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Technology Transfer and Commercialisation

01. Technology Transfer

02. Valley of the death and Technology Readiness Level (TRL)

03. Commercialisation

04. Approaches to tackle the research – business gap

05. The role of Government

01. Technology Transfer

Technology Transfer: Definition

The flow of know-how, experience and equipment amongst different stakeholders such as governments, private sector entities, financial institutions, NGOs and research institutions

Source: United Nations - UNCTAD series Transfer of Technology 2001

The transfer of new technologies from universities and research institutions to parties capable of commercialization

Source: World Intellectual Property Organization

Technology Transfer: Definition

Technology Transfer (TT) is the process of transferring:

- ✓Technologies
- ✓Skills
- ✓Knowledge
- ✓Methods of manufacturing
- ✓Samples of manufacturing (prototype, demonstrator, sample products)
- ✓Facilities

Source: Wikipedia

Technology Transfer: Aims and Ways

AIMS:

- Valorisation of R&D results and intellectual assets
- Increase accessibility of technology developments to a wider range of users
- Development and exploitation- including commercial – into new products, services & applications
- Increase competitiveness

WAYS:

- From **Academia (technology donor)** to **Industry (technology receiver)**
- Among **different industrial sectors**

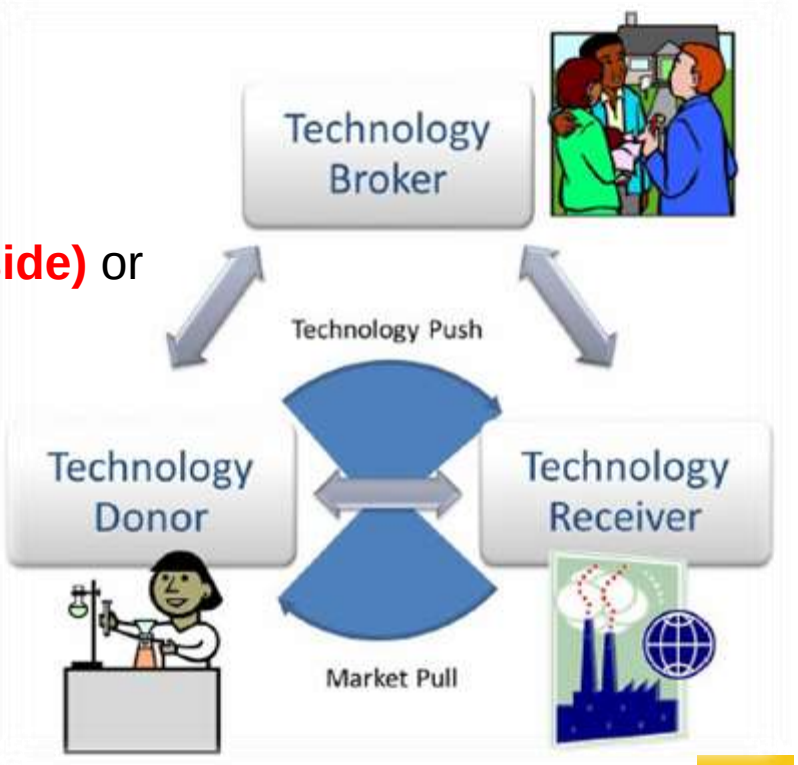
Source: Innovation Policy Platform

Technology Transfer: Mechanism

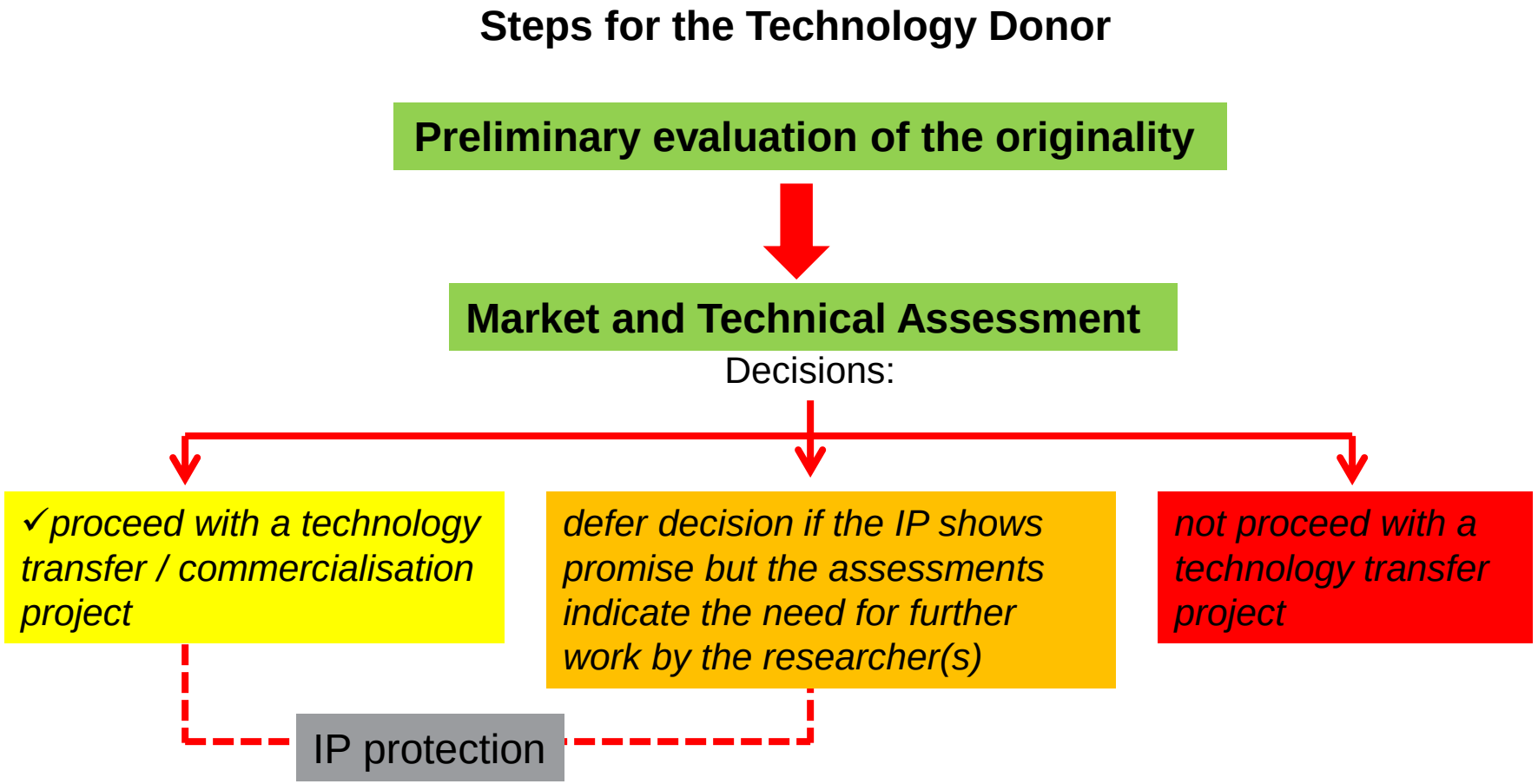
Technology transfer from Donor to Receiver may occur **directly or through public or private technology brokers/agencies etc**.

The transfer may be originated by:

- **Technology push (from the research side)** or
- **Market pull (from the industry side)**



Technology Transfer: Mechanism



Technology Transfer: Mechanism

Steps for the Technology Receiver

Evaluation of Business Opportunity

- Industry / Company business need
- Technology Readiness
- Market
- Innovation costs, including marketing

Identification of Suitable Business Strategy

IPR Agreement with Technology Donor

Technology Transfer: Mechanism

Steps for the Technology Broker

Access

❖ Access to industries and generate product innovations

Acquisition

❖ Acquiring new knowledge helps to understand with the existing technologies

Storage

❖ Storing specific knowledge, maintaining and refreshing that knowledge

Retrieval

❖ Bringing stored knowledge of potentially valuable technological solutions

Source: http://en.wikipedia.org/wiki/Technology_brokering

Technology Transfer: International Scope

International Technology Transfer encompasses the transfer of technologies and technology cooperation among countries:

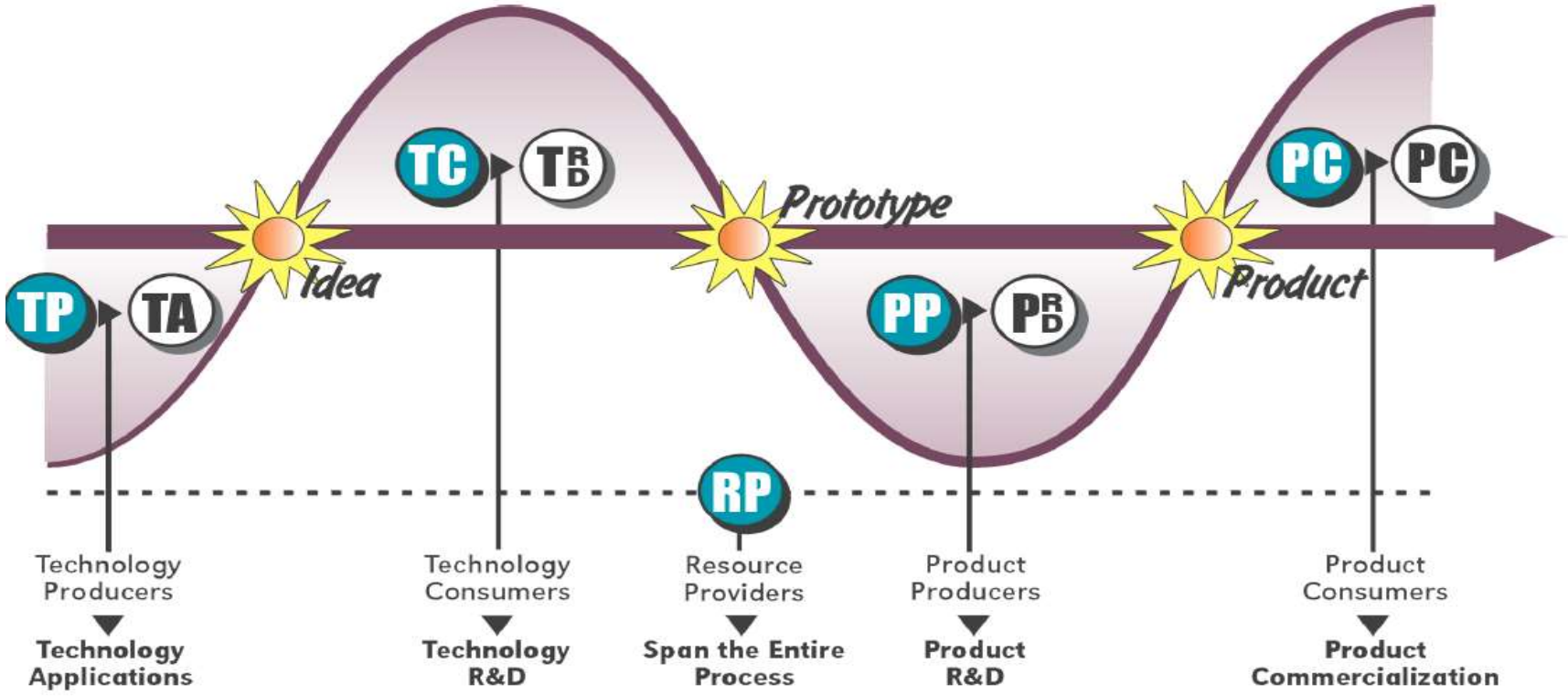
1. Between developed countries, developing countries and countries with economies in transition
2. Amongst developed countries
3. Amongst developing countries
4. Amongst countries with economies in transition

Technology transfer results from actions taken by various stakeholders, including:

Technology Transfer: Stakeholders Involved

Stakeholder group	Members
Technology producers	Independent inventors; researchers in universities; state laboratories; private laboratories
Technology consumers	Private sector manufacturers, government agencies; intellectual property brokers
Product producers	Private sector manufacturers; distributors; value-added retailers
Product consumers	End-users; professional service providers
Resource providers	Government agencies; inter-governmental institutions and donors; financial sector; technology transfer intermediaries

Technology Transfer: Stakeholders involved



Source: T2RERC, State University of New York, University at Buffalo

Technology Transfer: Networks and Partnerships

In the process of technology transfer partnerships and networks of various stakeholders are also often involved and may depend on the coordination of multiple organizations, such as:

- Networks of information service providers
- Networks of business consultants
- Networks of financial firms
- Partnerships among stakeholders

Interactions between Research and Industry – New Trends

- **Industry - Open Innovation Approach**
  - Companies are developing open innovation approaches to R&D – combining in-house and external resources
  - Treating public research as a strategic source

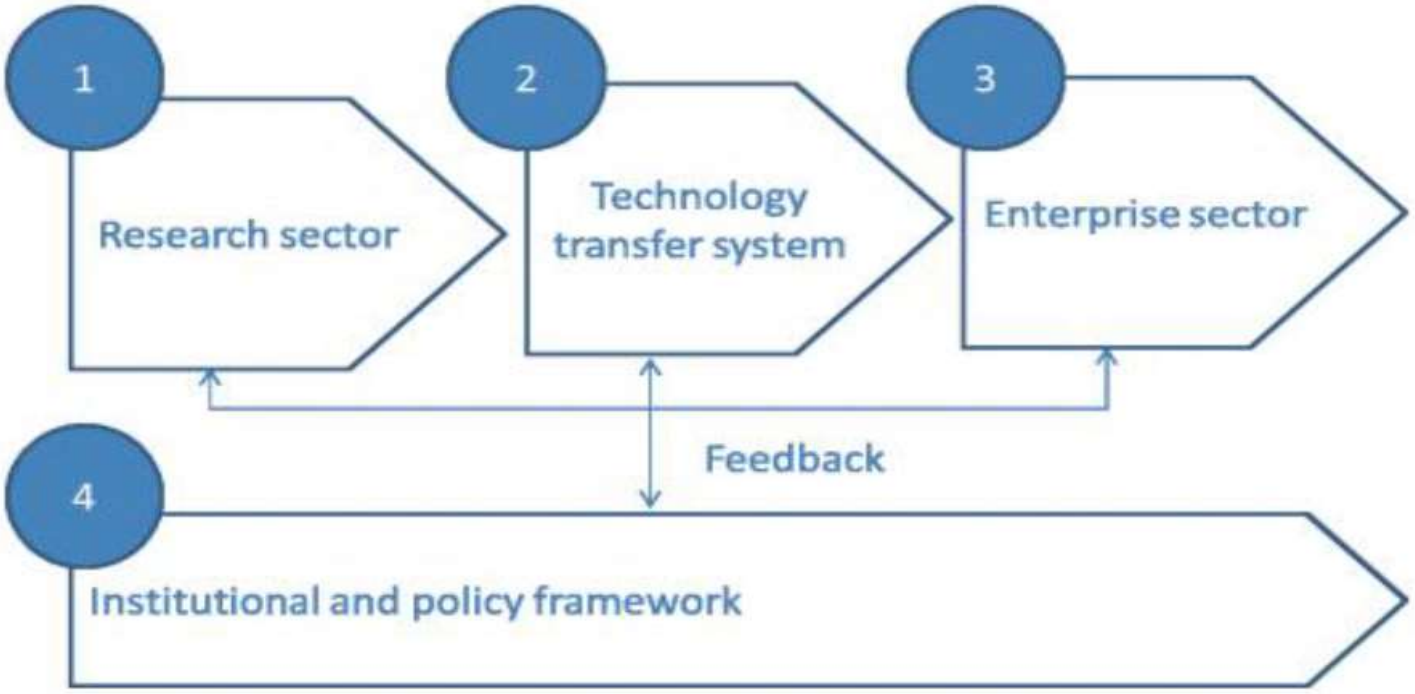
- **Academic Community – Seeking Additional Sources of Funding**
  - Institutions are taking a more proactive role in generating a financial return from research results.
  - Treating industry and the market as a potential funding sources.

Technology transfer and commercialisation do not evolve naturally and linearly from research and the discovery of scientific solutions.

Source: Innovation Policy Platform, OECD & World Bank

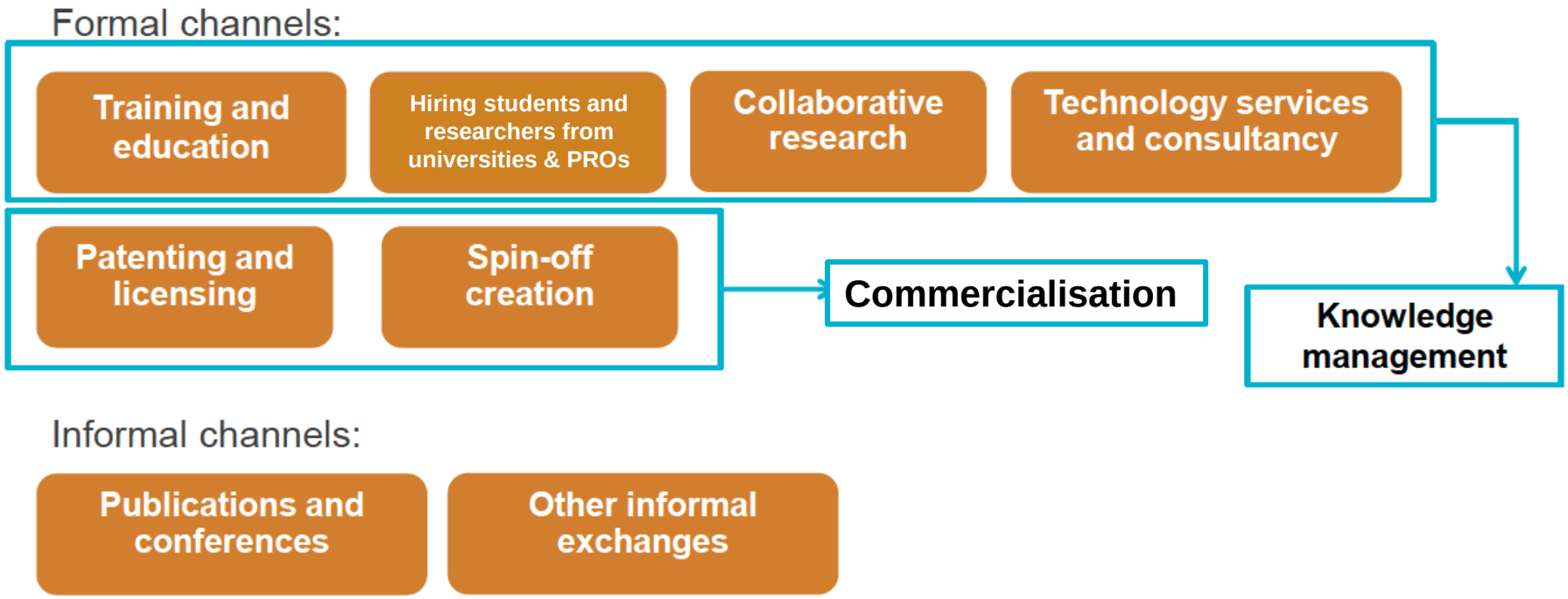
In the early days of transfer and commercialisation, the process was considered to be a linear progression:

Today, however, it is understood the process is highly **Non-Linear**

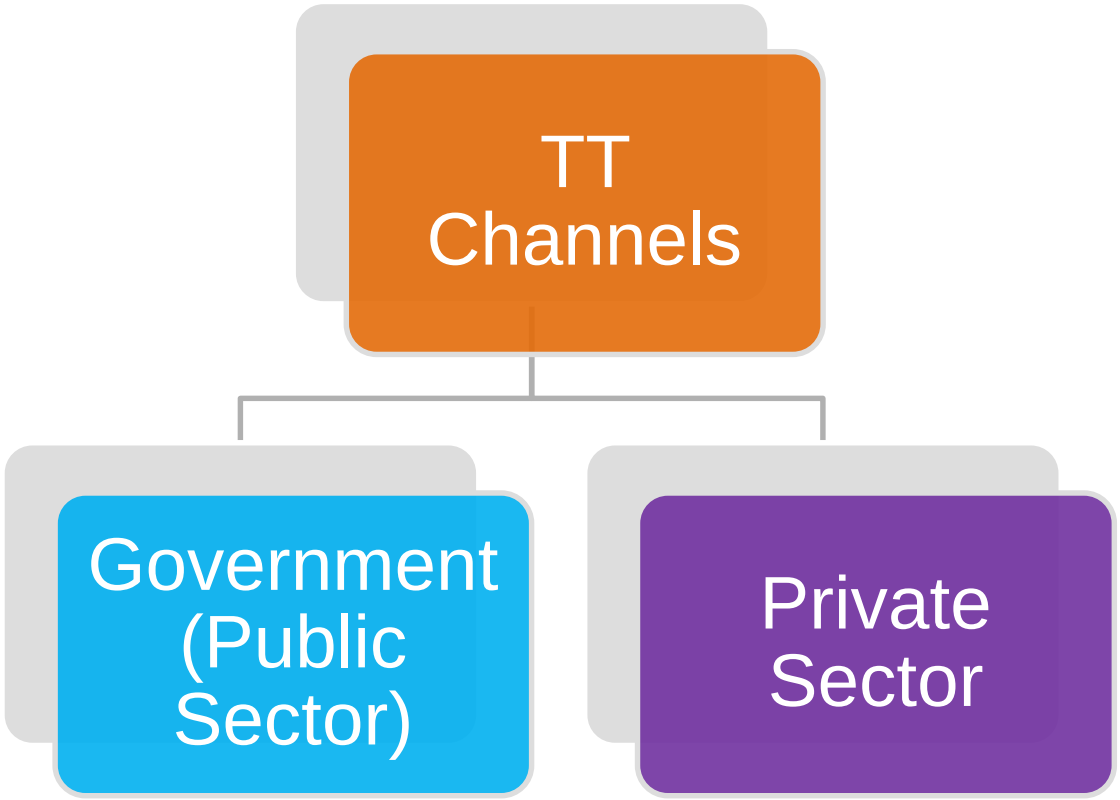


Source: World Bank, Overview of the Research and Innovation Sector in Western Balkans, 2013

Technology Transfer: Channels (Types)



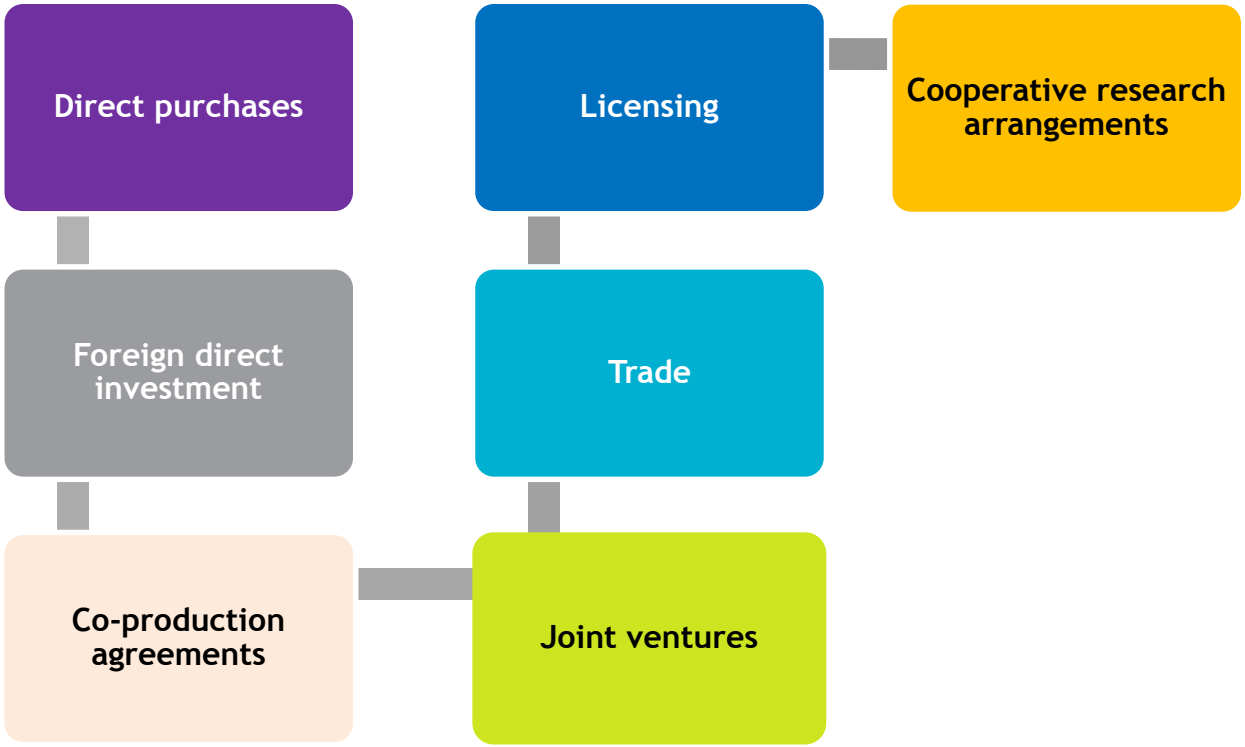
Technology Transfer: Channels (Providers)



Technology Transfer: Channels (Government)

Common Government (Public sector) channels include:

Technology Transfer: Channels (Private Sector)



PRIVATE SECTOR CHANNELS CAN BE HIGHLY INFLUENCED BY GOVERNMENT POLICIES

Technology Transfer: Channels (Private Sector)

✓ The **private sector channels** need special emphasis as they are regarded as the **more essential channels for technology transfer**.

✓ Companies have an **interest in external exploitation** of their technology (i.e. Technology transfer).

✓ Companies may perform **intra-firm technology transfer** (within the same company) and **inter-firm technology transfer** (between different companies).

Technology Transfer: Motivations and Barriers

The rate of transfer of technology is influenced by:

Technology Transfer: Values

- ✓Institute Image/Reputation
- ✓Solve real world problems
- ✓Attract creative researchers
- ✓Create public benefit
- ✓Build closer ties to industry
- ✓Local economy development
- ✓Access to R&D resources & partnerships
- ✓Jobs creation
- ✓Incentives for creative people

Technology Transfer: Motivations and Barriers

Firms are **motivated** to acquire technologies due to the potential for:

- Cost reductions (e.g. Production costs) and/or increase in revenue
- Increased technical capabilities or quality reductions that cannot be achieved on their own
- Higher perceived status of "international level" technologies
- Access to managerial and marketing expertise, and sources of capital
- Greater access to export markets
- Access to new distribution networks

Source: UNIDO - Innovative Technology Transfer Framework Linked to Trade

Technology Transfer: Motivations and Barriers

Universities are **motivated** to engage in tech transfer:

- To strengthen and establish research partnerships with industry
  - Contract research and collaborative R&D grants
  - Patents and licensing may have a faciltating/signalling role
- To support entrepreneurship
- To create technological standards and disseminate technology
- In-ward tech transfer: learning from industry
- To retain research teams and excellence through control of key technologies
- And last: It is motivating to have extra income

Technology Transfer: Motivations and Barriers

Possible **barriers** include:

- Lack of **human capital**
- Lack of **absorptive capacity**
- Lack of **connectedness**
- Lack of **trust**
- Lack of **prior experience** with partnerships
- Lack of **integrated policy and support**

Source: UNIDO - Innovative Technology Transfer Framework Linked to Trade

02. Valley of the death and Technology Readiness Level (TRL)

Europe & “Valley of Death” – Reasons

Major issues:

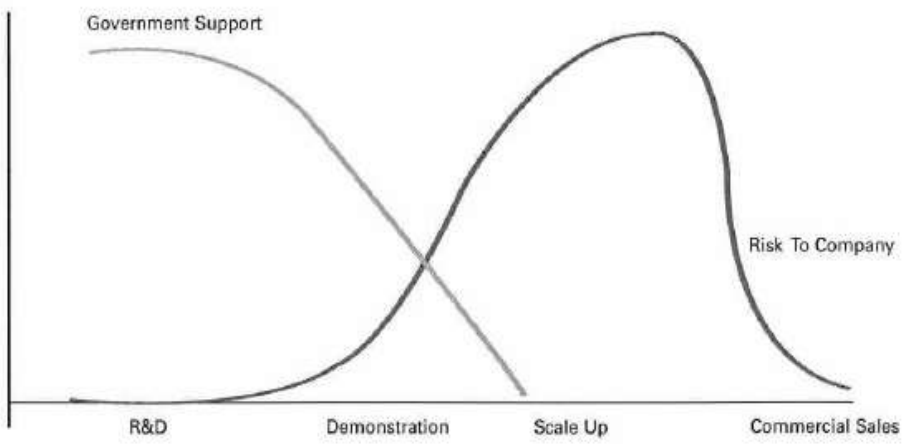
- **Difficulties in translating ideas into marketable products**
  basic R&D far from market: Needs further development/orientation and more funds to be more “usable ”

- **Risks**
  The private sector/investors will not pick up this R&D because it is too risky (has not been fully “applied” yet)

Europe & “Valley of Death” – Reasons

- Analysis identifies the **most significant problem hindering innovation**: manufacturers wait until there is a demonstrated demand before they develop and commercialise technologies, but buyers wait to see the product on the market before they demonstrate they will buy it (ten Cate et al, 1998).
- This problem arises because companies usually decide to invest in innovation by making a comparison of their likely benefits against the risks of their investment
- It is difficult for firms to share this risk, which has proved to be a **major barrier to the development and commercialisation**

Model of risk profile for companies of innovation processes



Source: DTI (2006:13).

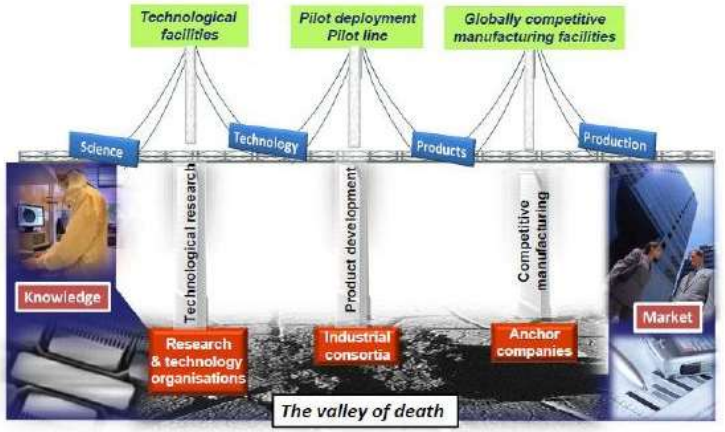
Europe & “Valley of Death” – Bridging the issues

Constructing a bridge comprising **three pillars**:

1) The **technological research pillar** based on technological facilities supported by research technology organisation;

2) The **product development pillar** based on pilot lines and demonstrator supported by industrial consortia;

1) The **competitive manufacturing pillar** based on globally competitive manufacturing facilities supported by anchor companies

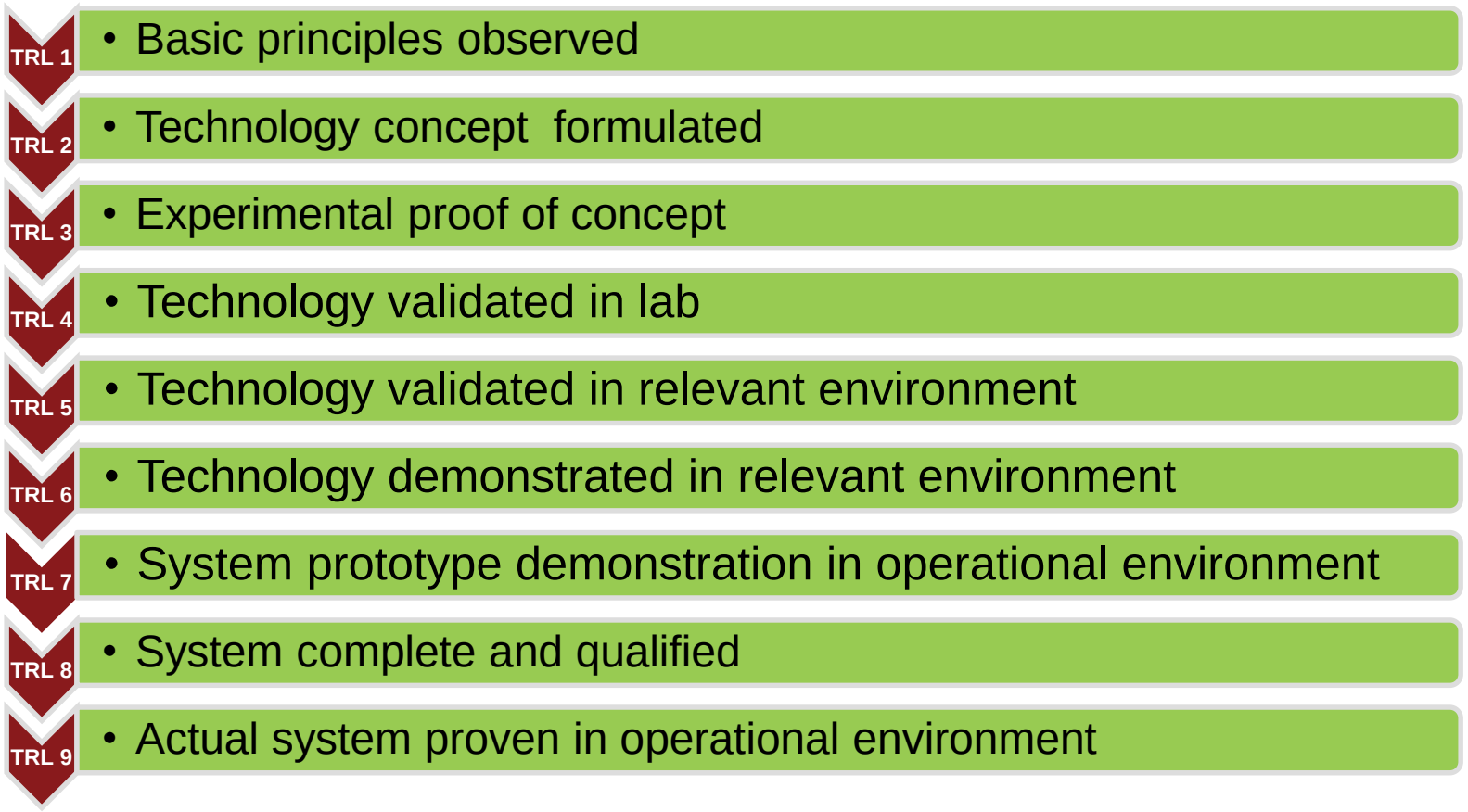


Source: High-level Expert Group On Key Enabling Technology Report

What is Technology Readiness Level (TRL)?

- Technology Readiness Levels (TRLs) are used as a measurement of the maturity level of particular technologies
- Providing a common understanding of technology status
- Addressing the entire innovation chain
- By evaluating a technology project against the parameters for each TRL, one can assign a TRL rating to the project based on its stage of progress.
- 9 technology readiness levels; TRL 1 being the lowest and TRL 9 the highest.

Technology Readiness Levels (TRL) in a nutshell



Source: http://ec.europa.eu/

Technology Readiness Levels (TRL) – Processes

TRL 1 – Basic principles observed

Lowest level of technology readiness. Scientific research begins to be translated into applied research and development.

TRL 2 –Technology concept formulated

Once basic principles are observed, practical applications can be formulated.

TRL 3 – Experimental proof of concept

Active research and development is initiated.

TRL 4 – Technology validated in lab

Design, development and lab testing of technological components are performed.

TRL 5 – Technology validated in relevant environment

The basic technological components are integrated together with realistic supporting elements to be tested in a simulated environment.

TRL 6 – Technology demonstrated in relevant environment

The prototype, which is well beyond that of TRL 5, is tested in a relevant environment.

TRL 7 – System prototype demonstration in operational environment

Prototype is near, or at, planned operational system level. The final design is virtually complete.

TRL 8 – System complete and qualified

Technology has been proven to work in its final form under the expected conditions.

TRL 9 – Actual system proven in operational environment

The technology in its final form and is ready for commercial deployment.

Source: http://ec.europa.eu/

Technology Readiness Level (TRL) – Roles

It is also useful to:

- ✓ Evaluate the development status of a given technology/material etc;
- ✓ Make decisions concerning technology funding
- ✓ Make decisions concerning transfer of technology.

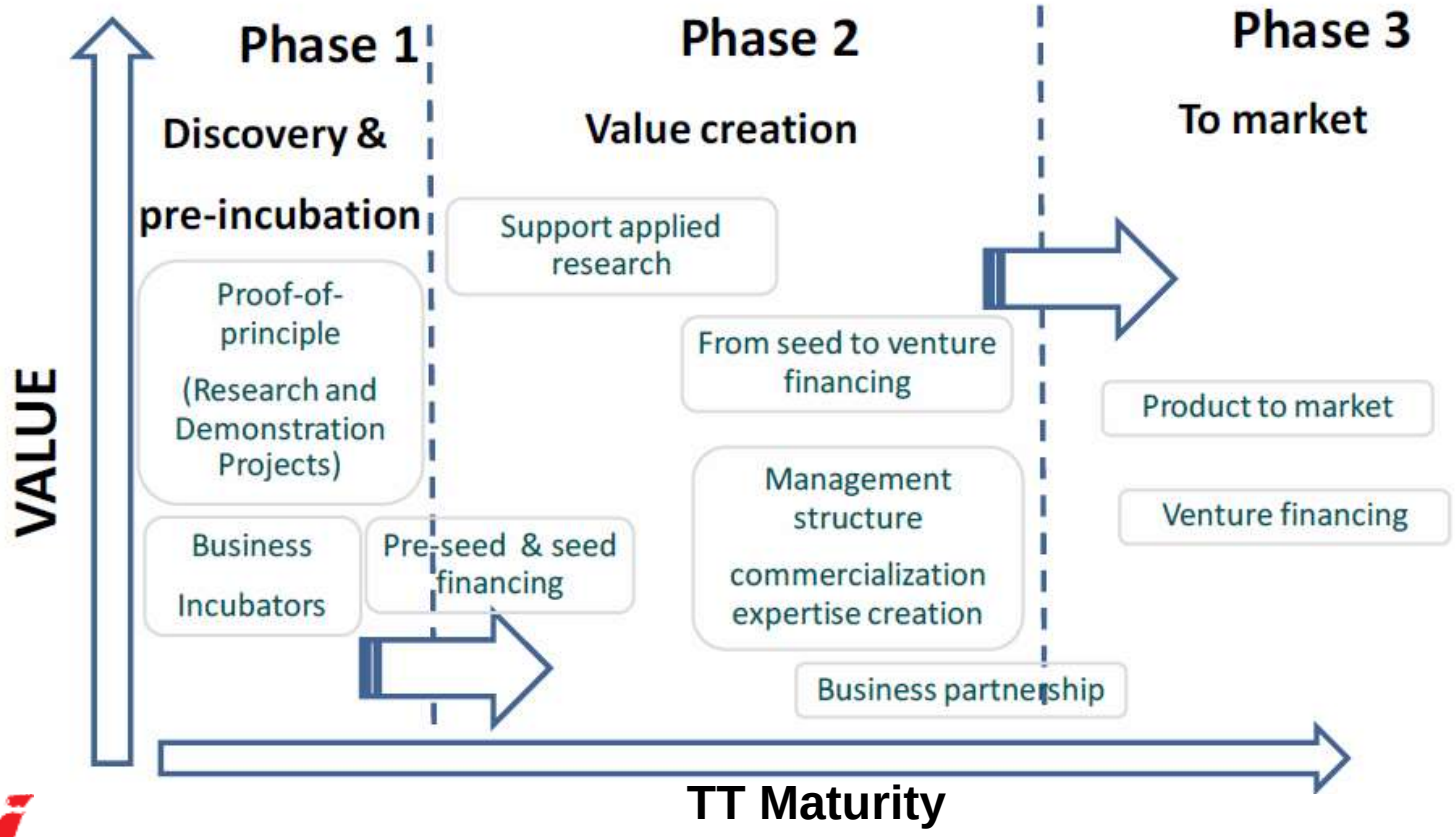
TRL as a measure for Technology Transfer!

Limitations of the use of TRLs

- **Doesn’t pay attention to setbacks in technology maturity**: State of a technology in pilot production can be sent back to another TRL level, if there are problems arising at any given stage.
- **Single technology maturity approach**: Higher TRL aren’t easily applicable to component development, which are not of huge complexity.
- **Sole focus on product development**: readiness of innovation to go to market, or organisational readiness to implement the innovation are not taken into account in TRL scale.
- **Context specificity of TRL Scales**: The scale to be used has to be carefully chosen based on the organisation’s needs.

Innovation Financing solutions

After identifying TT maturity level, Technology donors or receivers may need to have access to different type to innovation financing solutions :



03. Commercialisation

Commercialisation is a specific case of technology transfer:

It occurs when the party transferring technology receives money [consideration] in exchange for giving up some or all their rights to the technology. In involves a sale.

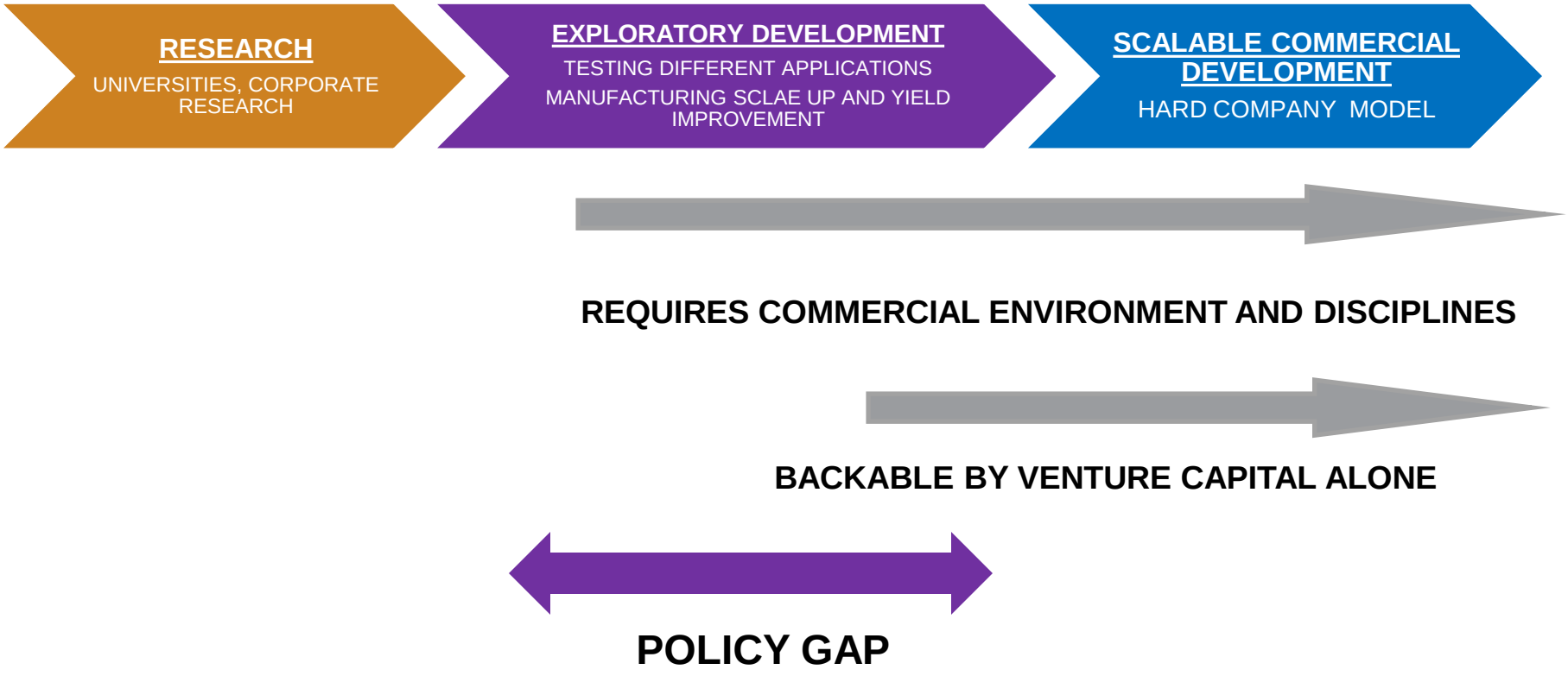
Source: Foresight Science and Technology Inc., What Every Researcher Needs to Know about Commercialization, 2008

What can be commercialised?

Any science, technology or engineering insight that might enable manipulating the world in a novel way and for which there is a demand

- Ideas and concepts alone can not be commercialised. It is necessary that they become inventions, i.e., that they can be reduced to practice
- If no demand exists, the technology will not be commercialised.

Commercialisation Process and Industry Differences



Source: UK Science and Technology Committee report 2013

Technology can be commercialised. Now what?

- Three main vehicles are normally considered relevant to bring a technology to the market: **internal development and use; spin-off creation; licensing**

- **Internal development and use**

  - Makes more sense if the researcher works in a company with the capability to produce and sell the invention or apply the invented process to make and sell products
  - Not particularly applicable to university and research centre work, unless developed under a strategic alliance with a firm

Technology can be commercialised. Now what?

- **Spin-off creation**
  - Makes sense if there is very profitable intellectual property to be explored and an entrepreneurial and business savvy management team
  - Might need investment if the technology needs maturing and further development

- **Licensing**
  - When the other two vehicles do not seem suitable. Good solution for academic researchers not interested in pursuing a business career
  - Can be used together with spin-off creation to produce joint ventures

Technology can be commercialised. Now what?

- Greatest risk is associated with spin-off creation

- Criteria to determine the opportunity of spin-off creation

  – Range of market opportunities for the technology. Does a competitive advantage exist?
  – Is the intellectual property portfolio strong enough?
  – Is the management team good enough?

Important issue to consider – Intellectual Property

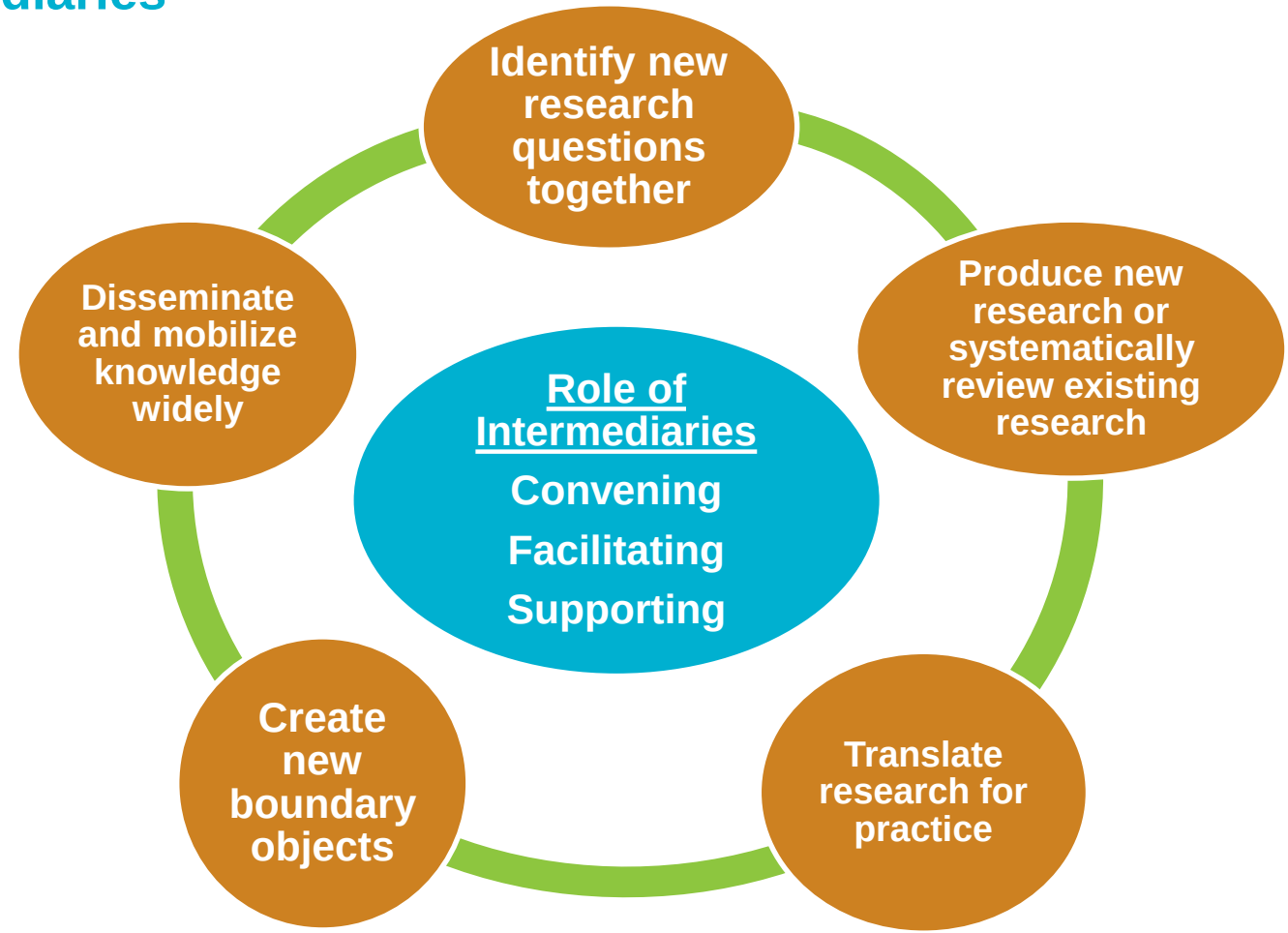
- Converting intellectual assets into intellectual property is a key step in technology commercialisation
- It is important to document all research work steps since the very beginning – Inventor Notebook/Lab book/signed records. Get the documentation witnessed
- Initial disclosures of work should be protected by Non-Disclosure Agreements (NDA)
- Not everything can be pattented and not everything should be pattented

Some relevant thoughts

- Commercialisation is about selling. Money gained from commercialisation can feedback into research work., but it is not the sole reason for tech transfer.
- Exposure is necessary. Successful commercialisation is achieved by pro-active researchers who go out there and engage relevant stakeholders
- Good deals are win-win. Contrary to some popular culture, greed is not always good.
- Getting rich is a long shot, but an important motive. While technologies can garner nice bonuses, most are not big hits for their inventors – typically generating under 10,000 USD

04. Approaches to tackle the research – business gap

The Activities That Bridge Research and Practice and the Role of Intermediaries



Source: Bridging the Research–Practice Gap
Bansal, Bertels, Ewart, MacConnachie, and O'Brien - 2012

Intermediaries example

- Technology Transfer Offices

The Role of Technology Transfer Offices

The role of Technology Transfer Offices. What are they?

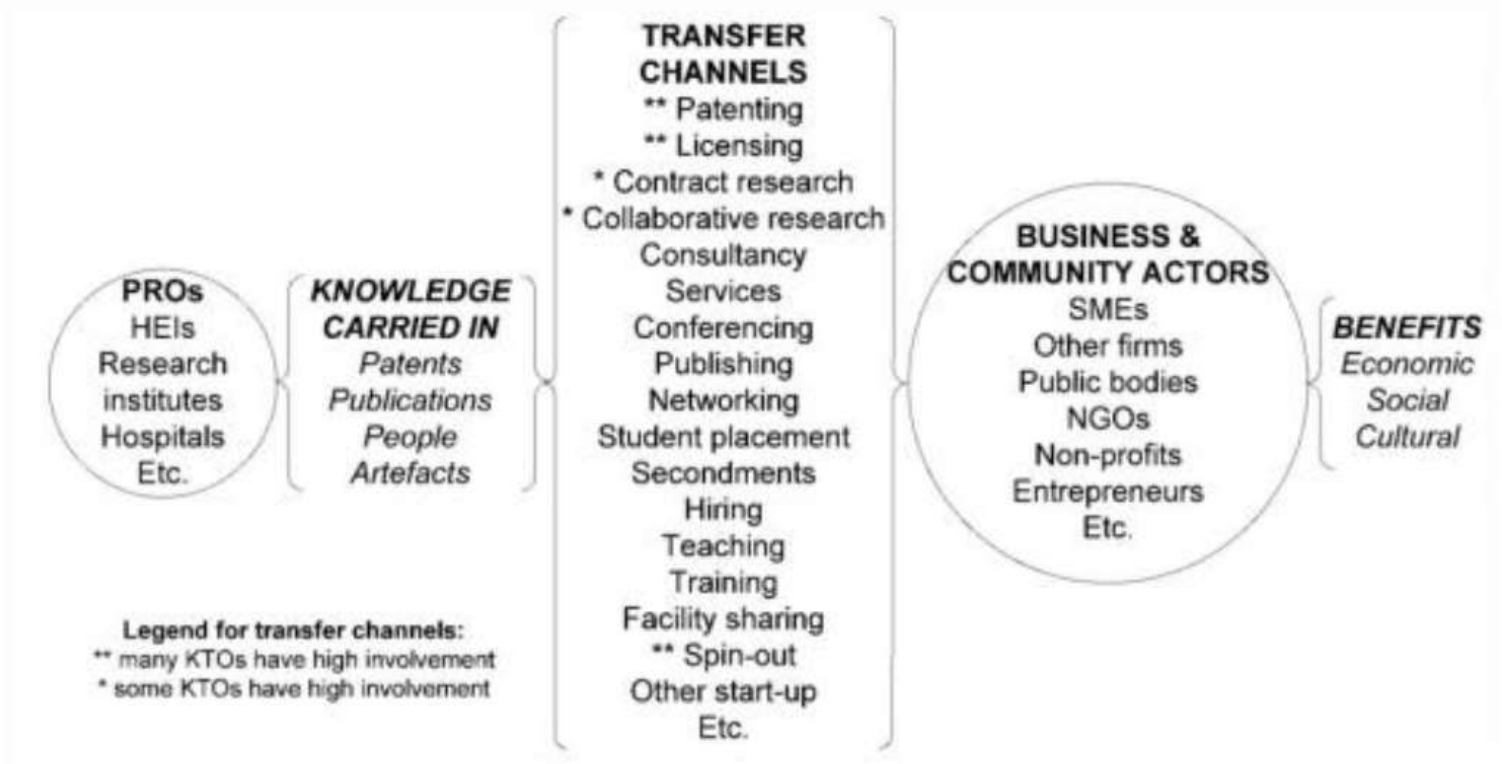
(…) structures whose common core role is to assist public research organisations (PROs) in managing their intellectual assets in ways that facilitate their transformation into benefits for society. In doing this, the TTO helps to bridge the gap between research and innovation.

Source: Innovation Policy Platform, OECD & World Bank

What do they do?

- Establish relationships with firms and community actors
- Generate new funding support from sponsored research or consulting opportunities
- Provide assistance on all areas related to entrepreneurship and intellectual property
- Facilitate the formation of university-connected companies utilising PRO's technology (start-up) and/or university people (spin-off) to enhance prospects of further development
- Generate net royalties for the PRO and collaborating partners.

What do they do?



Source: Innovation Policy Platform, OECD & World Bank

How do they work?

Motivations

The innovation paradox – linear model and underutilisation of research result

New rationale – academia-industry links

New legal frameworks – university patents

Need of a procative approach

New challenges – efefctiveness of IP management

Resources

Organisational – model and legal incentives

Financial – PRO budget, licencing, capital gains, overheads of contract reserch

Human – legal, business, technical

Network – establishment of links

Interactions

The PRO Community – researchers, students, administrative staff (inside)

Industry, business and community – making deals and growing companies

Government and public bodies – making deals, influence in policy making

Evaluation

Processes not harmonized

Indicator-based assessment

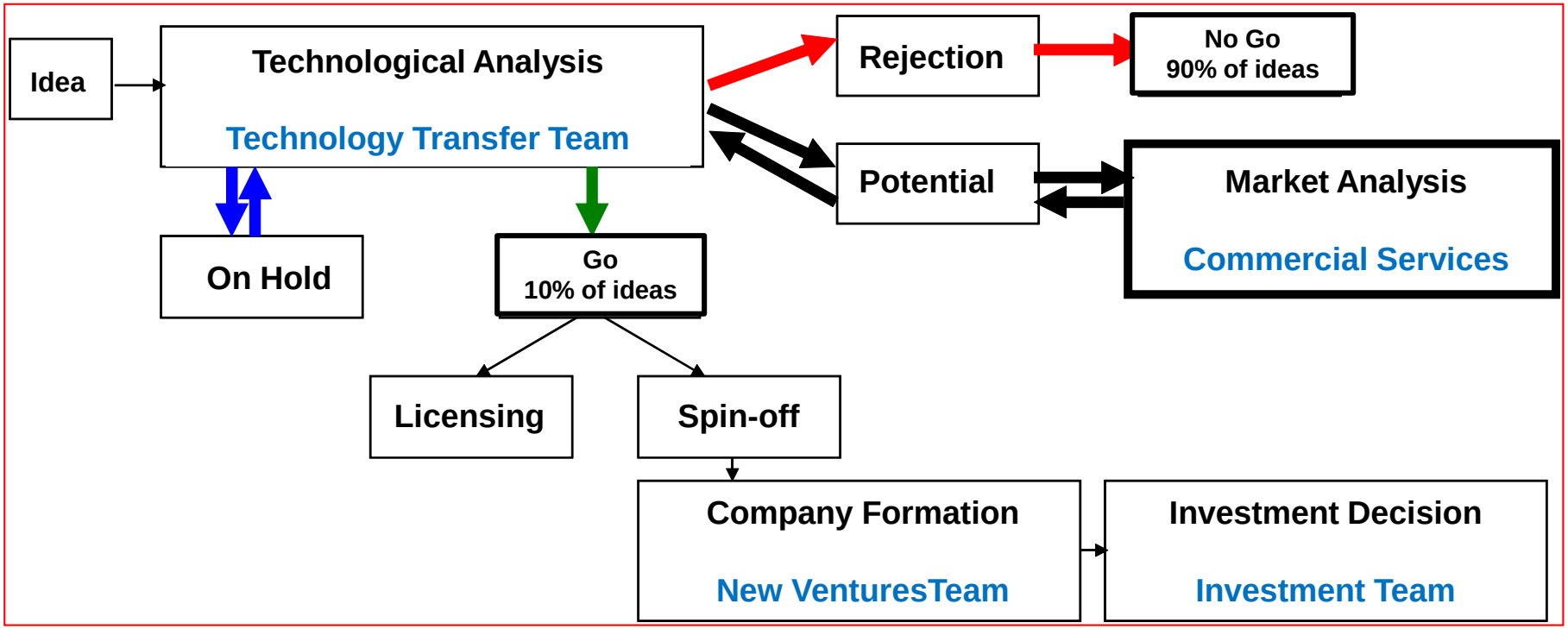
AUTM indicators:

- invention disclosures
- patent applications
- patent grants
- number of licenses executed
- established gross license revenue
- number of spin-offs / strat-ups

TTO are sensitive to policy intervention

- Governments shape the legal framework for IP management
- The mindset of PROs can be re-formated to have them acknowledge and treasure the role of TTO – codes of practices
- TTO have the need to acquire the necessary human, financial and organizational resources
- Allocation of resources to the TTO can be tied to performance to incentivize improvement and evaluation practices

A good practice example – Imperial Innovations (UK)



Source: http://www.fitt-for-innovation.eu/index.php?id=fitt_marketing, as of January 30, 2011
Slide provided by Technopolis

A good practice example – UTEN@Austin (US – Portugal)

- UTEN is funded by Fundação para a Ciência e a Tecnologia (FCT) through the Portuguese Ministry of Science, Technology and Higher Education and establishing a collaboration with The University of Texas at Austin, USA on T**echnology Transfer and Commercialisation called UTEN@Austin**.

- The mission of UTEN@Austin is to help build a globally competitive and sustainable science and technology commercialisation infrastructure in Portugal.

FCT Fundação para a Ciência e a Tecnologia

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

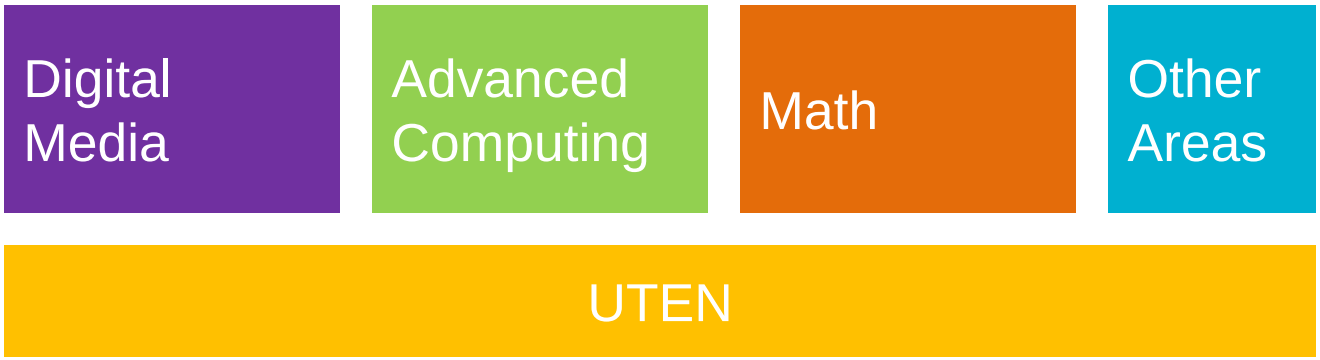
UT Austin | Portugal

International Collaboratory for Emerging Technologies, CoLab

THE UNIVERSITY OF TEXAS AT AUSTIN

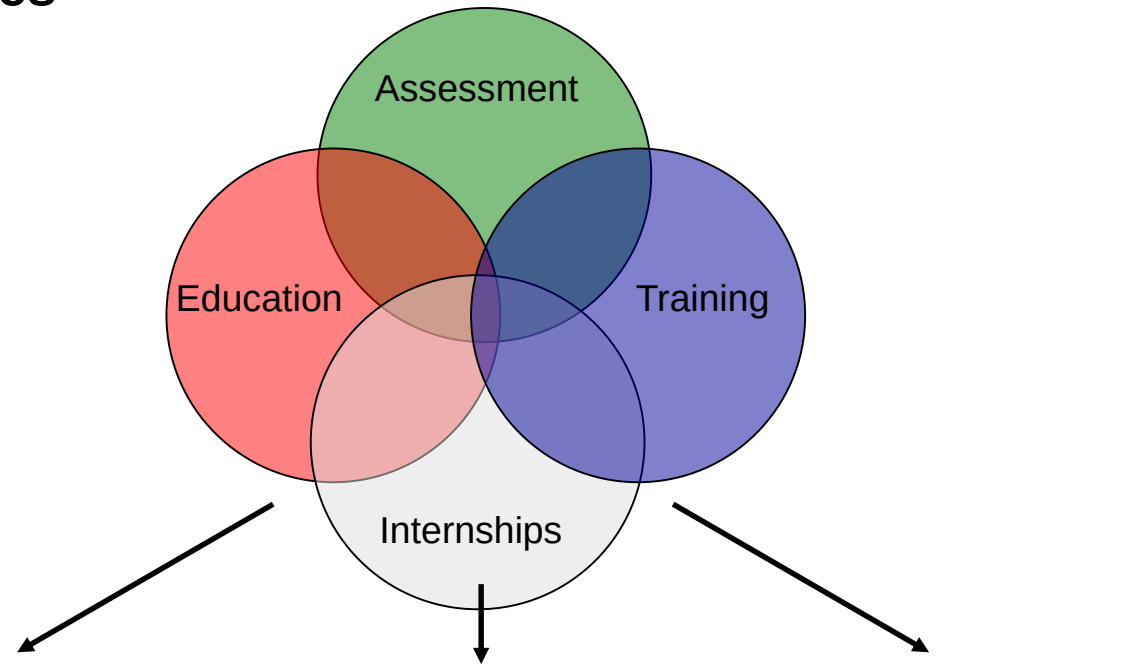
A good practice example – UTEN@Austin (US – Portugal)

- **UTEN@Austin** is one of four programs in the International Collaboratory for Emerging Technologies, or *CoLab*. UTEN works toward sustainable technology transfer in the program areas, and in other disciplines.



A good practice example – UTEN@Austin (US – Portugal)

- **UTEN Activities**



A good practice example – UTEN@Austin (US – Portugal)

Success Story : US Connect Case Study

- *US Connect* pilot program to help Portuguese start-ups make the transition to global markets, primarily by closing business deals in the United States. UTEN helps on develop a commercialisation plan and conduct business development activities towards the closing deals in the United States.

- Companies involved: BIOALVO, FeedZai, Sonicability & GimmeDaBlues, Tecla Colorida, Technophage, WS-Energia

A good practice example – Coway International TechTrans Co., Ltd (China)

Channel: Government Assistance Programmes/Licensing/Joint Ventures

Founder: Tsinghua University (Leading University in China for S&T)

Coway's Supporting Role in:

- Torch High Technology Industry Development Center (Torch Center) - Ministry of Science and Technology
- Beijing Municipal Science & Technology Commission
- China Innovation Relay Network (CIRN)

COWAY
Coway International TechTrans Co., Ltd.

Source: Coway International TechTrans Co., Ltd; www.coway.com.cn

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A good practice example – Coway International TechTrans Co., Ltd (China)

Approach

Coway's business model includes the following four aspects:

- Professional International Technology Transfer(ITT)
- Knowledge Transfer
- Technology Commercialisation
- Technology Localisation

Source: Coway International TechTrans Co., Ltd; www.coway.com.cn

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A good practice example – Coway International TechTrans Co., Ltd (China)

Successful Case Study of ITT Supported by Coway

Beijing Coway BioWorks BioTech Co., Ltd

- Coway identified Bioworks, a spinoff company of the Conell University specialising in bio-pesticide.
- In 2009, Coway and BioWorks established a Joint Venture with registered capital of 5 million RMB (0.8 million USD). It has been increased to 20 million RMB (3.2 million USD).
- Products have been successfully commercialized in the Chinese market.

Source: Coway International TechTrans Co., Ltd; www.coway.com.cn

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A good practice example – SUSTAIN EU-ASEAN: Sustain and enhance cooperation on sustainable development between Europe and Southeast Asia (EU - ASEAN)

Summary:

- SUSTAIN EU-ASEAN main focus is on climate action, resource efficiency and raw materials – and aims to enhance collaboration between researchers in the EU and the ASEAN region.
- The project is driven by the assumption that extensive knowledge has been generated by EU-funded projects relevant for the ASEAN region. However, the uptake of the research results and potential joint innovations should be improved.

- More information at http://cordis.europa.eu/projects/rcn/109786_en.html

A good practice example – SUSTAIN EU-ASEAN: Sustain and enhance cooperation on sustainable development between Europe and Southeast Asia (EU - ASEAN)

Project Consortium:

Project brings together organisations from all over Europe.

The project coordinator is the Freie University of Berlin (Germany).

The consortium also includes third country participation from:

- Thailand
- Laos
- Philippines
- Vietnam

A good practice example – SUSTAIN EU-ASEAN: Sustain and enhance cooperation on sustainable development between Europe and Southeast Asia (EU - ASEAN)

Approach:

- Transfer of technology and knowledge in a coherent way is vital for sustainable development leading to economic prosperity, social cohesion and environmental integrity.
- SUSTAIN EU-ASEAN draws primarily on EU funded projects focusing on these issues from various programmes, such as FP7, SWITCH-Asia, International cooperation and others.
- It will also use experiences from the ASEAN region and bilateral projects to feed into the mutual learning process.

A good practice example – SUSTAIN EU-ASEAN: Sustain and enhance cooperation on sustainable development between Europe and Southeast Asia (EU - ASEAN)

Results:

- Identify and cluster EU-funded projects on climate action, resource efficiency and raw materials issues relevant for the ASEAN region, analyse thematic gaps and funding and cooperation opportunities
- Provide services such as project twinning, access to mobility funds, showcasing and training to interested projects and institutions. These aim to enhance cooperation with ASEAN counterparts, initiate pilot actions to improve uptake and implement show cases for EU-ASEAN cooperation

A good practice example – SUSTAIN EU-ASEAN: Sustain and enhance cooperation on sustainable development between Europe and Southeast Asia (EU - ASEAN)

Why this is a good practice:

- Transfer existing knowledge and research from EU funded projects to the ASEAN region
- Transfer of the most cost-effective technologies from Europe to third countries
- Enhanced communciation and network efforts between key industrial sectors of EU and third countries

Group Discussion

- How could links between research organisations and industry be improved?

- How good are Public Research Organisations in assisting researchers commercialise their inventions?

05. The Role of Government

The role of governments. Why should they care about technology transfer and commercialisation?

- By improving the technology transfer and commercialisation contextual conditions, countries can increase innovation in the economy and thereby raise productivity, create better job opportunities, and address societal challenges.
- Not surprisingly, governments have been actively searching for new ways to improve knowledge transfer from PROs to industry.

Where should policy-making intervene?

Four key policies:

Intellectual property

Academia-Industry Linkages

Capacity Building

Incentives

How should policy-making intervene? – Intellectual Property

- Improve and ensure the capacity of national intellectual property institutions to support the creation of IPRs, and effective oversight and commercialization
- Improve understanding of IPR among key stakeholders and in education
- Do not treat IP as specialist topic – it is part of innovation policy to facilitate the business side of things
- Put IP management as main topic in front of audience
  - Question of value and quality over quantity
  - Skills to use all the different IP instruments important
- Having adequate enforcement mechanisms, efficiency, and timely patent processing and quality controls

How should policy-making intervene? – Academia-Industry Linkages

- Counter the trend under which career structures for scientists in academic and public PROs reward only academic accomplishments
  - But before you go IPR, you should have a clear and good idea what you want to do with IPR
- Eliminate employment regulations that unjustly limit the participation of researchers in entrepreneurial endeavours or joint research activities
- Ensure research organizations have legal mandates and operational flexibility to efficiently manage IPR (e.g., managing a portfolio of spinoff companies)
- Hold research organizations or researchers accountable for the management or commercialization of public research
  - Important tool: performance contracts
- Try to integrate offerings, also to make them sustainably and create critical mass of expertise

Good practice – The Bayh-Dole Act, USA, 1980

- Major milestone in the technology transfer and commercialization arena
  - P.L. 96-517, Patent and Trademark Act Amendments of 1980

- Created a uniform patent policy among the many federal agencies that fund research, enabling small businesses and non-profit organizations, including universities, to retain title to inventions made under federally-funded research programs

- The Act is a necessary, but not sufficient means to foster tech transfer. Careful to not misinterpret the Act such that it asks for a large number of patents to be filed...

Good practice – The Bayh-Dole Act, USA, 1980

- Provisions:
  - Non-profits, including universities, and small businesses may elect to retain title to innovations developed under federally-funded research programs
  - Universities are encouraged to collaborate with commercial concerns to promote the utilization of inventions arising from federal funding
  - Universities are expected to file patents on inventions they elect to own
  - Universities are expected to give licensing preference to small businesses
  - The government retains a non-exclusive license to practice the patent throughout the world
  - The government retains march-in rights
- Other countries with similar law: Brazil, China, Denmark, Finland, Germany, Italy, Japan, Malaysia, Norway, Philippines, Russia, Singapore, South Africa, South Koreia, UK

Group Discussion

- What can governments do to improve the technology transfer and commercialisation framework?

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