Technology Transfer Activities:

Knowledge Generation + Transfer, Research Results and Inventions

Georg Herdrich

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 737183.

Overview

- Knowledge Generation and the need of an innovation friendly environment
- Technology Transfer (TT): Definition(s) and aspects
- Relevant Research Results (The example of DISCOVERER, WP4 only) - Inventions
- Necessity on further relevant measures to promote a “product”
- Summary

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Knowledge Management (KM) as Basis of

Sharing, using + managing knowledge of an organisation. → Multidisciplinary approach to achieve organisational objectives by making best use of knowledge.

Creating knowledge for organization and organisational learning.

Necessary levels of creativity and innovation within the organsation.

Knowledge Transfer (of which TT is a sub set) also beyond organisation (horizontal KT or TT).

Knowledge is difficult to measure and evaluate → Tobin's q (joint stock companies) and inductive methods to measure knowledge.

TT: Share of technologies (in wider sense)
KT: Share of Knowledge that includes procedural knowledge (skills)

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Knowledge Development (→ The role of KM)

- **Development of "Knowledge" within an entity**
  - Knowledge has to be within context of entity (signifies a certain level of "focus" on core competencies)
  - Exceptions are allowed but have to be handled carefully (→ credibility problem)
  - Depends also on culture (→ Japan is different)
- **KM Tools** in use have to depend on branch and size of the entity

Schematic modified and extended, originally from: K. North, Wissensorientierte Unternehmensführung: Wertschöpfung durch Wissen, 6. Ed., Wiesbaden: Springer Gabler, 2016.

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Knowledge Development (→ The role of KM)

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- **Creativity**
  - Aspects such as culture and “environmental” conditions within the entity
  - Can be promoted
    - Motivating aspects (honor jobs, training, money, **coaching and mentoring**, etc.)
    - Identification level of the team (e.g. via KM-based inductive derivation/evaluation of Knowledge Base within the entity concerned)- i.e. “through success”
- How to “measure” knowledge?
  - PWK/ERA Knowledge Management Monitor, see below

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PWK/ERA Knowledge Management Monitor (started in 2016)

Achievements

- Publications: Development 2016, 2018, 2019, 2020 (still open)
- Theses: Student theses, doctoral theses
- What have the dissertants gone to? (→ networking)
- Awards
- Patents
- Projects (including development e.g. of budgets from 2016 to 2020)
- Personnel:
  - Team as of 2016; as of 2018; as of 2019; as of 2020 (still open)
  - Guest researchers and students 2016, as of 2018, as of 2019; as of 2020
  - Students sent abroad 2016, as of 2018, as of 2019, as of 2020 (COVID-19)
- Collaborations
  - Formally engaged collaborations (contracts)
  - Further living collaborations

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PWK/ERA Knowledge Management Monitor (started in 2016)

Additional Information

- New rules for dissertations (Qualification items linked to a minimum of 9 LP, Formal agreement between Prof. and PhD “student!)
- General aspects on conferences /conference contributions

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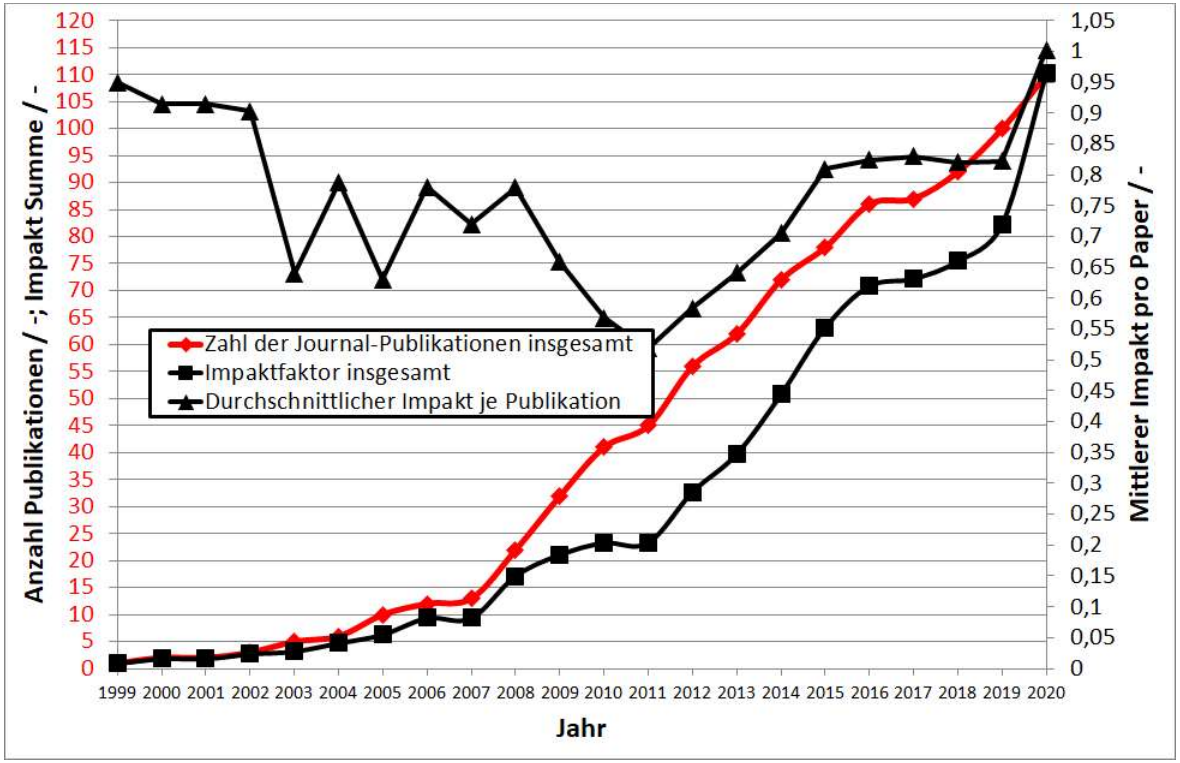
Public Example:
Number of Journal/Book Publications in PWK/ERA

- – Mean impact factor
- – Cumulated impact

- **Do the same for**
  - – Budget
  - – Patents
  - – Dissertations
  - – Student theses
  - – Awards
- **and (in a prosaic way)**
  - – Networking
  - – Collaboration
  - – …



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Technology Transfer (TT)

- **Technology Transfer** (**TT**): Process of transferring (disseminating) technology from the person or organization that owns or holds it to another person or organization.
  - TT: Between universities, businesses (any size), governments (across geopolitical borders, both formally and informally, both openly and secretly)
  - **Share of**
    - **Technologies, Samples, and facilities among participants.**
  - Closely related to (and may be considered a subset of) knowledge transfer.

- Horizontal transfer
  - Movement of technologies from one area to another. At present TT is primarily horizontal.
- Vertical transfer
  - Technologies are moved from applied research centers to R&D departments.

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Technology Transfer (TT)

- Technology brokers: People who discovered how to bridge the emergent worlds and apply scientific concepts or processes to new situations or circumstances.

- TT can involve
  - Dissemination of highly complex technology from capital-intensive origins to low-capital recipients,
  - But also appropriate technology, not necessarily high-tech or expensive, that is established (and disseminated), yielding robustness and independence of systems.

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Technology Transfer (TT): Significance of TRL

- Using TRL as a criterion: Research tends to focus on TRL 1–3 and 3-6 (the latter often in a collaboration)
- Readiness for production focuses on TRL 6–7 or higher.
- Bridging TRL 3 to TRL 6 has proven to be difficult in some organizations (see also below).
- Attempting to rush research (prototypes) into production (fully tested, reliable, maintainable, etc.):
  - Tends to be costly and time-consuming.
  - Funding systems promoting this are rare (depending on referred country).

TRL		
	9	Commercialized
	8	Pre-production
	7	Field Test
	6	Prototype
	5	Bench / Lab Testing
	4	Detailed Design
	3	Preliminary Design
	2	Conceptual Design
	1	Basic Concept

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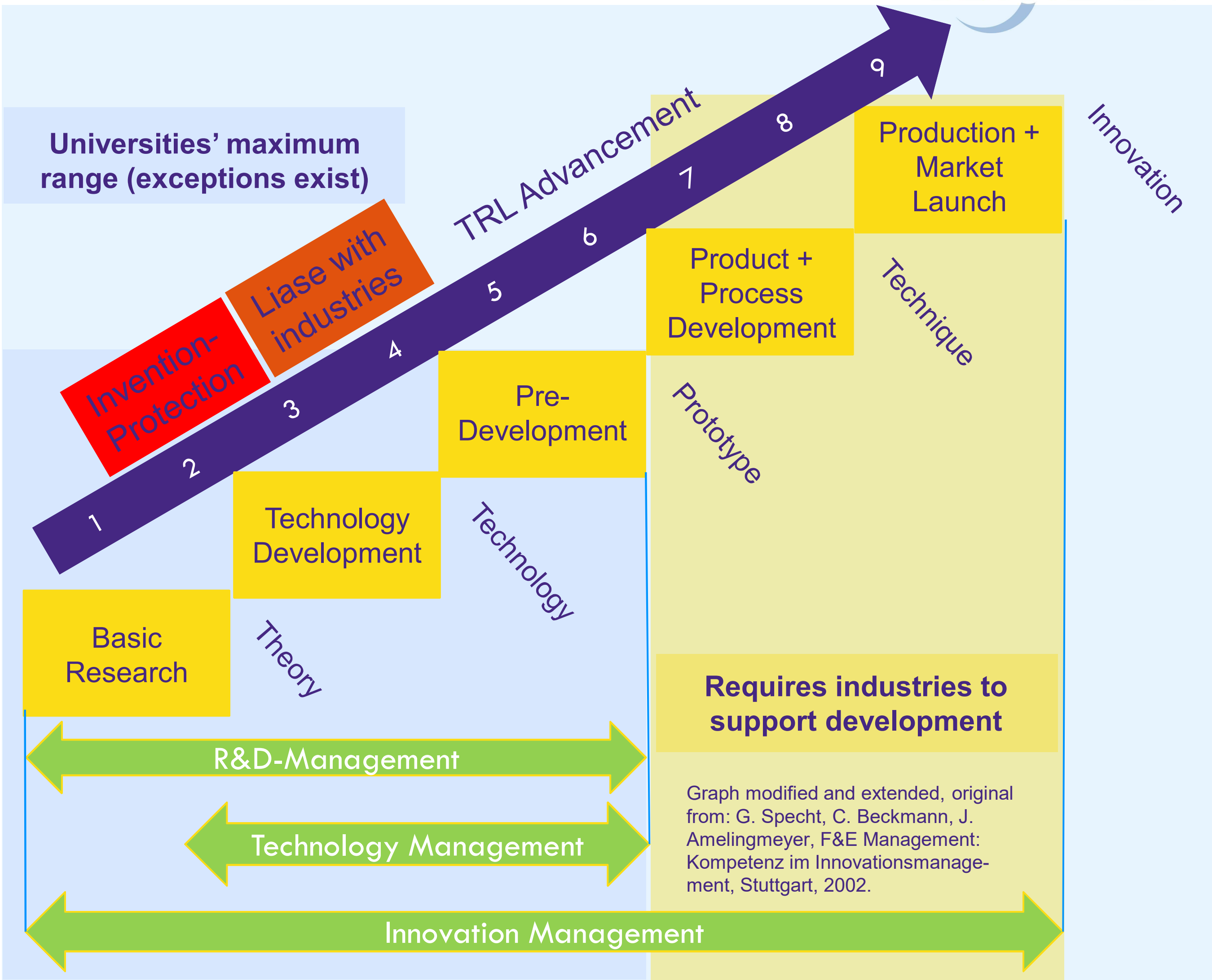
Way to (Market) Launch of a Product / Process

- TM part of R&D M. and this is part of IM (very simplified, there are at least 4 different views on this in literature). IM is a sub set of KM.

- Universities don't exceed TRL6 (exceptions exist)

- Follow-on development to be supported by industry

Knowledge Generation + need of innovative environment TT: Definition + aspects Relevant Research Results-Inventions Add. measures to promote "product" Summary



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Significance for TT from Product or Process Market Launch Development Process

DISCOVERER

- Mind: H2020 EU FET assumes low TRL
- **Use of TRL to demonstrate timing of patent.** Experimenting with invention in a lab → no block for patentability,
- However, using invention in public or in a commercial context can block IPR.

  → Patent applications should be filed at low TRL. (→ DISCOVERER!)

- **But:** Product development and launch requires both
  - Industry accompanying it and
  - Relevant funding schemes promoting it (…can be difficult)
- Early liaising, exchange and networking with relevant industries required
  - Collaboration from TRL3 recommendable

Risk balance of patenting at too low or too high TRL

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Some inventions….

- Gap between invention and product/process
  - Examples:

Total Internal Reflection
(William Wheeler, 1881)

Fiber Optics
1971

43 Years

Theory of Lasing
(A. Einstein, 1917)

First I Prototype Gas discharge laser 1950

X-Rays
(1895 – William Röntgen)

Few Years

1900's
Used in Medical Profession

Taken from: L.Crawford: Technology Transfer, Lecture, Brown University.

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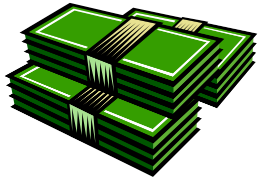
Some inventions….

- Gap between invention and product/process
  - Examples: “Need” preceded the product

Radar
(Patent, 1914)
unworkable

35 years

Nothing happened



1940’s
successful need
WWII

  - Speed to market dictates success or failure

  - “Extreme” example: Time to market in consumers electronics: < 1 year!

Taken from: L.Crawford: Technology Transfer, Lecture, Brown University.

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Innovation Management (DISCOVERER) → IPR (ex. WP4)

Task	IPR	Partner IPR	Update 04/11/2020
Task 4.2	Advanced intake incorporating a significantly increased efficiency	Specularly reflecting materials as contribution from UNIMAN would set UNIMAN as partnering entity. Analyses already performed with IRS PICLas (for intakes).	Would be worth to be assessed.
Task 4.2	Electrodeless thruster mitigating erosion and hence lifetime aspects with maximum propellant flexibility	Does not apply currently.	Already published using RF electrodeless plasma sources with magnetic nozzle. Birdcage antenna plasma source already patented by Helyssen Sarl. Chinese patent for Helicon ABEP.
Task 4.2	Method based on Faraday probe and/or Retarding Potential Analyzer to assess both momentum and impinging force of the local flow (→ potential thrust verification)	Does not apply currently.	
Task 4.2	Nozzle by either hybrid design using MHD elements or full MHD nozzle	Does not apply currently.	But promising pre-tests have already been performed with IEC plasma source (Yung-An Chan)
Task 4.2	Electron Beam induced Ionization to assess neutral particle flux: makes use of high energy electron flux to locally ionize the jet which will be assessed by Faraday Probe/RPA → neutral particle flux of the jet can be determined	Does only apply if used e.g. in UNIMAN facility. Significant effort. Electron beam source already existing.	Could be an interesting research-focused follow-on project. IRS could contribute probe techniques as well as an alternative electron gun.
Task 4.3	Candidate materials for intake and thruster (with flight approved low erosion due to atomic oxygen and appropriate level of particle reflection capabilities)	Origins from WP1 and belongs to WP1. Cross reference to WP4, so WP4 would be partner IPR	

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Significance for TT from Product or Process Market Launch Development Process (cont.)

7 potential patents just from DISCOVERER WP4 (ABEP)→ DISCOVERER: more than 10!

In addition:

- Existing patents can be improved by university institutes (mind: WP4 Helyssen and China examples)
- Can even be (re-)patented with improved design

- Patents can lead to several types of “benefit”
  - Licensing fees (e.g. for the university that has the patent and its inventors)
  - Budgets from selling a patent to interested entity (this can be even a patent that is shared between two entities where one of the two sells its “part” to the second)
  - Are part of the knowledge data base of an organisation

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TT and Innovation Promotors- some insights

- Study performed in reference outlined below. → **Most salient weaknesses: Communication between scientific research and industry + lack of mutual trust** (study in battery research)
- Suggestions to contribute to this observed issue: Identification + support of promotors in different stages of TT process. Thus, probability in initiation and realization of TT projects can be enhanced.
  - Especially lack of communication, experience exchange and mutual trust between university and industry have to be promoted
  - Motivates relationship promotor

Table 1: Barriers, power bases and innovation promotor roles in TT projects referring to [4].

Barrier type	Power base	Promotor role
Opposition, resources	Hierarchical potential, control of resources	Power promotor
Knowledge	Knowledge specialty	Expert promotor
Administrative	Organisational know-how, communication skills	Process promotor
Cooperation, dependency	Networking competence, potential for interaction	Relationship promotor

From: T. Hamadi, O. Krätzig, J. Leker, K. Meerholz, N. Sick, Technology transfer and innovation promoters: Insights from "Technology transfer between science and industry", Conference: Advanced Battery Power, March 2017

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Summary

1

- Successful TT needs adequately motivated environment and strategy. Network of trust needed within the concerned entity (→ promoters).

2

- Environment + strategy can be continuously improved making use of KM based tools. Depending on entity's branch and size these tools need not be that complex.

3

- DISCOVERER has achieved this successfully via the IM driven measures within the conditions that a consortia project as such has (mentorship, IM approaches).

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Thank you!

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TT and Innovation Promotors- insights 2

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Table 2: Results from the questionnaire in order of the frequency of equivalent answers.

Rank	Strengths	Weaknesses	Opportunities	Threads
1st	Well-trained specialists	Communication / exchange of experience and mutual trust	Enormous innovation / efficiency potential at interface	Competitive research collaborations by financially strong corporations
2nd	Mutual interest of science and industry	Lack of commitment	Synergies exist, technology transfer is suitable as a cooperation level	Legal / political obstacles
3rd	Well-developed scientific infrastructure	Financial conditions	An acceleration of knowledge transfer is possible through competence centers	Technology transfer can lead to unwanted knowledge drain

From: T. Hamadi, O. Krätzig, J. Leker, K. Meerholz, N. Sick, Technology transfer and innovation promoters: Insights from "Technology transfer between science and industry", Conference: Advanced Battery Power, March 2017

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Example: Patents

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Current list (most of the items have also relevance for technology transfer):

1. ~~Sensor system based on intake → competing invention: Patterson Probe!~~
2. Advancement of intakes based on specularely reflecting materials in work
3. Helyssen Type Helicon Thruster still open
4. Oxygen source patent
5. Material based patent(s)

6. …. any other?

→ **Need to accelerate both disclosure and patent process in order to be able to achieve some of them during the project phase.**

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Management

KM, IM, TM, R&D M

1. KM: Creation and coordination of learning processes (knowledge transformation) in organisational structures. Holistic KM includes generation and maintenance of structural frameworks that support learning processes in organisations.

2. IM: Systematic planning and control of innovations in organisations. In contrast to creativity, that refers to development of ideas, IM also assesses the recovery of ideas and their transformation into commercially successful products or processes.

3. TM is a set of management disciplines that allows organizations to manage their technological fundamentals to create competitive advantage. Typical concepts used in TM are:
   - Technology strategy (a logic or role of technology in organization),
   - Technology forecasting (identification of possible relevant technologies for the organization, possibly through technology scouting),
   - Technology roadmap (mapping technologies to business and market needs), and

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