craftsmanship, training capability, understanding of how something works, a protected formula or a method, undisclosed customer or technical information, algorithms, etc.

WHY LICENSE?

There are several reasons for licensing for both sides of a licensing agreement. Successful licensing occurs when the benefits available for all parties are understood well and characterised as a "win-win" transaction.

The new invention might not be a strategic fit for a company that owns the intellectual property (e.g. the organisation has no manufacturing / production capacity, does not want to be involved in the production, a brand mismatch, no access to market, etc.), so licensing out such IP assets can prove beneficial. The IP owner might not want to or have resources to engage in further development or have the capacity to open a new foreign market or lack access to distributors, etc.

Licensing to multiple verticals and use cases to different application or industry.

- Access to new markets within own industry
- Access to new industry application (licensing to an established manufacturer)

Especially for the licensee it can be beneficial to use or adapt technological solutions developed by others instead of investing in own technology creation and R&D. Examples of such instances can be e.g. where the company needs to bring to the market new products incorporating a third party technology in a short time; where the company does not have the resources to engage in in-house R&D activities; where

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the company needs to maintain a market position that is threatened by the commercialisation of a new technology or when its new or improved product violates an existing IP already owned by a third party.

Cross-licensing and patent pooling can be used as an arrangement for technology pooling where all engaging parties' open their respective intellectual property to other contract parties and grant rights to a specific technology, product or research. This can occur for example when two companies' patents cover different essential aspects over the same commercial product and are often associated with complex technologies that require complementary patents in order to provide efficient technical solutions or parties want to avoid litigation due to conflicting patents.

Summarised examples on the benefits of licensing include:

- Commercialising IP and generating profit (monetize R&D outcomes for licensing revenue)
- Sharing business risk
- Providing a channel to enter into R&D collaboration
- Gaining access to new markets
- Low capital requirements (e.g. no investment in own manufacturing capacity, machines etc.)
- Accessing innovative technology (faster and cheaper than through in-house research and development)
- Settling and/or avoiding infringement claims
- Access to technology via cross licensing

DISADVANTAGES OF LICENSING

Despite the many benefits, there can also be disadvantages to out-licensing. Out licensing often gives only a low level of control over several aspects, such as strategy and implementation, production and marketing. The licensor also has to rely on the licensees' abilities to commercialise the IP (the risk is higher with single licensees). Poor strategy and implementation or inadequate quality management can damage the brand reputation and product success. A licensee may also turn into a competitor in the future, and should be taken into account when drafting license agreements. Instruments like geographical or field-of-use restrictions are often used to minimize this risk.

LICENSING AGREEMENTS AND NEGOTIATING

Many license agreements can involve a combination of one or more types of intellectual property rights (e.g. a combination of patent and know-how or an accompanying trademark). A multitude of factors are considered by the TTO when negotiating a license, including:

- type of technology in question
- current stage of development

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- projected cost of bringing a product to market
- potential market size
- anticipated profit margin
- strength of the patent claims (has a patent been issued and the prospects for pending patent applications)
- accumulated cost of research that lead to the invention
- scope of the license being issued
- known royalty rates for comparable inventions.

Several aspects can be agreed upon in the license agreement (Scope of the License). There are several types of licenses and some of the major agreement considerations are presented below:

- Object and the purpose of the contract, what rights are granted
- Obligations of the contractual parties, description of what actions are to be performed to fulfil the agreement (in addition to the actual licensed IP, e.g. technical assistance for the licensee to begin production)
- Term of the contract, expiration date and renewal (a license is valid for a specific period of time)
- Geographical scope / territory, defining where the licensee is allowed to use the licensed rights (for e.g. segmenting markets). Rights can be granted worldwide, or be limited to specific countries or even specific parts of countries or regions. Often the licensor holds on to the rights to operate on local markets and relies on licensees to act or expand to new foreign markets.
- License exclusivity: The licensor must decide whether to issue licenses to single companies or to several users. Two main types of licenses are Exclusive or Non-Exclusive licenses. In exclusive licenses, the parties agree that only the licensee is able to use and exploit the licensed intellectual property or technology. The licensor cannot use or license it to other licensees. On a sole (semi-exclusive) license, the licensor also retains full rights to exploit the IP. A non-exclusive licence on the other hand grants to the licensee the right to use the IPR, but the licensor can still exploit the same IPR and can also allow other licensees to exploit it. When the risks and rewards are spread in this way among several licensees, the licensor is not dependant on the success of a single licensee. Exclusive licenses are often desirable in situations where the licensee is making a high-risk investment and incentives are required to invest in the further development of the invention. Non-exclusive licenses are favoured when the invention is a broadly useful process that may appeal to multiple licensees, and when exclusivity is not needed to create interest in the license.

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- Transferability and licensees' right to issue sublicenses, cross licenses.
- Technical or Commercial Field of Use: Organisations can license a technology exclusively or non-exclusively without any limitations on its commercial use. Use is limited only by the license agreement and the current and future applications of the technology. Field-of-use restrictions are one of the most frequently used clauses in licensing agreements.

  A field-of-use restriction (FOUR) is a contractual provision in a license that limits the scope of the licensee's right to use it for a specific purpose (one or more), a defined field of use and precludes licensees from operating outside of the technical field specified.

  Technologies may have several distinct applications and production efficiency may require splitting usage rights among different companies.

  Limiting the uses and scope of operation available to a single licensee can often prove beneficial, as one company is most likely not able to develop all the possible uses of a technology. This might be due to its business focus, limited resources or production capacity. Using FOUR allows licensors to allocate production efficiently among several licensees. Having multiple licensees with different fields of use may help to ensure that several uses of a technology are developed. This may also help to introduce different types of products to market and increase the return to the licensor.

  For the licensee, FOUR gives a possibility to acquire a license in the relevant fields (fit to strategy, resources, access to market, etc.) without being forced to pay the cost of the entire patent in fields that the company is not willing to utilise a license for.

  As agreements can be international in nature, this also requires familiarity with several legal frameworks and regulatory environment (e.g. in relation to FOUR the restriction of competition and antitrust laws should be taken into account)
- Financial aspects and compensation: In general, the contract parties are free to set any financial conditions. Both parties determine if the expected revenues will be adequate to justify the costs involved in engaging in licensing activity and if the financial terms suit both parties.

  There are many ways to define the compensation e.g. based on percentage of revenues derived from the use of an asset, percentage of the sale price or profits made, or a fixed amount per each product unit sold. Royalties reflect the use of the technology by the licensee and are the most frequently used type of payment.

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In addition to royalties, financial aspects can include payment structure, licensing fees, reimbursement of the university patent costs, fees related to annual license renewal and maintenance. If the commercialisation is done via a spin-off path, potential equity shares in the company can be used to finance the development of the innovation. In regards to licensee non-performance, especially with exclusive licenses, minimum guarantees or annual royalties, requirement for production or revenue should also be taken into account.

- Improvements: Usually both parties have the right to improve the licensed technology (original IP) through further research or by developing related know-how. Licensees are often interested in improving and developing the licensed technology, especially when improvements result from necessary adaptations to the production environment. The licensor may be keen to learn of those adaptations, so that he can more successfully license it to others. Ownership and use of possible future improvements should be addressed already in the contract. It is often necessary to define what are considered as improvements, (i.e. versions) and new models and when there will be a situation in which it would be considered that a new technology or new IP has been generated.
- Dispute resolution and dealing with third party Infringement: Agreements need to define how are possible conflicts to be resolved, as well as to define jurisdiction or alternative dispute resolution out of court (ADR; mediation, arbitration, negotiation, neutral evaluation, etc.), applicable law, etc. If the contract is international in nature, it has to be agreed which country's law is applicable, how are possible third party infringements handled and what support does the licensor provide.
- Termination of contract

FURTHER READING

Choi, J-P. (2003). *Patent Pools and Cross-Licensing in the Shadow of Patent Litigation*. International Economic Review. 51. 441-460. 10.1111/j.1468-2354.2010.00587.x.

https://www.researchgate.net/publication/226650611_Patent_Pools_and_Cross-Licensing_in_the_Shadow_of_Patent_Litigation
This article develops a framework to analyse the incentives to form a patent pool or engage in cross-licensing arrangements.

European IPR Helpdesk. (2015). *Fact Sheet - Technology Licensing-in*. http://www.iprhelpdesk.eu/sites/default/files/newsdocuments/Fact-Sheet-Technology-Licencing-in-EN.pdf

WIPO - World Intellectual Property Organisation (2015). *Successful Technology Licensing*. IP Assets Management Series. https://www.wipo.int/edocs/pubdocs/en/licensing/903/wipo_pub_9

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03.pdf
This Manual focuses on understanding licensing, the context in which licensing may occur; key terms of a licensing agreement and considerations for contract negotiation.

European IP Helpdesk. (2019). *Your Guide to IP and Contracts.* https://www.iprhelpdesk.eu/sites/default/files/2018-12/european-ipr-helpdesk-your-guide-to-ip-and-contracts.pdf
An overview on IP contracts including some of the most common IP contracts and IP clauses.

SUMMARY OF KEY POINTS

- A license is an agreement or an official permission with a statement of terms that permits an action to do, use or own something.
- There are at least two parties to a license agreement: a Licensor - the owner of the intellectual property who does the out-licensing and a Licensee - the receiver of a license who does the in-licensing.
- License agreements can involve a combination of one or more types of intellectual property rights e.g. a patent and related know-how or a trademark.
- Several aspects can and should be agreed upon in the license agreement
- Best way to negotiate license agreements is to aim for a win-win transaction. This requires understanding of both sides' needs, out-licensing and in-licensing.

CASE STUDIES AND REAL WORLD EXAMPLES

- **Cross licensing - Microsoft and JVC Enter Into Patent Cross-Licensing Agreement to Foster Mutual Innovation and Collaboration – 2008**

https://news.microsoft.com/2008/01/15/microsoft-and-jvc-enter-into-patent-cross-licensing-agreement-to-foster-mutual-innovation-and-collaboration/

- **Gore-Tex fabric made under license for first time in Taiwa**

https://www.just-style.com/news/gore-tex-fabric-made-under-license-for-first-time-in-taiwan_id128738.aspx

- **Exchanging Value - Negotiating Technology Licensing Agreements**
  A Training Manual- World Intellectual Property Organisation WIPO
  Examples of license negotiation and agreements

https://www.wipo.int/edocs/pubdocs/en/licensing/906/wipo_pub_906.pdf

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PROPOSED ASSIGNMENTS AND EXERCISES

Structure your understanding by first drawing a mind map on the topic of licensing in regards to technology transfer.

Questions and assignments for personal contemplation on licensing:

- What reasons and benefits are there to out-license an IP from a university?
- What about from an enterprise perspective?
- In what circumstances would it be beneficial for a company or a university?
- What benefits would a company gain by obtaining a licence from a licensor (e.g. via a TTO)?
- How should a TTO approach potential clients for out-licensing?
- What type of process would benefit these activities?
- When would external commercialisation be a suitable approach?

The legal and regulatory environment is different in all countries. Carry out self-study on concepts and relevance of Restriction of Competition, monopolies and antitrust law to licensing.

Research and study alternative dispute resolution (ADR) practices, procedure and benefits.

ASSESSMENT

Multiple choice test	
Question 1: The benefits of licensing include	
Answer 1	Gaining access to new markets
Answer 2	Sharing business risk
Answer 3	Accessing new technology
Answer 4	Retaining tight control on manufacturing
Answer 5	Lower demand on capital
Correct answer(s)	1, 2, 3 & 5
Question 2: Select the claims that are correct for Cross Licensing	
Answer 1	Cross Licensing is often used when two companies' patents cover different essential aspects over the same commercial

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	product.
Answer 2	Cross Licensing is often associated with complex technologies that require complementary patents to provide efficient technical solutions.
Answer 3	Cross Licensing is used for avoiding litigation due to conflicting patents.
Answer 4	Cross Licensing is used for licensing crosses of different design and features.
Answer 5	Cross Licensing describes the crossing of the line between licensing and start-up/spin-off development.
Correct answer(s)	1, 2, 3.
Question 3: A sole license is best described as granting use rights to…	
Answer 1	a single licensee
Answer 2	several licensees
Answer 3	a single licensee while the IP owner (licensor) also retains use rights
Answer 4	the Technology Transfer Office
Answer 5	none of the above
Correct answer(s)	3
Question 4: In which one of the following circumstances would an exclusive license be favoured? Select a single choice that is the best answer to the question.	
Answer 1	Large investments are required from the licensee.
Answer 2	The licensor wants to divide the risk and benefit among several companies.
Answer 3	The Licensor wants to use Field-of-Use restriction in the contract.
Answer 4	Commercialisation activities require gaining access to a new market.
Answer 5	Patent pooling is planned by all contract parties.

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Correct answer(s)	1
Question 5: Select all that apply: From a licensors point of view, Out-licensing makes sense, when	
Answer 1	there is no strategic fit with the licensee company
Answer 2	the licensor lacks production capacity
Answer 3	the licensor lacks market access
Answer 4	the licensor wants to monetize an IP
Answer 5	a win-win agreement can be made with the licensee
Correct answer(s)	2, 3, 4, 5

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World Intellectual Property Organisation WIPO. (n.d.). *Exchanging Value. Negotiating Technology Licensing Agreements. A Training Manual.* https://www.wipo.int/edocs/pubdocs/en/licensing/906/wipo_pub_906.pdf

GLOSSARY

Licensor	A licensor is the owner of the intellectual property who does the out-licensing
Licensee	A licensee is the receiver of a license who does the in-licensing.
Cross licensing/ Patent pooling	One or more parties license each other's patents for exploitation
Geographical scope / territory	Definition on the geographical area in which the licensee is allowed to use the licensed rights (e.g. for segmenting markets). Rights can be granted worldwide, or be limited to specific countries or even specific parts of countries or regions. Often the licensor holds on to rights to operate on local markets while relying on licensees to act on or expand to new foreign markets.
Exclusive license	The parties agree that only the licensee is able to use and exploit the licensed intellectual property or technology, and the licensor cannot use or license it to other licensees. On a sole (semi-exclusive) license, the licensor also retains full rights to exploit the IP.

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	Exclusive licenses are desirable in situations where the licensee is making a high-risk investment and incentives are required to invest in the further development of the invention.
Non-exclusive license	The licence grants to the licensee the right to use the IPRs, but the licensor can still exploit the same IPR and can also allow other licensees to exploit it. When the risks and rewards are spread among several licensees, the licensor is not dependant on the success of a single licensee. Non-exclusive licenses are favoured when the invention is a broadly useful process that may appeal to multiple licensees, and when exclusivity is not needed to create interest in the license.

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