Asia-Pacific
Economic Cooperation

Advancing Free Trade
for Asia-Pacific Prosperity

Handbook on Technology Commercialization Practices in APEC Economies

APEC Policy Partnership on Science, Technology and Innovation

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Background to the Handbook

This Handbook had its genesis in an APEC (Asia-Pacific Economic Cooperation) funded project (PPSTI 01 2017A) under the Policy Partnership of Science, Technology and Innovation (PPSTI) working group. The project included four workshops and meetings over one year and it received endorsements from 9 APEC member economies. The first version of the Handbook was presented at the APEC meeting in Port Moresby in late February 2018. As a result of suggested improvements by some PPSTI representatives present, it has been modified to provide this final draft focusing on the good practices of voluntary, market-based technology commercialization for use in the APEC region.

We see two main reasons for providing this Handbook as a guidebook for fostering technology commercialization practices in the APEC region.

Firstly, we believe that increased understanding of the approaches presented in this Handbook will assist emerging economies in the APEC region with their programs towards innovation driven economic growth and further help introduce the technology commercialization knowledge system which has already been proven in developed economies.

Secondly, we also see the need for ongoing education and training in innovation models and technology commercialization across the APEC region and we feel the Handbook can go a small way in helping with that process. In fact, we envisage that it can form the basis of future training and education programs for both early stage practitioners and government representatives involved in the science and innovation field.

As will be described further in the text of the Handbook we have focused on the typical process of public sector voluntary, market-based technology commercialization practices but have also included related approaches of private sector innovation and entrepreneurship as paths to technology commercialization.

Related methodologies such as open innovation, disruptive innovation, and frugal innovation, as well as the trend and application of digital technologies and globalization are presented.

We believe that the Handbook is not just one single outcome from an APEC funded project but rather we would intend to update and add to it based on future projects, pending approval by PPSTI. So, after sharing and viewing by all APEC economies to collect further feedback, the proposal that the Handbook provide the basis for education and training in the region can be tested and any new material used in this process can be added to these contents. For more information on this proposed pathway please see the attached document covering policy suggestions and executive plans. There is also an appendix that includes presentation materials that were collected during the project activities. Finally, the Handbook and all related appendices will be officially released online to reach interested parties in the region.

Acknowledgement

The authors and compilers of this Handbook would like to thank the APEC PPSTI, representatives of participating APEC member economies, and related professional organizations in the APEC region for their great support to this project and this final draft. In addition, we thank a number of technology commercialization experts for their knowledge and experience in this effort for their written and editing contributions. In particular, the support of Dr. Andy Sierakowski, Chairman ITTN International Committee has been invaluable and is gratefully acknowledged.

MaTRineX Academy of International Innovation and Strategy
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Executive Summary

This handbook has been prepared to assist interested entities within APEC economies to better understand the basis and processes of successful voluntary, market-based technology commercialization practices, also referred to interchangeably in this text as technology commercialization. In addition, the handbook stresses the importance of successful science and technology commercialization and its relationship to both, domestic innovation performance and domestic economic development. Furthermore, the focus of this handbook is predominantly around the commercialization of publicly funded research or in other words, of government funded research in the various institutions where such research is carried out. But other types of technology commercialization are covered in context.

It should also be noted that this Handbook is the main output document arising from an APEC-Funding Project for 2017-2018 under the heading of "Foster International Technology Transfer (ITT) Professionals for the APEC STI Cooperation and Connectivity". This project was supported by over 50 technology transfer and commercialization experts from some 10 APEC economies. See the background of this Handbook for more information

However, we advise that this document cannot provide prescriptive rules on voluntary, market-based technology commercialization practices given that there are differences by economy and even by institution around important issues such as intellectual property ownership. Each economy will need to be familiar with such differences and the specifics when entering into any innovation projects or collaborations.

In preparing this document we have included numerous links (URLs) embedded in the text to allow the reader to refer to and broaden their understanding by particular topic including new innovation models and trends.

Note: All URLs provided in the Handbook are only limited to reference use,without intention of copyright violation by the authors of the Handbook. For any contents of the Handbook that cause or hide relevance to potential infringement, please contact: service@ittn.com.cn

Finally, this handbook pre-supposes a basic understanding in the field and those readers unfamiliar with terms used in the text below will be further aided by the Glossary of Terms in Appendix 1.

Over-arching Good Practices

The contributors and parties involved in the preparation of this document wish to highlight the following main good practices for successful technology commercialization throughout APEC economies.

- Acknowledge and respect Intellectual Property rights of others
- Attribute authorship and inventorship appropriately
- Negotiate any deals in good faith
- Share benefits with all project participants
- Demonstrate respect, act with integrity and encourage inclusion and diversity

The Challenge

An inherent challenge in commercialization of public and academic research processes is bridging the gap between basic research and commercialization. This theme will re-occur several times in this text. The figure below shows this gap which is often referred to as the "valley of death". According to Jackson D.J. (2013), many potential innovations fail to "cross this valley" due to a lack of resources (funding or human capital) that moves them from inventions to the next stage of commercialization. There are a number of risks at this early stage, but lack of funding is a critical one. To address this gap, in this handbook we discuss both classical knowledge of technology commercialization for academia (to introduce their technology to market) and approaches for industry to promote innovation and reduce their risks. This handbook will cover a number of ways that resources, both funding and personnel, from the innovation ecosystem will be required to work together to bridge this gap for successful technology commercialization. Collaboration between "sellers", "buyers", and facilitating parties to the business opportunity will therefore be key to the achievement of a good result. Much of this challenge also includes breaking down barriers of communication and perceptions between the parties, specifically, the private and public sectors entities.

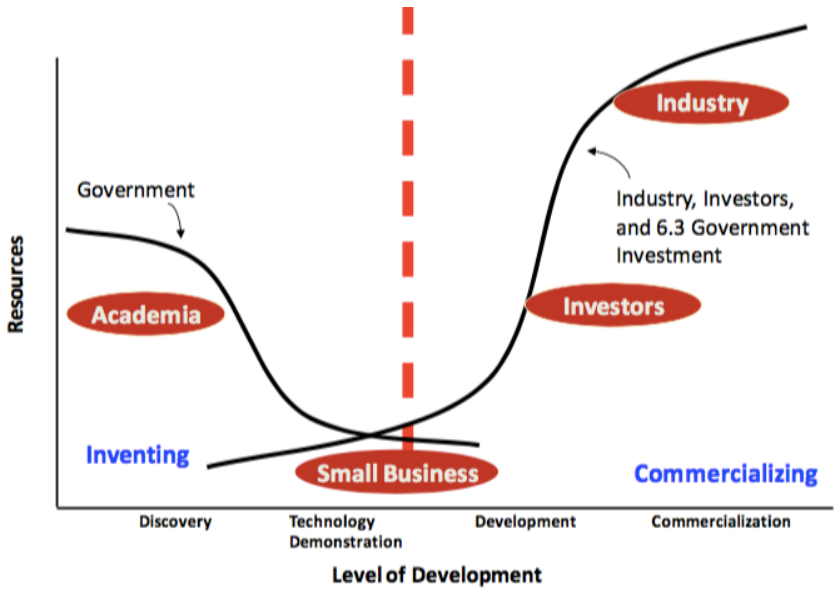


Figure 1: the Valley of Death from Deborah J. Jackson "What is an Innovation Ecosystem?"

1. Innovation Models

In this opening section, we will first explore the open innovation model and some other innovation models and theories that have become popular in recent times. For the purposes of this discussion, we define *innovation* as the process of "bringing new products or services to the marketplace."

i. Open Innovation Model

The concept of open innovation stems from the notion that no entities can do all the necessary research and development as well as product development work to bring new products to the marketplace solely and in isolation. Companies will increasingly need to license technologies in and out and also form research linkages with research institutes and universities. This trend has been accelerating over the last two decades particularly as pharmaceutical companies look to outsource some of their research and development activities.

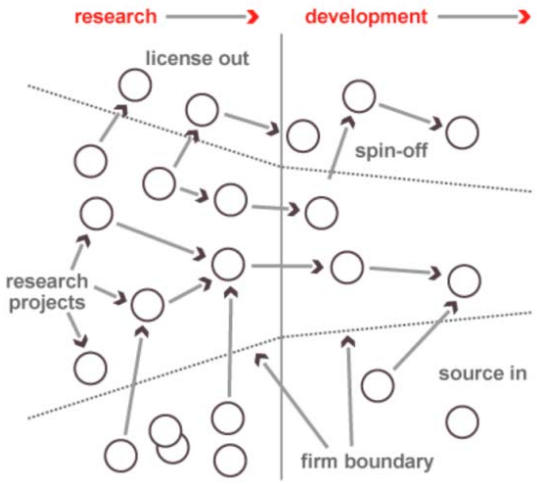


Figure 2: the open innovation model as proposed by Professior Henry W. Chesborough

In 2003, Professor Henry W. Chesborough proposed the concept of "open innovation". Overall, when compared with the traditional mode of closed innovation, Chesborough argues that open innovation is more effective and cost efficient and he stresses two core philosophies in his theory. Firstly, companies should use external knowledge and technology to strengthen their own innovations and secondly, companies should try and create value from internally developed innovations that are not immediately applicable in their own business. So, put another way, these two core philosophies are examples of the need for both in and out licensing strategies for companies to remain innovative.

In the open innovation paradigm defined as a system of mutual cooperation between partners to develop and launch new products, services, there is both inward and outward collaboration. **Inward** open innovation calls for externalizing and diversifying sources of innovation beyond internal R&D or to license processes or inventions including patents from other companies. Also, internal inventions not being used in a firm's business should be taken outside the company (e.g. through licensing, joint ventures or spin-offs), this process is called **outward** innovation. The recent trends in "open innovation" expand the focus on interaction between the corporation and outside developers, towards the ecosystem comprising developers, companies, creative consumers and communities of user innovators.

Most of the open innovation deals fall into the following basic scenarios and combinations thereof:

- **Sell/buy innovative product/service.** In this scenario, the external company becomes the supplier of an innovative product/service to the client. To pursue this scenario the external developer company must possess enough manufacturing capacity and competence, which is typically not the case for university-linked small technology companies.

- **Sell/buy/license technology.** In this case the external company and/or university licenses the right to certain technology to the industrial client. For this scenario, the external developer company must possess strong and well protected IP, which is the object of the deal. Typically, such deals take longer to finalize, but in successful cases lead to long period of royalty-based passive income for the external developer.

- **Sell/buy competence.** This refers to commercial R&D contracts between the external developer organization and the client industrial company. It is important to stress that the licensing deals are often accompanied by R&D contracts, simply because the licensing deal transfers rights, while the R&D contract transfers knowledge. For such deals the external developer company must possess proven necessary competence and access to resources like scientific equipment, specialized software, etc., with well-protected IP is not that important. R&D contracts may be signed relatively quickly, but the income from them is limited to the period of contract and does not imply royalty-based passive income.

- **Acquisition (spin-in).** In this case the client company acquires the external developer company with all its tangible and intangible assets including IP, equipment and software, and, most importantly, the professional team. The team in this case typically takes on the obligation to work for the acquiring company for a certain period of time.

The outward innovation scenario is similar, except for the acquisition, which, in this case, is replaced by a spin-out company.

The biggest fears in applying the open innovation model are: IP theft, loss of control over the innovation process, negative impact of cultural differences, difficulties in management of remote stakeholders and inefficient knowledge sharing.

Conceptual sources

Chesbrough, Henry William (1 March 2003). Open Innovation: The new imperative for creating and profiting from technology. Boston: Harvard Business School Press. ISBN 978-1578518371.
Chesbrough, Henry William (2003). "The era of open innovation". MIT Sloan Management Review. 44 (3): 35–41.
West, Joel; Lakhani, Karim R. (2008-04-01). "Getting Clear About Communities in Open Innovation". Industry and Innovation. 15 (2): 223–231. doi:10.1080/13662710802033734. ISSN 1366-2716.

ii. Disruptive Technologies and Disruptive Innovation

The theory of disruptive innovation was first coined by Professor Clayton M. Christensen in *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*.
In essence, disruptive technologies are defined as those *where no known market or incumbents currently exist,* and disruptive innovation is defined as *a product or service designed for a new set of customers.*

According to this theory, "low-end disruption" and "new-market disruption" could be distinguished as two types of disruptive innovation. The low-end disruption targets those potential customers who may not need the full functionality of a product, and the new-market disruption targets those who own the demands without required consumption capacity. In figure 3 below, the ascending arrow of "disruptive technology"essentially *leap-frogs* the market segments from low quality use to most demanding quality use over time and this rate of disruption can be quite rapid.

Classic examples of disruptive innovation include the advent of personal computers and the introduction of the internet.

More information on disruptive innovation can be found here:

https://hbr.org/2015/12/what-is-disruptive-innovation
https://www.christenseninstitute.org/key-concepts/disruptive-innovation-2/

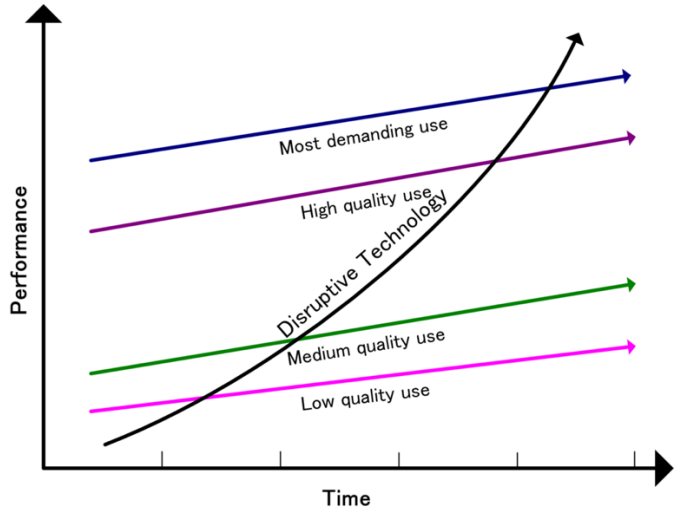


Figure 3: How low-end disruption occurs over time

iii. The Approach of Frugal Innovation

The concept of frugal innovation was highlighted in an article from The Economist in 2010 *"First break all the rules: The charms of frugal innovation". The Economist. The Economist Newspaper Ltd. Apr 15, 2010.* It has particular relevance in developing economies and there are numerous examples from where it has a strong following.

According to originators of frugal innovation, Navi Radjou and Jaideep Prabhu, practicing frugal innovation has six principles:

- Engage and iterate;
- Flex your assets;
- Create sustainable solutions;
- Shape customer behaviors;
- Co-create value with prosumers;
- Make innovator friends.

For more reading see:

https://www.innovationleader.com/frugal-innovation-six-principles-case-study-new-book/

See APEC member presentations:

04.Appendix- 1. Innovation Models – 01. MaTRineX Eye (by Mr. Ning Chen from MaTrineX Academy)

04.Appendix- 1. Innovation Models – 02. Cross- Border Peer-to- Peer Technology Transfer in APEC with ITTN (by Mr. Igor Rozhdenstvenskii from Martal Spb)

iv. Innovation Prizes

Innovation prizes are large-scale innovation contests whereby a fixed monetary award is offered to the first competitor that fulfills a specific objective. The objective of these prizes is to accelerate the development of new innovations to solve problems where the specific goal is clear but the mechanism for accomplishing the goal is not. Prizes seek to attract scientists and inventors to the competition who might not otherwise participate in innovation development projects. However, innovation prizes are not utilized in isolation; their effectiveness likely depends on contextual factors, such as prior R&D investments, policy, culture, and timing. Though of only recent interest to scholars and policymakers, innovation prizes have been used for at least two centuries to, for example, spur development of the first marine chronometer in the mid-1800s and encourage the first non-stop, transatlantic flight between New York and Paris (won by Charles Lindberg) in the 1920s. Recent examples include: (1) the Defense

Advanced Research Projects Agency (DARPA) Grand Challenges, the first three of which were focused on the development of autonomous vehicles, and (2) the Ansari X-prize, illustrates use of innovation prizes by a private organization—the X-prize Foundation—to encourage innovation in sub-orbital spaceflight.

National Research Council. (2007). Innovation inducement prizes at the National Science Foundation. National Academies Press. https://books.google.com/books?hl=en&lr=&id=pKJTAgAAQBAJ&oi=fnd&pg=PR1&dq=innovation+prizes+national+research+council+2007&ots=e-Tego97tm&sig=533ZGWpbyqVzjQkUqQeFCj8K_Is

Burstein, M. J., & Murray, F. E. (2015). Innovation prizes in practice and theory. *Harv. JL & Tech.*, *29*, 401. https://heinonline.org/hol-cgi-bin/get_pdf.cgi?handle=hein.journals/hjlt29&section=16

Kay, L. (2011). *Managing innovation prizes in government*. Washington, DC: IBM Center for the Business of Government. http://www.businessofgovernment.org/sites/default/files/Kay.pdf

2. Innovation Ecosystem

The innovation ecosystem is often defined and described as the large and diverse range of resources and participants that are necessary and that contribute to continuous innovation in an economy. These include investors, entrepreneurs, technical and business development service providers, and researchers amongst others. The strength of an economies's innovation ecosystem will thus define that economy's innovative capacity. So, the domestic innovation ecosystem or innovation system is the sum of all the private and public sector entities engaged in technology commercialization and innovation. Below, we will discuss public sector technology commercialization in more detail but it is worthwhile noting that each university or research institute engaged in technology commercialization and engagement with industry is in effect aiming to create its own functional innovation ecosystem thus furthering its goals.
Further information can be found in the links below:

https://www.cleverism.com/lexicon/innovation-ecosystem-definition/
http://www.rhgraham.org/RHG/Recent_projects_files/Benchamrking%20study%20-%20Phase%201%20summary%20.pdf

At the macro level, it is well appreciated that there are three key stakeholders that need to collaborate closely for the innovation ecosystem to flourish and prosper, namely, the private sector, the public sector, and government. This trio of stakeholders, often referred to as "the Triple Helix", need to interact closely through various programs for innovation success and hence leading to economic development. Efficient public sector technology commercialization specifically more universities is entwined in this model. See the following link:

https://triplehelix.stanford.edu/3helix_concept

See APEC member presentations:

08.Appendix- 2. Innovation ecosystem – 01. Crossing the Chasm Establishing Ecosystem Building the Bridge (by Mr. Ning Chen from MaTRineX Academy)

i. Research Impact

As background to further discussions on public sector research commercialization, we should touch on research impact. It is an important topic involving measuring the value of the outputs and outcomes of publicly funded research. Many domestic government research funding agencies grapple with the best way to measure research impact in order to involve it in their policies and funding rationale of the publicly funded research sector. (See Domestic Innovation Metrics in iii below). One of the challenges is that "research impact" has various interpretations depending on the viewpoint of the assessor and the target audience.

Generally, the subject can be broken up into two levels of impact, namely:

- Academic research impact
- Economic and Societal impact

See the following UK review for further information on this topic:

https://www.ukri.org/innovation/excellence-with-impact/

The topic of research impact has also individual and institutional measures and metrics. For example, on the individual or researcher aspect, there are measures such as:

- The number and quality of research publications
- Prestige/ranking of the publishing journal
- Citation number referencing a researcher's publications
- Public research honors received (including Nobel prizes)

At an institutional level, academic research impact is measured by a range of more aggregated research quality and impact measures, for example:

- University research ranking tables
- Research activity levels by institution (number of grants and funding dollars)

In terms of public sector technology commercialization, research impact falling under the category of economic and societal impact is of more specific interest and involves outreach, engagement, and commercialization activities such as:

- Consultancies with external parties
- Contract research with industry
- Collaborative research and open innovation activities with industry
- Licensing of intellectual property
- Start-up company formation

As a result, the economic and societal benefits of these activities can then be measured through "impact metrics" such as:

- New products and/or services created
- Jobs created
- Revenues generated
- Profits generated

However, as indicated above, the topic of research impact is under constant debate, review and further refinement.

ii. Economic Development

It is well accepted that adoption of new technology through technology commercialization and innovation will have a major impact on the economic development and international competitiveness of economies. At the macro level, it is the World Bank that concerns itself measuring economic development on a domestic and global scale. Some of the key measures determining economic development and prosperity include:

- Productivity growth
- GDP levels
- Access to funds
- Consumer Price Index and inflation levels
- Employment/unemployment levels

The following paper and the references cited therein is a useful guide in linking, technology, innovation, and entrepreneurship to economic development and prosperity.

https://www.brookings.edu/wp-content/uploads/2016/06/1019_technology_innovation_west.pdf

iii. Domestic Innovation Metrics

The innovation process is complex and multi-variate as well as ever changing so it is not easy to provide simple innovation metrics and rankings at a domestic level. The following link describes some of these challenges and methodologies:

https://www.conference-board.org/pdf_free/workingpapers/EPWP1701.pdf

The following Australian report also concerns itself with domestic innovation metrics:

https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Pages/Australian-Innovation-System.aspx

The World Intellectual Property Organization (WIPO) together with co-publishers, Insead and Cornell university, produces an annual Global Innovation Index. The 2018 report has been released and can be accessed here:

http://www.wipo.int/publications/en/details.jsp?id=4330

The report focusses on innovation inputs versus innovation outputs by economy and is therefore useful for economies to better understand their innovation strengths and weaknesses and to develop improvement plans and government policies accordingly.

More information on China's innovation inputs and outputs are provided in Appendices.

See APEC member presentations:

04.Appendix- 2.iii Domestic Innovation Metrics – 01. Chengdu APEC Talk (by Mr. Andy Sierakowski from ITTN)

04.Appendix- 2.iii Domestic Innovation Metrics – 02. Austrade LP Presentation (by Selina Yuan from Austrade)

04. Appendix-2.iii Domestic Innovation Metrics- 03. APEC – International Technology Seminar – STI & Connectivity: ITT Professional Training Manual (by Dr. Kulala Mulung from Science and Technology Secretariat of Papua New Guinea)

04. Appendix-2.iii Domestic Innovation Metrics- 04 International Technology Transfer and Activities of the JST by Hidekazu Chayama from JST

04. Appendix-2.iii Domestic Innovation Metrics- 05 Practice & Trend of Technology Transfer in China by Chang Linzhao National Technology Transfer Zhengzhou Center of China

04. Appendix-2.iii Domestic Innovation Metrics- 06 Technology Transfer Program of Korea by Dr. Sang Keun Lee from Dongshin University

04. Appendix-2.iii Domestic Innovation Metrics- 07 Information Paper of the PPSTI Workshop on "Development of Domestic Innovation Systems and Networks" by Jeffrey Noro from Science and Technology Secretariat of Papua New Guinea

04. Appendix-2.iii Domestic Innovation Metrics- 08 BPPT'S INNOVATION DEVELOPMENT by Dr. Erlan Rosyadi from Agency for Assessment and Application of Technology of Indonesia

04. Appendix-2.iii Domestic Innovation Metrics- 09 China's domestic programs for international connectivity of STI young professionals- Yu Qianwen from China Science and Technology Exchange Center (CSTEC)

04. Appendix-2.iii Domestic Innovation Metrics- 10 Korea's Industrial Technology ODA Programs by Dr. Sang Keun Lee from Donshin University of Republic of Korea

04. Appendix-2.iii Domestic Innovation Metrics- 11 Strategic IP Utilization Planning- Benefiting from ITRI's Experience- by Elsie Huang from ITRI of Chinese Taipei

04. Appendix-2.iii Domestic Innovation Metrics- 12 Technology Transfer Offices Consortium by Ms. Alba Sanchez from CONACYT of Mexico

04. Appendix-2.iii Domestic Innovation Metrics- 13 The Role of IP in the Technology Transfer and Innovation Collaboration Singapore Domestic R&D Framework by Jack Cheng from IPOR

04. Appendix-2.iii Domestic Innovation Metrics- 14 TECHNOLOGY TRANSFER AND COMMERCIALIZATION PHilMech Setting by Roderic Verena from PhilMech

04. Appendix-2.iii Domestic Innovation Metrics- 15 Technology Commercialization of Korea by Dr. Sang Keun Lee from Donshin University of Korea

04. Appendix-2.iii Domestic Innovation Metrics- 16 INSTITUT TEKNOLOGI BANDUNG TOWARDS ENTREPRENEURIAL UNIVERSITY Challenges, Opportunities and Efforts- by Prof. Tatacipta Dirgantara from Bandung University of Indonesia

3. Intellectual Property

i. Introduction to Intellectual property

Protection of intellectual property (IP) is an indispensable element in technology commercialization.

For intellectual property management, detailed professional knowledge is required and technology transfer or commercialization offices in universities and institutes will often contract specialists such as IP specialists and patent lawyers to assist in their work. Provided below are some important concepts and links to IP resources of which the reader can avail themselves of.

ii. Basic concepts

a. Definition of Intellectual Property (IP)

Intellectual property (IP) refers to creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce.

b. Key Types of IP and its Protection

IP as it relates to technology commercialization usually falls under one of the following categories:

- Copyright
- Trademark
- Plant breeder rights
- Industrial designs
- Patents
- Trade secrets
- Know-how

iii. Key Agencies Involved with IP

a. The World Intellectual Property Organization (WIPO) is the global forum for intellectual property services, policy, information and cooperation. It is a self-funding agency of the United Nations. More detailed information on IP as discussed on this page can be found on the following website:

www.wipo.int/about-ip/en/index.html

b. The World Trade Organization (WTO) is an organization sponsoring a forum for governments to negotiate trade agreements.

The importance of intellectual property in trade agreements between economies was highlighted in the WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), negotiated during the 1986-94 Uruguay Round. It introduced intellectual property rules into the multilateral trading system for the first time.

iv. Cross-border conventions

Intellectual property has a dual nature, in that it has both a domestic and an cross-border dimension. For instance, patents are governed by domestic laws and rules of a given economy, while cross-border conventions on patents ensure minimum rights and provide certain measures for enforcement of rights by the contracting states.

http://www.esa.int/About_Us/Law_at_ESA/Intellectual_Property_Rights/International_Conventions

v. Intellectual property protection and the importance of patents

In (b) above, we have listed the various forms of IP protection encountered in technology commercialization. In public sector research institutions, an office of technology commercialization,

which are sometimes referred to as technology transfer offices (TTO), staff will have the role to determine whether the IP disclosed to them by the inventors is to be protected and in which form. However, given the importance of patents in IP protection and technology commercialization, we will discuss this in a little more detail. The most common practice is for the TTO staff to work directly with external patent lawyers to determine the patenting strategy and the lodgment of patents. To this end, the TTO will usually share the invention disclosure and the results of their initial assessment with their patent lawyers as a first step. The patent process is a specialist area and the reader is directed to a number of reviews describing IP protection and patenting, specifically:

http://euro.ecom.cmu.edu/program/law/08-732/Patents/PatentLawPrinciples.pdf

https://www.uspto.gov/patents-getting-started/general-information-concerning-patents

In addition, in Appendix 2, we have listed the patent offices or agencies by APEC Economy for ready reference.

In terms of some other forms of IP protection and public sector technology commercialization, we note that:

- Trademarks are usually lodged by commercial partners such as start-ups rather than the technology transfer office themselves. As with patents, they can only be granted after due registration with the appropriate domestic agency which is usually also the domestic patent office. See:

  http://www.wipo.int/trademarks/en/

- Plant breeders' rights (PBR's) provide IP protection for new plant varieties. As with patents and trademarks formal registration through the appropriate domestic agency is required. More information on this topic can be accessed here:

  https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/plant-breeders-rights

- Trade secrets involve the protection of various forms of IP internally by keeping them "secret" and are usually the domain of commercial and industrial entities rather than public sector research institutions where issues around open information sharing and academic freedom arise. Naturally trade secrets have no registration requirements as patents do but the two are often complimentary. See the following for more information:

  http://www.iphandbook.org/handbook/ch11/p05/

- Know-how involves tacit knowledge which usually cannot be easily captured in written form. Again "know-how" is closely related and linked to any patents or trade secrets that might be protecting the IP. See the following for more information:

  https://scholarship.law.berkeley.edu/cgi/viewcontent.cgi?referer=https://www.bing.com/&httpsredir=1&article=1028&context=bjil

In addition to the above listed Intellectual Property categories, there are other related IP assets of a research organization which can be the basis for a research collaboration or commercialization partnership. Such "other assets" include collections of information or materials, access to human patients, and the access to research infrastructure including skills and equipment which exist in such research organizations.

4. Overview of Technology Commercialization

i. Industry, within and between organizations

In industry and business**,** there can be both inter- and intra- organization technology commercialization processes occurring as required. For example, when mergers and acquisition happen between technology companies, there may be a need for intra-company technology sharing after the new entity comes into being. Also in cases where a manufacturing company wishes to set up a new plant in a new location, an internal process of technology sharing and accreditation will be needed. And inter-company technology sharing occurs regularly whenever products or services are licensed between two commercial entities.

ii. Public sector technology commercialization and entrepreneurship

a. Definition

Public sector technology commercialization is defined as technology commercialization emanating from government funded entities such as universities, research institutes, and other government sponsored research entities. It is practiced world-wide and it has received more attention as domestic governments focus more on economic development and return on their research funding.

b. The US Experience

The US is often held up as an example of best practice in university technology commercialization. Indeed, technology commercialization in the US university sector has been operational for a long time. Some early examples include:

- In 1912, Professor Frederick G. Cottrell at the University of California, Berkeley initiated the Research Corporation (RC), the first off-campus patent management company in the United States specifically for universities.
- In 1923, in one of the first examples of academic technology commercialization, the University of Toronto exclusively licensed its US Patent and related know-how of its discovery of Insulin to the Eli Lilly company of Indianapolis for the US market.
- In 1925, the Wisconsin Alumni Research Foundation was established to manage the university of Wisconsin's patents.
- In 1937, MIT and RC signed an agreement to submit the college's invention to RC, which was to manage patent applications and licenses.

Bayh-Dole Act (1980)

However, although US university technology commercialization had an early start, it was not very effective until the passing of the Bayh-Dole Act (see https://www.autm.net/advocacy-topics/government-issues/bayh-dole-act/) which passed IP ownership from the federal government to the public sector research entities. With this legislation, US universities and government laboratories were able to significantly accelerate their technology commercialization performance in both quantity and quality and a major increase in the number of technology commercialization offices and supporting companies resulted. This activity also saw the growth of the organization representing the university TTOs known as AUTM, Association of University Technology Managers, see www.autm.net . AUTM provides a number of key roles for its members, one of which is the annual licensing survey which has been running for over 20 years and can easily be linked to economic development and impact. The 2016 AUTM survey results were collated into the infographic shown below linking the technology commercialization process to economic development and impact.

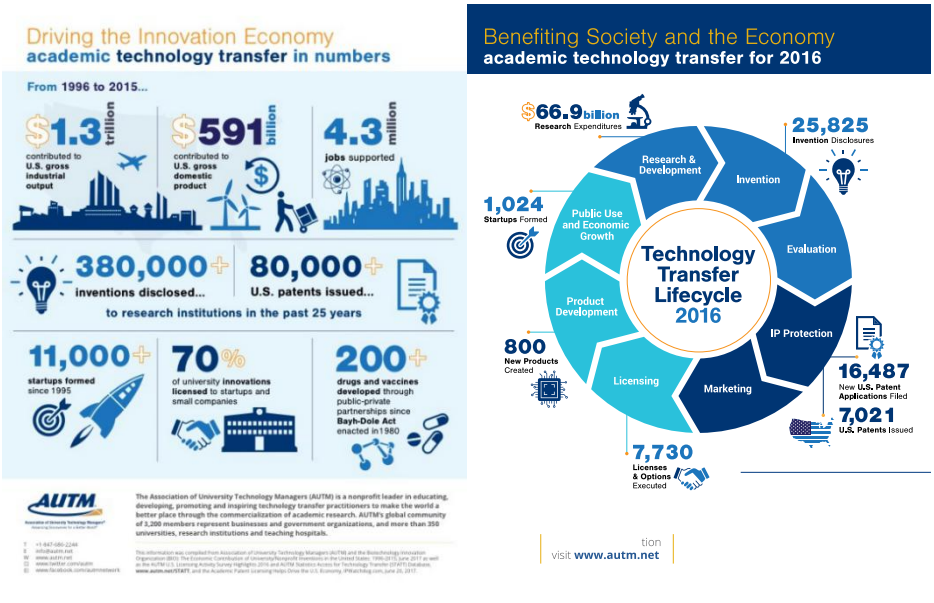


Figure 4. AUTM's graphic of academic technology commercialization analysis

(a) The Specifics of Technology Commercialization

The schematic in figure 5 below identifies the major components of the technology commercialization process and each component will be discussed in more detail in (5) below.

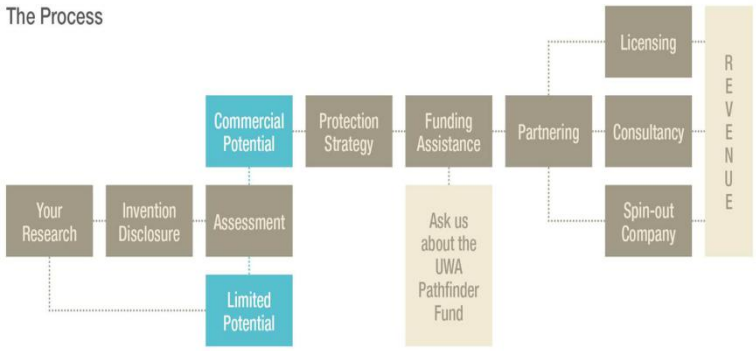


Figure 5. A typical process flow of technology commercialization from research to outcomes

The reference to the UWA Pathfinder Fund refers to a university proof of concept fund and this topic is discussed further under **7 (ii)** below.

iii. Innovation Vouchers

Innovation vouchers are small scale financial incentives for companies, usually small and medium-sized companies, to acquire assistance from R&D organizations—universities, research organizations, specialized consultants, and other providers. The aim of these programs is to encourage these smaller companies to connect with people in other R&D organizations to work on new science and technology products, prototypes, or other projects. The vouchers may be targeted to certain technology areas or industry sectors, or certain R&D organizations, such as universities. Supply side programs are widespread in innovation policies. Demand side programs to foster investment in research and development are less common. The experience of the Innovation Voucher programs demonstrates that there is a role for this type of service in that it can encourage companies to seek out specialists in organizations outside their own to obtain advice on technology development options, assistance in implementation of new products and processes, and guidance on subsequent steps needed to undertake innovations.

CORFO (Corporación de Fomento de la Producción de Chile) (2016), "Voucher de Innovación", [Innovation voucher], webpage, Corporación de Fomento de la Producción de Chile, Santiago, Chile, www.corfo.cl/programas-y-concursos/programas/voucher-de-innovacion.
https://www.oecd.org/innovation/policyplatform/48135973.pdf
https://www.nesta.org.uk/report/creative-credits-a-randomized-controlled-industrial-policy-experiment/
https://www.cpb.nl/en/publication/do-innovation-vouchers-help-smes-cross-bridge-towards-science
https://www.smeportal.sg/content/smeportal/en/stages/grow/2017/how-to-make-the-innovation-and-capability-voucher-icv-work-for-your-business.html

iv. Technology Extension

Emphasizing the next exciting research discoveries and innovative new technologies is attractive in technology commercialization policy. However, major economic and societal value will only be obtained if these technologies are scaled up, diffused, and improved in use. The McKinsey Global Institute estimates that 55% of potential productivity gains in developed economies comes from catching up to current best practice rather than from frontier R*D, and the gains are even higher in developing and emerging economies (Manyika et al., 2015). One such program for diffusion of current best practice is technology extension. Technology extension involves assistance provided directly to enterprises, primarily established SMEs, to foster technological modernization and improvement. The services are usually delivered through a decentralized network of specialists who work at the company facility on projects designed to address company problems and needs. Technology extension provides a range of assistance in areas such as quality systems, lean manufacturing, energy efficiency, environmental protection, health and safety, computer systems and software applications, and product development and marketing. These services offer solutions to company problems, assessments of the company or an operational area of the company, the development of an in-depth project, and customized training. Services can be provided through in-house experts or through referral to other providers including private consultants, government programs, education and training organizations, and applied R&D centers. These services are typically financed through a mix of client fees and core public support. A cross-economy synthesis of evaluative studies of technology extension services found that technology extension services generate positive outcomes for client companies (Shapira and Youtie, 2016).

Manyika, J. et al. (2015), *Global Growth: Can Productivity Save the Day in an Aging World?,* McKinsey Global Institute, San Francisco.
https://assets.mckinsey.com/~/media/B07C74E1DE934BB7AD8C1E5263C6B2F8.ashx

Shapira, P., Youtie, J., Cox, D., Uyarra, E., Gok, A., Rogers, J., Downing, C. (2015), Institutions for Technology Diffusion, Inter-American Development Bank, Washington, DC, https://publications.iadb.org/handle/11319/6994.

Shapira P., Youtie J. (2017). The next production revolution and institutions for technology diffusion. In Nolan, A. (Ed). *The Next Production Revolution: Implications for Governments and Business*, (243-270). Paris: OECD *http://dx.doi.org/10.1787/9789264271036-en*.

Shapira, P., Youtie, J. (2016). The impact of technology and innovation advisory services. In Edler, J., Cunningham, P., Gok, A., Shapira, P. (Eds.) Handbook on Innovation Policy Impact (pp. 254-306). Cheltenham: Edward Elgar. http://www.innovation-policy.org.uk/share/18_Technology-Innovation-Advisory-Services-Final.pdf

v. Responsible Innovation

Responsible innovation anticipates ethical, legal, and societal as well as the environmental, health and safety implications of new science and technology. It then aims to reduce adverse effects, and promote more inclusive approaches to, and benefits from, research and innovation (EU, 2012; Owen, Stilgoe and Macnaghten, 2012). Emerging technologies such as artificial intelligence, synthetic biology, and nanotechnology have attracted attention to responsible innovation processes. Responsible innovation is more than just complying with laws and regulations. It involves assessing the likely development pathways of these technologies; considering the potential social, economic, and environmental effects; engaging with possible proponents, opponents, and users; and taking action to influence the innovation process. Issues typically raised include protections of privacy and security in next generation information technologies; medical ethics in next generation life sciences; inclusion of multiple economic

groups in enjoying benefits; reducing harmful environmental and health effects; and understanding where job displacement might occur so that retraining can take place. The results involve building explicit plans and practices into innovation projects to address these issues.

Responsible innovation practices are especially prominent in Europe and the United States.
http://synbiochem.co.uk/national-synthetic-biology-research-centres/
http://cns.asu.edu/

Owen, R., J. Bessant, and M. Heintz (eds.) (2013), Responsible Innovation: Managing the Emergence of Science and Innovation in Society, John Wiley & Sons, Chichester.

See APEC member presentations:

4. Overview of Technology Commercialization

04.Appendix- 4. Overview of Technology Transfer – 01 APEC Technology Transfer Workshop by Dr. Jet Shu from Chinese Taipei

08.Appendix- 4. Overview of Technology Transfer – 02 Learning- by- doing or Doing- by- Learning by Dr. Igor Rozhdenstvenskii from Martal Spb, Russia

04.Appendix- 4. Overview of Technology Transfer – 03 Practical Methods Tech Transfer Success by David Melander from Discovry Neos Capital LLC

04.Appendix- 4. Overview of Technology Transfer – 04 Suggestions for Cross border Technology Transfer from Activities of the JST by Chayama Hidekazu from JST

04.Appendix- 4. Overview of Technology Transfer – 05 Innovation, Transfer And Commercialization Initiatives Philippines by Roderic Vererna from PhilMech

04.Appendix- 4. Overview of Technology Transfer – 06 The Knowledge Transfer System in the US by Ashley J. Stevens from US

04.Appendix- 4. Overview of Technology Transfer – 07 Valley of Death by Mr. Carl Rust from Gerogia Institute of Tech of US

04.Appendix- 4. Overview of Technology Transfer – 08 ITTN Russian cross-border tech transfer by Dr. Igor Rozhdenstvenskii from Martal SPb. from Russia

04.Appendix- 4. Overview of Technology Transfer – 09 Innovation Entrepreneurship in Japan by Mr. Chayama Hidekazu from JST

4.i Industry, within and between organizations

04.Appendix- 4.i Industry, within and between organizations - 10 KCA Introduction- by Dr. Erin Rayment from University of Southern Queensland of Australia

04.Appendix- 4.i Industry, within and between organizations - 11 Xi'an Sailest Biomedical Investment Consulting Co. Ltd by Xin Bu from China

04.Appendix- 4.i Industry, within and between organizations - 12 Strategic Value Creation from Scratch - Mr. John McEntire from US

04.Appendix- 4.i Industry, within and between organizations - 13 Techbeidges Venture- Dr. Ho Woon Yee from China

04.Appendix- 4.i Industry, within and between organizations - 14 A Discussion on Difficulties in Technology Transfer from Industry Side- Ms. Wenbo Yuan from China

4.ii Public sector technology transfer and entrepreneurship

04.Appendix- 4.ii Public sector technology transfer and entrepreneurship - 15 International Technology Transfer and APEC– an Australian Perspective by Dr. Andy Sierakowksi from Australia

04.Appendix- 4.ii Public sector technology transfer and entrepreneurship – 16 Technology Transfer from University to Industry by Dr. Alexander Kvashnin from Novosibirsk State University of Russia

04.Appendix- 4.ii Public sector technology transfer and entrepreneurship – 17 Australian initiatives to build collaboration For innovation by Dr. Matt Wenham from the Australian Academy of Technology and Engineering (ATSE) of Australia

04.Appendix- 4.ii Public sector technology transfer and entrepreneurship – 18 The University of Texas at Dallas by Mr. Steven Lin from UT Dallas from US

04.Appendix- 4.ii Public sector technology transfer and entrepreneurship – 19 International Technology Transfer Practice and Economic Inclusive Growth in APEC Zone by Marcus Wade Fulghum from US

04.Appendix- 4.ii Public sector technology transfer and entrepreneurship - 20 Commercialization at the University of Waterloo by Ling Loerchner from University of Waterloo from Canada

5. Public Sector Technology Commercialization

The process of taking inventions from an idea to the marketplace can be quite challenging. For that reason, universities and research institutes operate offices that cover technology commercialization issues and challenges. While it is common for these offices to be called technology transfer offices (TTOs), these offices can go by many different kinds of names and titles. What they share is a mission to assist researchers in the commercialization of research and technology. For the remainder of this document we will refer to these types of offices collectively as TTOs, recognizing that names of these offices may vary by institution or economy and the duties of these offices may extend beyond technology commercialization.

The operating models of TTOs can be quite different depending on the size and budget of the office as well as the research funding of the institute or university. In some cases, a university-controlled company rather than an office is charged with the technology commercialization function. In this section, we will cover the key parts of the process as shown in Figure 5. Although it is shown as linear, the process often has some non-linear and overlapping aspects. TTO staff will usually first become involved at the invention disclosure stage although earlier involvement, for example, by following the research from an earlier stage, can be very beneficial for both the technology commercialization or technology transfer professional (hereafter collectively referred to as "TTPs") as well as the inventors. A very good description of this entire process can be found on the following two US-based websites:

http://otl.stanford.edu/documents/OTLinventorsguide.pdf
http://www.ohsu.edu/xd/research/techtransfer/upload/Guide-to-TTBD_FINAL-WEB-VERSION-for-4-3-13-presentation-2.pdf

It should be stated that any commercial revenues from successful commercialization will be covered under the institution's IP policy. Normally it will be the TTO that will administer this policy and its commercial aspects such as:

- Any IP protection or patent costs incurred by the TTO will first be recovered from any revenues received
- The remaining monies will be shared with the inventor(s) according to the IP policy

How much is shared with inventors varies by institution but the usual split is that the inventor(s) receive at least one third of any income but sometimes much more. The remainder is usually split across the inventors' department and held centrally within the institution.

i. Invention Disclosure

Most universities and research institutes will have IP policies that require their researchers to signal any intellectual property of potential commercial value through an invention disclosure to their TTO. It is good practice to disclose an invention as soon as it is an invention or believed to be so. Filing an invention disclosure declares the invention, the inventors, and the date of invention. Occasionally, a delay in disclosure may be appropriate, for example, if the inventor is continuing to conduct experiments that may provide better enablement or broader utility, which would provide broader claims should a patent be sought. However, the decision to delay filing an invention disclosure should be made in consultation with TTO staff and appropriate IP specialists. For an example of an invention disclosure form, see the link below from the University of Western Australia:

http://www.rdi.uwa.edu.au/research-innovation/commercialisation

ii. Assessment

Assessment of the disclosed invention is a crucial phase of the technology commercialization process and involves several aspects that will be further described below. Depending on the operating model and size of the TTO, the assessment of the invention can be carried out either internally or externally using consultants, or a combination of both. The TTO may have regular staff meetings to screen new invention disclosures and determine how promising the invention appears. At this initial screening phase, the following factors come into play to answer questions such as:

- How strong is the IP and can it be protected?
- Can the disclosed invention be developed to a product or service?
- If so, does it have good market potential?
- What is its stage of development?

If the technology doesn't pass this screening it is returned to the inventor(s) with an explanation of what needs further work, see Figure 5 above, under "limited potential". If the screening is positive, more detailed assessment will be required and may involve activities such as:

- Better understanding the IP landscape around the disclosed invention by searching patent databases
- Market feedback from relevant external parties under confidentiality agreements
- Market assessment report(s) including strengths and weaknesses of the technology

The University of Michigan website link below, describes this further:
http://www.technologies.msu.edu/researchers/tech-transfer-process#assessment

The assessment phase of technology commercialization is crucial because if it is handled poorly, it will reflect badly on the professionalism of the TTO staff and potentially cause friction with the inventors. It also has the potential to either miss significant technology opportunities or conversely, to take up time and money pursuing technologies that have no real market applicability.

iii. IP Protection

Figure 5 above further highlights the need for an IP protection strategy although it is not specific on which form of protection as this will vary by commercialization opportunity presented to the TTO through the invention disclosure. In the majority of cases, patenting will be the preferred method of protection. As discussed in section 3 v, the TTO will usually work with external patent agents although in some cases larger TTOs may have their own in-house patent officers. The TTP's role in determining whether to patent or not is a crucial one. This decision should depend on various factors including the novelty of the opportunity and its market potential as well as its stage of development. For example, in some cases it may be best to ask the inventors to conduct key experiments or other steps to strengthen the IP before filing a patent application. As patenting is an expensive process, care must also be taken not to patent interesting scientific findings that may have little eventual market place fit. Any decision to file an application is also best taken with an experienced patent attorney who can be called in to assist in the following areas:

- Review the invention disclosure
- Clarify the novelty of the invention
- Work with the inventors to clarify and confirm inventor-ship
- Work with the inventors to establish the claims to be filed in the application
- Identify any patents related to the technology filed by companies

This latter point can help identify prospective partners or licensees for the technology and this is discussed further under **v.** Market Research.

Another aspect for public sector TTOs that is highly relevant with regard to patenting is cost and internal budgets. This is a balancing act as the patent process becomes expensive in the domestic phase whereas TTO budgets are usually tight. The efficient TTO will have processes to manage patenting costs from rules on IP protection initiation through to triage of non-performing technologies and patents. For example, monitoring the percentage of successful outcomes either as licenses, contracts with industry, or start-up companies against the percentage of invention disclosures patent protected may be a useful indicator.

It is useful to point out that non-patent protected opportunities are increasing in frequency. One example is software. In some jurisdictions software is eligible for patent protection as well as copyright protection. Software can range from laboratory apps to full programs.

And TTOs are realizing that software licenses tend to be non-exclusive and so can be used to build up networks of collaborators with the originating laboratory. This in turn can create multiple commercial partners to commercialize the software in different markets, use it internally or in partnership with the originating lab, and to seek further research and developmental monies together.

See APEC member presentations:

04.Appendix- 5.iii IP Protection - 01 The Intellectual Properety Office of the Philippines (IPOPHL) by Roderic Verena from PhilMech of the Philippines

04.Appendix- 5.iii IP Protection - 02 APEC International Technology Transfer Cooperation and Industrialization Workshop by Mr. Kim Sum Wook from Nam&Nam Law Firm from Republic of Korea

iv. Value Proposition

Following the assessment and IP protection steps outlined above, the TTO staff should have a good sense in which form the opportunity will be presented to external parties and the market place. If the technology has a strong market fit and has application in multiple market segments thus potentially leading to multiple products, a start-up company may be the preferred option. In other cases, with a narrower scope of opportunity, a license with established companies might be a better fit. Whichever option is chosen, it is desirable that the TTO develop a clear value proposition for their opportunity. This will help greatly in marketing and negotiation with external parties; see “business opportunity” in section 5 **vii**. In its simplest terms, a value proposition is a positioning statement that explains what benefit is provided for whom, and how the opportunity is unique. A example of the format to use follows: **For the [customer], Technology X offers [this], [this] and [this], allowing the user to achieve [this] and solve [this problem] better than [the competition].** It thus describes for any target buyer of the opportunity which problem is solved, and why this opportunity is superior to any known alternatives. We have described the technology process in Figure 5 above, as linear but a number of these areas overlay closely. For example, the value proposition and target market can change or be modified as a result of more detailed market research.

v. Market Research

To better develop the value proposition, the TTO will need to engage in more detailed market research. Again, this can be done internally or through contracted external parties or often through a combination of both. There are consulting firms that specialize in early stage technology assessment and valuation that the TTO can contract. This market research should also include patent database searching to identify competitors and potential buyers or license targets for the technology. The final report from this market research ideally should provide:

- Strengths of the technology and any identified weaknesses
- Patent /IP assessment including any possible infringements, competitors etc.
- Improved valuation of the technology (see next section)
- Identify the preferred commercialization strategy- licensing or start-up
- Timelines and costs for next steps including any identified development required internally

If the preferred commercialization strategy is through a start-up company, there should be adequate information to develop a preliminary business plan for presentation to and negotiation with prospective investors.

vi. Valuation

The valuing of intellectual property is a key aspect in the technology commercialization process as it establishes the financial basis on which any license with a prospective licensee or discussions with an investor will take place. Of course, the valuation, at this stage, is that as viewed by the seller or licensor and it may be modified during the negotiation with the buyer or licensee to establish the final price of the IP which will then be outlined in the terms of the signed legal agreements. IP valuation and the method(s) used to establish that valuation are also key components to a successful negotiation because

they provide a quantitative basis for discussions. Conversely, without any valuation such discussions can quickly become emotional and unfruitful. There are various valuation methods available to the technology commercialization professional but most methods rely on the following three fundamental aspects:

- Cost
- The market
- Income

In the first case, a basic valuation could be arrived at based on either the "sunk" costs of the research or the cost a buyer would need to invest to get to the same point of development. However, cost based valuations are of limited use because the approach does not really put a value on the technology's future worth.

The market based approach, on the other hand, utilizes other methods and includes:

- Industry norms and standards by sector
- Comparable
- Ranking and rating methods
- Auction
- Equity

Finally, income based valuation approaches include:

- Rules of thumb such as the 25% rule
- Net present value (NPV) methodology
- Monte Carlo methodology

These latter valuation tools are better suited to later stage technologies where less uncertainty exists and the assumptions made in the methods can be limited and are narrower. Another source of valuation is IP litigation where the costs and damages of infringement are publicly disclosed.

Finally, it needs to be stated in regard to IP valuation that both risk and value are closely inter-related. Risks are reduced as a particular technology proceeds to commercialization and revenues; at the same time the value of the opportunity increases. This fundamental needs to be understood by both the buyer or licensee and the seller or licensor for their discussions and negotiations to reach a compromise and agreement.

For more detailed information on IP valuation and its relationship to license negotiations, the reader is referred to the following report:

http://www.wipo.int/meetings/en/doc_details.jsp?doc_id=332588

vii. Marketing

The TTO can be engaged in various marketing activities on a continual basis to interact and support both its internal and external stakeholders. In this regard, we will would signal the following marketing and related activities:

- Regular electronic newsletters on technology commercialization updates to inform faculty and students within the organization and to seek more invention disclosures
- Use of social media to encourage entrepreneurial activities, to signal upcoming workshops and related activities and to keep up a level of internal interactions
- External newsletters to investors, industry contacts, and alumni to signal interesting success stories and call for engagement with the faculty and the TTO on new opportunities

Business Opportunity Marketing

Any new licensing and start-up opportunities that are to be presented externally need to be properly "packaged" and then can be offered in both direct and indirect avenues to the marketplace. The usual method would be to prepare a brief one to two pages document that contains the following elements:

- A clear description of the technology
- The issues that the technology addresses and how
- Identification of the faculty inventors
- The stage of IP protection if any
- The applicable market segment envisaged
- The type of interest sought (licensing, start-up or industry research contract)

Such business opportunities, including the value proposition elements described above, can then be assembled and put up on the TTOs website. These opportunities need to be kept updated with any new developments in the research or any changes in IP protection status. This type of marketing is however indirect and passive and depends on interested parties viewing the web site and contacting the TTO. Of course, the TTO staff and the inventors can market the opportunities with external parties by referring them to the web-site. It is important that business opportunity items be removed from the website as they are taken up or dropped by the TTO. For example, it can lead to frustrations if a potential licensee approaches the TTO only to be told that the business opportunity has already be licensed. As an example of this approach, please see the MIT Technology Licensing Office website below:

https://tlo.mit.edu/explore-mit-technologies/view-technologies

The direct marketing approach relies on the fact that the market research conducted by the TTO has clearly identified the market fit for the technology and in addition has identified the main companies operating in that field, in other words, the prospective licensees. The TTO staff will then need to conduct a secondary analysis on these companies to decide which of these companies to approach. For example, the largest company may not be the best fit. Factors in this decision may include:

- A smaller company may have lower market share and be “hungry” to grow
- Which company has R&D facilities that have a good fit with the inventors, in other words, what do the inventors think?
- Previous dealings with the company that have been positive
- Known contacts or alumni in decision making positions within the company
- Location of the company. Is it close for regular visits if required?
- Confidential enquires to check reputation of the company

The next step will be to conduct further market assessment on the target licensee(s) to identify the key contacts and decision makers as well as any financial details on the target licensee(s) that may be relevant. On assessment of the above factors the TTO should be able to execute the chosen strategy by approaching the identified contacts within the target licensee(s) directly by email or better still by setting up an appointment.

Finally, it needs to be stated that the faculty inventors are an important marketing tool to support these activities and also a key to direct marketing. Faculty staff and students are regularly at conferences where industry partners are present and they can very much support the TTOs marketing efforts. Indeed, the inventors have a vested interest in a successful outcome and they must be a key part of the marketing efforts.

viii. Negotiation and Deal Execution

There has been much written on strategies and tactics for successful business negotiations and it is not our purpose to present this topic in great detail. It is often the case that the negotiation preparations commence by email but where possible final negotiations should be face-to-face. Below we will provide some general comments on negotiation and also remind ourselves that the main types of deal negotiation in our context are:

- Licensing (or assignment)
- Start-up company formation
- Industry to research institution research contracts (or consultancies)

We will concentrate on the first two above but firstly some general comments.

General

The following are some key things to keep in mind when negotiating the deal:

Preparation is Key
- A successful negotiator will be armed with facts and data
- How are you justifying your valuation? What data do you have to support it?
- What facts do you have on the other party that you can present on how it benefits them? In other words, present data on a mutual benefit where possible.

Know the end-point
- Know exactly what you need to finally get out of the negotiation
- But also, know that you will need to concede things. Which things? Know which concessions from the start
- Check this off with your management first agreeing possible end scenarios before entering the negotiation

Strive for a "win-win" result
- Remember that both parties need to be happy at the conclusion of the negotiations
- If one party concedes something they didn't want to give up it may be a problem to deal execution or turn up as an issue even later

Act with Respect
- Treat the other party fairly and with respect
- Don't talk down to the other party or spend time talking about other deals done trying to make comparisons. Keep on topic.

Get a Decision
- Set a timeline and get an agreement
- Ending up without a decision and with numerous items outstanding (requiring checking with your management or legal team) usually shows bad planning

The Licensing Agreement

A license agreement is a legal contract between a licensor and licensee. These agreements may involve the grant of permission to use intellectual property, such as may be needed to produce, sell or distribute goods and services. In the high tech arena this also may inclusion of permission to reproduce or distribute copyrighted works, or to use a brand name or trademark. Licenses differ from assignments which typically involve a complete transfer of those rights. A license can be either exclusive or non-exclusive, and limited in geographic, technical and/or temporal scope, as determined voluntarily by the parties. On execution, the licensing agreement covers the terms of the license, both financial and non-financial. Some of the financial terms may include:

- Upfront payment or license fee
- Ongoing pre-commercial payments
- Reimbursement for present and f
- Future patent-related and patent prosecution costs
- Milestone payments
- Royalty payments on sales or profit sharing
- Ongoing annual minimum royalty
- Sub-license income sharing
- Research support costs
- Manufacturing

In addition, the license will reflect a number of non-financial terms which will also be key to the negotiations and the final deal execution. For example, the term of a license may extend from execution for the life of any patents involved, although this is also subject to negotiation. Some other non-financial terms may include:

- IP definition
- Rights in pending patents and technological improvements
- Diligence obligations
- Warranties
- Indemnities
- Dispute resolution and arbitration
- Choice of law
- Termination

In some cases, the negotiation of these terms can be more problematic than the financial ones particularly if the TTO is dealing with a large cross-border corporation. The TTO staff will work closely with their legal team before negotiating and finalizing a license agreement. A useful checklist for negotiating license agreements is provided here:

http://www.iphandbook.org/handbook/ch11/p11/

Once both parties and their legal advisors are satisfied with the license agreement documents then can be executed.

ix. The Start-Up

As already described, the formation of a new company or start-up from the technology and business opportunity follows a different path in that the negotiations here are conducted with different interested parties namely investors. Depending on the scope of the opportunity and the amount of funding sought the negotiating parties are usually angel investors or potentially early stage venture capitalists. At this stage, the funding sought is seed funding and is usually under $1 million. The usual endpoint for the first set of negotiations is an agreed term sheet. This first agreement is non-binding and will be followed by legal agreements in particular the shareholders' agreement. The role of the inventors or in this case the "founders" will vary in different economies. For example, in the US the inventors take a much more active role in seeking out the investors whereas in other economies the TTO will take the lead supported by the inventors on the technical aspects.

Whatever the approach, the founders (inventors and TTO representing the university) will need to work closely together. In larger TTOs, there will usually be one or two TTP's (Technology Transfer Professionals) to assist in negotiating the term sheet given that this is a specialist area and pre-supposes an understanding of venture capital processes, see 7 vii. The investor will first assess the opportunity in preliminary due diligence so there will be numerous questions of the founders. As we described above on page, the investor needs to assess their risks versus rewards before proceeding to negotiating a term sheet. The founders should also be conducting due diligence on the investors. This can often be achieved in confidential discussions with parties who have had dealings with the investor including other TTOs. In addition, a business plan will need to be developed for the start-up between the founders and investors. It should also be noted that in most economies the preferred model for the TTO is to execute a license for the IP rights to the start- up rather than an assignment.

Some elements in the term sheet will include:

- Valuation (normally pre-money)
- Types of Shares (preferred versus common shares and implications)
- Pro-rata rights (who can invest in future investment rounds)
- Options pool (shares set aside for future employs, advisors etc.)
- Founder Vesting Period (there will be a period locking in the founders from not selling their shares)
- Liquidation or Exit strategy (will describe how the different types of shares will be treated in the event of an exit)
- Reporting Requirements (what will be the reporting requirements of the start-up)
- Board composition (how is this proposed between founders and investor?)

The following Canadian link provides more information on term sheets and shareholder agreements, see:

http://venturechoice.com/articles/key_term_sheet_clauses.htm

During the period between term sheet and shareholder agreement signing any further issues identified in due diligence can be signaled and reflected in the final agreements which can then be executed once both parties are satisfied.

It should also be noted that over the last two decades the desire of TTOs to create start-ups has increased significantly. As an example, in the US, AUTM reported that in 1998 there were approximately 300 start-ups created by university TTOs. That number had risen to 1,024 start-ups in the year 2016.

x. Faculty and Graduate Student Startups

As mentioned, in the United States, some universities have TTOs that can work with faculty and graduate students to protect inventions from federally funded research. In some cases, these innovations lead to potential faculty/ student startup formation. The process for supporting these faculty/ students teams varies by institution. In general, the process is designed to nurture the team and its invention within the university lab until it has matured toward market readiness. TTOs and other university programs nurture these teams with mentorship, gap funding, access to talent, and other resources to accelerate the idea to commercialization. In the past, the commercial potential of the inventions would have been validated by a team of technical and market experts to pick potential winners.

The latest methods involve educating faculty/ student teams on lean startup methods to validate their idea themselves. Once the team has validated their idea, small milestone measured grants are provided to mature the invention. A startup company is then formed to launch the most viable innovations. TTOs and other support organizations within the university often find external chief executive officers for the startups. This allows the faculty member to continue teaching while participating in the venture. The following is a link to a white paper on the faculty accelerator program operated by VentureLab at the Georgia Institute of Technology. They employ the following model.

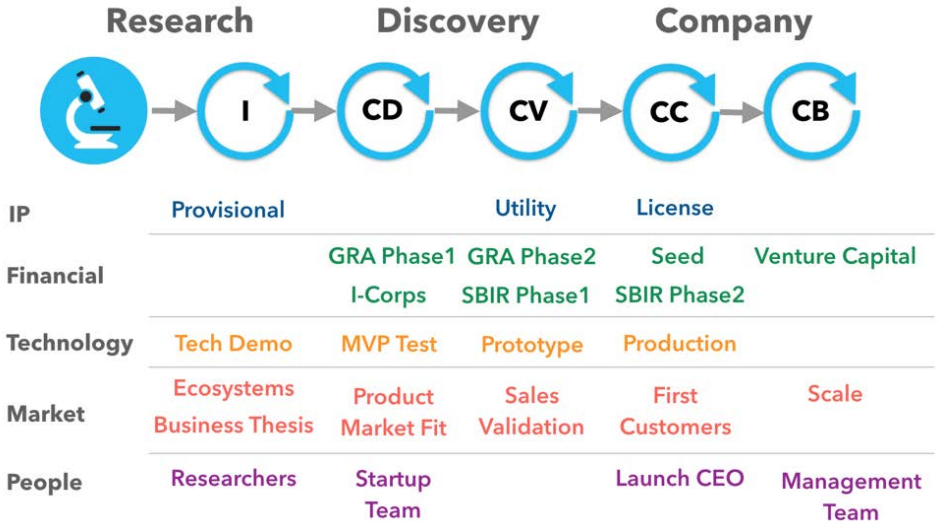


Figure 6. Model of Graduate Student Start-ups

https://venturelab.gatech.edu/wp-content/uploads/documents/creating-a-research-startup-at-georgia-tech.pdf

xi. Post-deal management

It is important to remember that the real work of the collaboration begins with the signing of the formal documents. TTOs will need an efficient electronic data and project management system to monitor the progress of each deal signed. If a license, there will be both financial and non-financial elements to monitor regularly. Naturally, as more deals are completed and activity begins on each separate

collaboration, having an electronic system is key to ensure prompt responses to commitments negotiated by both parties. Both parties will be bound by the agreement they signed and their responsibilities contained in the agreement.

As an example, some follow up items on each license by the TTO might include:

- Royalty and milestone monies collections
- Sharing the revenues with inventors according to the IP policy
- Patent prosecution responsibilities
- Ensure obligations are met on research reports from inventors
- Auditing of licensees as required
- Annual review of performance

6. Innovation Entrepreneurship

In this section, we will touch on the importance of entrepreneurship in relation to technology commercialization and discuss some new methodologies around entrepreneurship. As described above, academia is able to commercialize their advanced technologies by promoting and establishing start-ups. Large enterprises are able to establish innovation entrepreneurships as well. Multi-cultural issues need to be addressed for cross-border cooperation on entrepreneurships.

i. Innovation Entrepreneurship and Start-up

a. Start-up

In 5 viii we discussed start-up formation and here we will present some more information and newer concepts around start-ups. According to Aileen Lee's (investor of Cowboy Venture, 2013) definition, those start-up companies that grow rapidly and are valued at over $1 billion are called "unicorns". Establishing start-up companies based on advanced technologies, is an effective approach for technology commercialization in both the private and public sectors even though "unicorns" will be rare. There are processes for inventors to develop innovation start-ups in academia. As an example, Stanford University, Peking University and other universities operate specific departments and standard processes for technology start-ups.

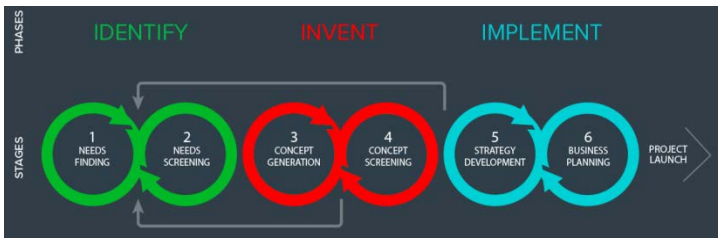


Figure 7. The Innovation Process of Stanford Biodesign

See Biodesign Innovation Process (Stanford University) at:
http://biodesign.stanford.edu/about-us/process.html

See School of Innovation and Entrepreneurship (Peking University) at:
http://ostd.pku.edu.cn

b. Lean Launchpad

Lean Launchpad is also called "lean start-up" and refers to an entrepreneurship methodology applied to start-ups which involves establishing the business whilst testing and developing its model based on key learning from the market and customers. The concept of Lean Launchpad was first proposed by Eric Ries, an American entrepreneur, in 2018. One feature of this methodology is that it places very little emphasis on a structured business plan arguing that such a plan is practically out of date as soon as it is written. Instead it is argued that the focus needs to be on working closely with the customer and modifying the company's direction or products to meet those customer needs.

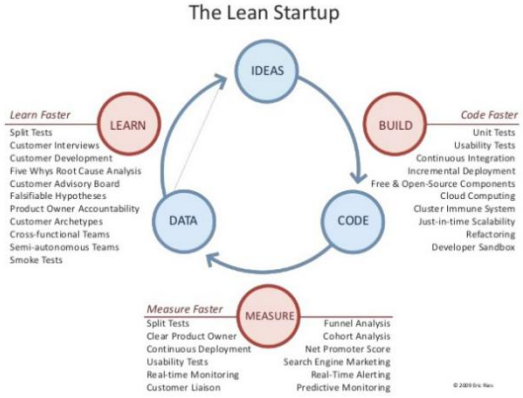


Figure 8. Eric Rise's Lean Launchpad Model

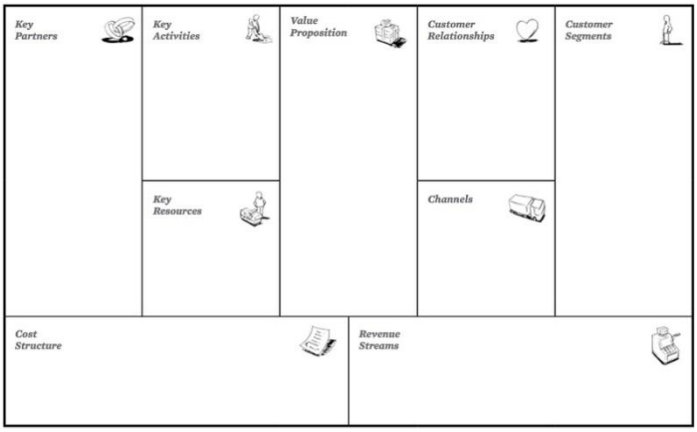


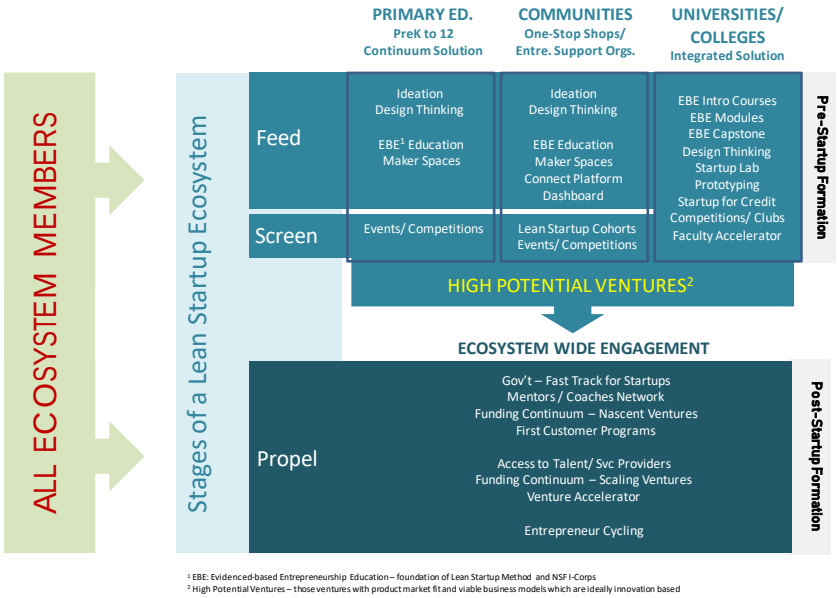
Figure 9. Business Model Canvas

An example of a Lean Launchpad template for business models management, Business Model Canvas, is available from: https://strategyzer.com/canvas/business-model-canvas

The Lean Launchpad methodology also means that any start-up needs to be flexible as it receives customer feedback and change direction accordingly. Any such change in direction is referred to as a "pivot".

Nascent Innovation Ecosystems | Lean Startup Ecosystem Building

Hallmarks of nascent innovation ecosystems are the overall limited presence of successful or serial entrepreneurs, mentors, gap funding, and startups integration into clusters and value chains. Of note, an ecosystem may have numerous assets such as incubators, government policies, and educational curriculum at universities. However, the true measure of a thriving ecosystem is the intentional, forward movement and maturation of entrepreneurs and their ventures. Nascent or those in emergence are the critical jumping off points for ecosystem lifecycles. (Gauthier, Herrman, & Marmer, 2015) However, with limited forward movement, how are these nascent ecosystems able to gain momentum and traction? The answer is to efficiently and expeditiously leverage its minimal resources to grow technology based startups or innovation driven enterprises (IDE) with large global markets. While the methods they utilize to jump start the ecosystem can support all types of startups, the nascents must develop "born global" (Rasmussen & Madsen, 2002) startups which can impact the local economy through a value-added exports. The challenge for any willing partners in a nascent startup ecosystem is how to find, validate, and accelerate these types of high-potential ventures which will eventually take ownership over the ecosystem.



[1] EBE: Evidenced-based Entrepreneurship Education – foundation of Lean Startup Method and NSF I-Corps
[2] High Potential Ventures – those ventures with product market fit and viable business models which are ideally innovation based

Figure 10. Lean Start-up Ecosystem

The Georgia Institute of Technology has developed a Lean Startup Ecosystem model which was designed to rapidly accelerate nascent ecosystem development. The model has been in practice since 2014. At the highest level, the model utilizes evidenced-based entrepreneurship techniques to feed, screen, and propel high-potential ventures toward scale. The model directs all resources of the nascent ecosystem toward rapidly maturing community and university based startups. In addition, the model supports culture change through experiential education within primary education systems.

Bridges, Byron D., "Creating Innovation Ecosystems: Utilizing Lean Techniques to Energize a Nascent Startup Ecosystem - A Puerto Rico Case Study." presented at Congresso Internacional de Inovação e Conhecimento – ciKi, 2016. Paper.

Gauthier, JF, Bjoern Herrman and Max Marmer. "Startup Ecosystem Lifecycle Model." Global Ranking Study, 2015. Publication.

Rasmussen, Erick S. and Tage Koed Madsen. "The Born Global Concept." European International Business Academy. EIBA, 2002. Paper.

c. Organized innovation entrepreneurship in large enterprises

Unlike start-up company innovation entrepreneurship, big enterprise innovation entrepreneurship encourages employees to pursue opportunities that are independent of their existing resources, which includes carrying out new business and to search for new opportunities. The result of internal innovation entrepreneurship can usually bring about the establishment of a new organization or result in innovation. The enterprise can be viewed as a system that encourages individuals to use creative processes to apply and invent technology, or apply new methods of work.

d. Corporate cultures and their effect on tech commercialization and innovation

One of the principal barriers to open innovation and corporate venturing remains substantial differences in the cultures and thinking of small innovation technology start-ups and developer teams when compared with big corporations including poor communication between them.

Major differences between corporate and start-up cultures are are summarized below:

Theme	Corporation	Start-up
Strategy	Appears and is adopted at the very beginning of any changes, rules and regulates the forthcoming planning	Appears at the very end as a result of trial-and-error development
Business processes	Form the foundation of the corporate management process, highly formalized, control and monitoring	Business processes not formalized, roles and activities in the team are mixed
Vision of future product	The shape of new product is formulated before or at the very beginning of the development process. In some cases, the sales are contracted well before the development process takes off. Typically, the product is understandable to potential customers.	The vision of new product/service/technology may change as a result of multiple pivots, the final product is not obvious and the vision exists in the form of product hypotheses which is tested through simultaneous customer development
Management of product development	Waterfall model of development. Subsequent achievement of consecutive Technology/Product/Manufacturing Readiness Levels (TPMRL)	Agile, lean development, quick launch of Minimal Viable Product (MVP) versions, constant improvement based on client approval and feedback
Personnel and HR management	Hierarchical management of competent and responsible personnel. "Order beats class"	Informally managed teams of active and motivated competent people without, or very little of, formal management hierarchy. "Class beats order".
Risk management	Risk avoidance and commercialization, minimalization of risks. High uncertainty considered as a negative factor which should be minimized.	Acceptance and mitigation of risks, high uncertainty often constitutes important source of new product/service/business model ideas.

Decision making processes	Long and hierarchical decision making process	High speed of decision making, even for critically important decisions.
Result	Mass production of high quality products/services/ with substantially slower and more expensive new product development process. Priorities – quality and economic efficiency.	Short time-to-market for new products/services with concomitant improvement on-the-go. Priorities – speed of development and launch.

Conceptual sources

https://www.randstad.ca/workforce360-trends/archives/corporate-culture-vs-startup-culture_510/
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https://www.rocketspace.com/corporate-innovation/more-corporations-are-looking-to-corporate-venture-capital
https://betterworkingworld.ey.com/growth/can-corporate-venture-solve-the-innovation-paradox
https://www.sparkcentral.com/blog/startup-life-compared-corporate-life/

Practical resources

https://www.inc.com/marla-tabaka/how-to-preserve-your-company-culture-as-you-grow.html
http://marketplace.yet2.com/app/insight/insight/20021020_tentips
https://business.tutsplus.com/tutorials/how-to-get-big-corporate-clients--cms-29049
https://www.inc.com/magazine/201503/adam-bluestein/tipsheet-hunting-big-game.html
http://financialpost.com/executive/c-suite/four-keys-to-selling-innovative-ideas-to-company-decision-makers
https://www.forbes.com/sites/work-in-progress/2010/11/08/bridging-corporate-and-startup-cultures/

ii. Funding and Capital

a. Industry sponsored research funding

Working early with industry can be beneficial for universities and institutes as i allows the technology commercialization process to be more market pull driven rather than the more traditional model of public sector technologies being offered to the market to see if they will gain acceptance. In addition, many corporations are developing collaborative research projects with universities and institutes around innovating new products and services. Any agreement covering such collaborations will have aspects governing the exploitation of any new IP, payment of patents and a funding schedule by the industry partner. Thus, the funding from the industry partner can cover the costs of both the research and the initial IP exploitation. Moreover,APEC economies have realized the importance of industry to public sector research interactions and how important they are in developing an economy's innovation ecosystem and innovative capacity. Such interactions are not limited to industry sponsored research but to a variety of benefits under the umbrella of knowledge transfer. For more information on this topic, see:

http://sciencebusiness.net/sites/default/files/archive/Assets/94fe6d15-5432-4cf9-a656-633248e63541.pdf

b. Proof of Concept Funding

Public sector inventions are invariably at an early stage of development and are high risk propositions for external investors. They require nurturing to develop their potential as a start-up or as a licensing opportunity. Many university and institute TTOs have understood these challenges and have established proof of concept funding schemes. This allows promising technologies that have passed the assessment phase to be progressed further with internal funding to make them more investment ready thus increasing the chances of future success. Proof of concept funding schemes will have rules on how the funds can be used usually to pay for prototype development or to fund key experiments to progress the technology to being market ready. In Figure 5 above, the University of Western Australia's proof of concept, Pathfinder fund, is referenced. See:

http://www.rdi.uwa.edu.au/research-innovation/pathfinder-fund

See also University of Colorado proof of concept fund details at:

https://www.colorado.edu/techtransfer/cu-proof-concept-programs

On how to set up a proof of concept fund, see:

http://techtransfercentral.com/reprints/ttt/912-proof-of-concept/

c. Pre-seed Funding

Pre-seed funding is generally defined as the funding required to establish a start-up company or if already established to help it develop and grow in order to later access venture capital. In this category, there are a number of types of funding mechanisms meeting the broad definition of pre-seed funding. For example, angel investing where the funding comes from high net worth individuals is often a valuable source of funds for early stage technology start-ups. It is not unusual for TTOs to cultivate known angel investors and serial entrepreneurs to assist with their technology start-ups. Another source, may be a co-investment by the university or research institute with federal government funding schemes. These schemes aim to accelerate commercialization outcomes at a domestic level although not all economies offer such schemes.

See Report on the New Zealand Scheme under:

https://www.cdc.org.nz/wp-content/uploads/2015/10/10-Year-PreSeed-Analysis-Nov-2014.pdf

See Report on how Governments assist in Pre-seed Funding

https://www.tandfonline.com/doi/abs/10.1080/09537325.2012.705119?needAccess=true&journalCode=ctas20

d. Venture Capital

Under 5 viii, we have already mentioned the important role of investors in setting up and supporting start-ups. Traditional venture capitalists will usually invest in the next phase once the start-up is operating and on track and looking for the next round of funding. One of the challenges for TTOs and their start-ups is often access to venture capital at this point both locally and even domestically; a further factor related to the "valley of death" previously discussed. In addition, the TTO and inventors need to understand how venture capitalists operate if they expect to conduct meaningful discussions to get start-ups progressed to the next stage.

The following points give a sense of most venture capitalists' operating guidelines:

- Invest in specific market segments where they have intimate knowledge
- Look for low valuation opportunities with high reward
- Minimize risk by using a portfolio approach and by staging their investment
- Very selective and reject many more than they accept
- Only make money when they exit

Rounds

In venture capital parlance, using the US as an example, there will be various "rounds" of investment as the company moves through stages of growth and expansion presuming it shows good performance. These rounds are referred to as Series A, B, C etc.… The amounts of funding in the various Series will depend on factors such as the market segment. For example, biotechnology companies will usually require more funding than IT companies as a general rule. As an indication, Series A can range between $2 million and $15 million.

A useful Australian report embracing the innovation ecosystem, the role of universities in commercializing research within the context and the role of venture capital can be viewed here:

https://australiancentre.com.au/wp-content/uploads/2016/04/Innovation-in-Australia_.pdf

Corporations as Venture Capitalists

Corporate venturing refers to larger corporations taking an equity stake in smaller technology companies or start-ups. Below we compare some differences between traditional venture capital and a corporate venture capital (CVC) fund.

Venture capital fund	Corporate venture capital fund
One or more financial investors as Limited Partners (LP) Management company General Partners bring in [at least some] understanding of portfolio companies' business Governance driven by stated objectives, milestones and Business Plan The Board as the main governance vehicle Focus on financial gain	Typically, an industrial company is the only Limited Partner (LP) Legal entity or company department Investment policy defined by the industrial company's priorities Support from the LP available to open doors and provide assistance Still, portfolio companies live their own life like any VC-backed companies

Various types of investment by CVC answer the strategic needs of corporations in different time frames

Type of investment	Aim and scope	Time-frame	Project readiness sought
Driving investments	The purpose of this investing option is to advance the strategy of the **current business**. The CVC looks for key growth areas within the start-up companies and then hopes to combine them with the company's initiatives. Can benefit the investing company by furthering the current corporate strategy.	Short-term	High level of readiness
Enabling investments	Enabling investments are also made for strategic purpose, but they are not linked closely with the investing company's operations. The idea is to take advantage of **complementary products**. Enabling investments complement the strategy of the current business.	Middle-term	Moderate
Emerging investments	Do not promote current strategies, but link tightly with the investing company's operations. Allow to **explore new markets** that they are unable to enter due to their focus on the current markets Emergent investments are initially made for financial gains but could ultimately result in strategic gains as well.	Long-term	May be very early stage

There is a variety of ways the corporation may work with outside developers:

Internal/external incubation/acceleration.

The instruments of internal incubation vary from unstructured approaches (20 % rules and labs) to highly organized incubator/accelerator programs (internally both programs are necessary). External incubation offers various incubator services to external early-stage start-ups and entrepreneurs.

Wide and narrow collaboration models.

The wide collaborative model engages with start-ups operating in strategically important domains. Narrow collaborative model is the model's focused approach using start-ups to solve clearly defined problems for the benefit of the company.

Virtual incubators have no physical location and are built around IT platform services with the goal to increase the amount of content or lock-in future paying customers.

Community model is typically built around a co-working facility located within corporate offices and constitutes a single-location program with minimal infrastructure, allowing safe experimentation with start-up collaboration

Conceptual sources

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Chesbrough, Henry William (2004), Corporate Venture Capital in the Context of Corporate Innovation
https://www.researchgate.net/publication/37421748_Corporate_Venture_Capital_in_the_Context_of_Corporate_Innovation

Corporate venturing – Harward Business Review:
https://hbr.org/2013/10/corporate-venturing
https://yourstory.com/2018/01/pattern-building-successful-corporate-accelerator/

Corporate Accelerators: What's In It For The Big Companies?
https://www.forbes.com/sites/groupthink/2016/02/23/corporate-accelerators-whats-in-it-for-the-big-companies/#2326d8695f62

CVC History:
https://www.cbinsights.com/research/report/corporate-venture-capital-history/
http://www.cameronconsultingco.com/2014/07/12/challenges-of-corporate-venturing/

Success stories

Generations corporate accelerator Russian Venture Company:
http://en.generation-startup.ru/
https://www.pivotint.com/blog/3-venture-capital-success-stories

Practical resources

Database of corporate accelerators:
http://www.inventright.com/irconnectlandingpage

iii. Entrepreneurship and Innovation ecosystem

a. Incubators and Accelerators

Incubators and accelerators are entities that help start-ups and businesses develop by providing services around company operations, management, etc., including access to physical resources such as a space to operate and IT support. For technology companies, these organizations can play an even more important role, because the founders may have the technical but not the business skills to succeed.

Economies are attempting various models of incubation and acceleration. At one end of the spectrum might be the innovation café whilst at the other end are incubators involving laboratory space and access to hi-tech research equipment. In addition, incubators are trying to assist start-ups at different stages of development including support for IP management, company registration, staff recruitment and even to first product sales.

The following are some examples of the typical services that incubators and accelerators can provide to start-ups:

- Intellectual property consulting and management;
- Infrastructure, business operations and access to capital;

- Marketing, sales, and presentations;
- Public relations;
- Researching and product manufacturing.

It could be clarified to distinguish incubators and accelerators by business cycle, which is from customer discovery, validation, creation, to company building. Incubators focus on making ideas becoming demos, and then accelerators make them to businesses. Which means incubators would most select IP management etc. as their services, when accelerators focus on sales and marketing etc.

Find more at:
https://www.techrepublic.com/article/accelerators-vs-incubators-what-startups-need-to-know/

New Generation of Incubation Programs

A traditional incubation model offers acceleration support for a select number of startups with either a viable business model and/ or customers. The purpose of incubation is to scale these high-potential ventures as quickly as possible with a combination of access to talent, resources, customers, service providers, and investors. In general, the challenge for incubator managers is continually finding quality applicants to fill the incubator. To address this challenge, a small number of incubators are beginning to look toward serving broader populations of entrepreneurs with education services. This is in addition to their more traditional acceleration programs. The idea is that incubators are now engaged in building their pipeline of startup teams, as opposed to waiting for startups to appear.

One such incubator is the Advanced Technology Development Center (ATDC) at the Georgia Institute of Technology. ATDC provides a badging process whereby entrepreneurs enter at the educate level to complete educational courses and validate their business models. Those who complete the educate level then move forward to accelerate where more one-on-one services are provided. Approximately, five percent of the educate members move forward each year. The following is a link to this ATDC ecosystem building program.

http://atdc.org/about/

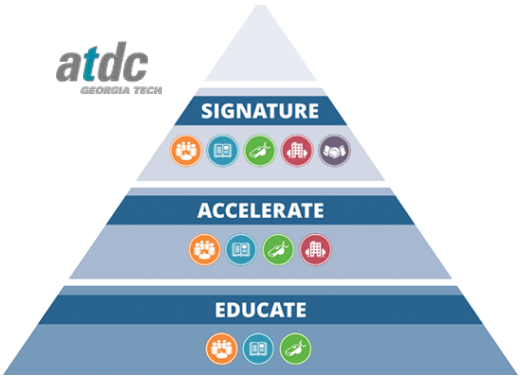

Figure 11. ATDC ecosystem

b. Technology Parks and Clusters

Technology parks have gained acceptance in many economies to foster innovation and have a key role to play. Many have been developed trying to imitate the innovation clusters made famous in the US, namely Silicon Valley and Boston. Now economies are making more comprehensive plan for various types of technology and science parks. In many cases these are industry sector specific, like biotechnology or IT and computers. In other cases, they may be based on a particular region or state where numerous manufacturing companies are already operating although there is mixed evidence as to the effectiveness of this model. One way of enhancing and growing the innovation ecosystem is to try and put start-ups in the science park in proximity to established companies as a way of way fostering collaboration and other synergies—again, a practice that has had mixed results throughout the world.

Many economies in the APEC region have science and technology parks and many have organizations or associations supporting these efforts. For example, China is promoting its provinces to establish parks for technology commercialization, which combine elements of technology commercialization skills, agencies, incubators, and policy support from both the local and central governments. Both academia and industrial entities are facilitated through funding and other resources to make use of this system

For information on technology parks and Science Parks in various economies, see International Association of Science Parks and Areas of Innovation at:

https://www.iasp.ws/our-industry/definitions

See APEC member presentations:

04.Appendix- 6.iii Entrepreneurship and Innovation ecosystem – 01 University's Role in Economic Development of DFW by Christopher John Bhatti from UT Dallas of the U.S.

04.Appendix- 6.iii Entrepreneurship and Innovation ecosystem – 02 International Cooperation to Enhance Entrepreneurial Competitiveness by Eugine Krentsel from U.S.

04.Appendix- 6.iii Entrepreneurship and Innovation ecosystem – 03 Innovation Development Mode by TANG KOK MUN from Genesis Incubation Centre from Malaysia

04.Appendix- 6.iii Entrepreneurship and Innovation ecosystem – 04 Case and Commercial Practice of APEC Regional Knowledge by edResearch from Republic of Korea

04.Appendix- 6.iii Entrepreneurship and Innovation ecosystem – 05 Entrepreneurial Trends by Bryan Chambers from Blackstone LaunchPad of US

7. Information Systems and the Digital Future

In today's world, digital platforms are critical to business growth and development. Companies that have embraced digital systems fully including for marketing and operational issues are today's business leaders. Those companies slow to engage with digital technologies, social media marketing and to keep up in these areas will fall behind. These aspects are defined in the following Harvard Review Article, see:

https://hbr.org/2017/01/what-the-companies-on-the-right-side-of-the-digital-business-divide-have-in-common

In this section we present some applications of digital technology for technology commercialization, and APEC economies' attempt to bridge the digital divide.

i. Online platforms for technology commercialization

An online platform for technology commercialization can be a website or digital application which can be accessed through the internet and where the technology providers and the "buyers" can be linked in some way for the purpose of commercialization. As an example, there are standard technology commercialization online platforms founded by private sector companies such as, InnoCentive, a platform offered by Eli Lilly and Company.

See InnoCentive at:
http://www.innocentive.com/about-us/

Most universities provide digital platforms for either business and licensing opportunities through their TTOs or related functions like industry liaison. As an example of the latter, MIT-ILP is a successful and well-known platform linking MIT resources with industry globally.

See MIT-ILP at:
http://ilp.mit.edu

ii. Digital Divide and Connectivity

Economies in the region are recognizing the importance of digital technologies, and the divide between more developed and less developed areas. At a domestic level, this provides challenges for governments to keep up with the ongoing digital revolution providing infrastructure and improved internet access as well as educational programs in digital systems. It has been known for some time that fluency in ICT and digital use has a strong link to domestic innovation and economic development. Conversely, a lack of digital infrastructure creates a digital divide. The following paper discusses these issues:
http://iisit.org/Vol6/IISITv6p471-478Fong597.pdf

In 2017, the concept paper for PNG's hosting 2018 APEC conference was presented as "Harnessing Inclusive Opportunities, Embracing the Digital Future", and is one of the main goals for PNG moving forward to bridge the digital divide.

See Background Paper of APEC 2018 in PNG at:
http://mddb.apec.org/Documents/2017/SOM/ISOM/17_isom_006.pdf

Digital technologies are therefore highly relevant to physical connectivity, institutional connectivity, and person to person connectivity in the region.

iii. Sharing Economy

In this section, we describe another model which is an internet-based one called the "sharing economy". Essentially, the sharing economy is an economic model often defined as an activity where individuals can acquire, provide or share access to goods and services facilitated by a community based on-line platform. The sharing economy is driven by data and the growth in digital platforms and

those platforms are driven by business specific algorithms. The sharing economy gives rise to businesses or platforms such as ride and car sharing, apartment sharing, crowd funding or lending, all on a peer to peer basis. For more information on the sharing economy see:

https://www.forbes.com/sites/bernardmarr/2016/10/21/the-sharing-economy-what-it-is-examples-and-how-big-data-platforms-and-algorithms-fuel/#

https://www.moneycrashers.com/sharing-economy/

Globally, governments around the world that took the lead in developing the sharing economy have been moving from a conservative perspective to an open and supportive attitude. As an example, the EU has attempted to standardize its sharing economy by improving the relevant legal taxation system, raising public awareness and guiding correct participation in it. See:

https://europa.eu/european-union/about-eu/figures/economy_en

See APEC member presentations:

04.Appendix- 7.iii Sharing economies- 01 Some Examples of Technology Transfer related to the JST Activities by Chayama Hidekazu from JST

04.Appendix- 7.iii Sharing economies- 02 Tech-Demand Based Business Creation Project in Korea by Ms. Ha Kwei Rye from Nam&Nam Law Firm of Republic of Korea

04.Appendix- 7.iii Sharing economies- 03 Introduction about Innovation Management and Entrepreneurship Service in Germany- Hong He from Helmholtz of Germany

8. Worldwide Cross Borders and Diversification in APEC region

Today's world is undoubtedly more open and diversified. Government departments are driving policies to stimulate and encourage innovation which leads to growth in both domestic and cross-border markets. With regard to the idea of improved APEC connectivity, technology commercialization specialists within APEC economies can help build more cross-border cooperation in science and technology and innovation. APEC economies can assist each other in the adoption of new technology by utilizing technology commercialization resources.

i. APEC Connectivity Blueprint and Innovation Cooperation

The declaration of APEC Connectivity Blueprint for 2015-2025 announced “a seamlessly and comprehensively connected and integrated Asia-Pacific”, in which expression, Physical, Institutional, and People-to-People Connectivity were identified to be pillars of regional connectivity.

Some key concepts have been highlighted through these pillars, for example:

- public private partnerships (PPP)
- the improvement of information and communication technology (ICT) for Physical Connectivity,
- structural reform and
- a strategy to tackle the policy challenges for Institutional Connectivity
- cross-border approaches to education and science, technology and innovation exchanges for People-to-People connectivit

And the whole Blueprint focus especially on capacity building and private sector cooperation.

One obvious feature is that, APEC is concentrating on breaking borders and barriers of region, technical fields, and institution etc., which could be the trend for regional connectivity and development including in the areas of science, technology, and innnovation

See APEC Connectivity Blueprint at:
https://www.apec.org/Meeting-Papers/Leaders-Declarations/2014/2014_aelm/2014_aelm_annexd.aspx

See APEC member presentations:

04.Appendix- 8.i APEC Connectivity Blueprint and Innovation Cooperation – 01 Trial applications in technology commercialization by APECTT- Mr. Yizhong Lu from APEC Center for Technology Transfer

ii. APEC Technology Commercialization Practice and Consideration

Starting from April 2017, APEC PPSTI held three workshops on the theme of *APEC Technology Commercialization* in Shenzhen, Chengdu and Xi'an. Delegates were invited from relevant technology commercialization institutions of APEC economies and introduced technology commercialization and innovation cooperation of their economies or the organization. It is not hard to see that under the background of APEC connectivity, an increasing number of APEC economies are exploring and introducing the institutional system of technology commercialization, which lead to diversified practices, and demands of acknowledgement of best practices in developed economies.

Few economies or institutions have not carried out exchanges and cooperation in the cross-border aspect. From the speeches made by the experts of the economies participating in the seminars, we will extract concrete cases and practices of their cooperation in technology commercialization.

9. Education in Innovation and Technology Commercialization

An important aspect for effective technology commercialization and effective interactions between private and public sector entities is ongoing education and training. It is important that people understand innovation concepts and speak a common language for effective communication. To achieve these goals both informal and formal ongoing education and training sessions are needed. Below are some examples of the approaches taken by corporate and public sector entities engaged in innovation and technology commercialization training.

Teaching Corporate Management

Typical programs in Open Innovation, Entrepreneurship and Intrapreneurship for corporate management cover the topics of:

- Open innovation,
- Venture investment and corporate venture instruments,
- Technology transfer and IP,
- Technology and innovation management,
- Technology entrepreneurship and intrapreneurship,
- Design thinking and product development,
- Agile product development and lean entrepreneurship, and
- Teaching entrepreneurs.

There is also a number of entrepreneurship education programs, typically covering the topics of Introduction to entrepreneurship, Design thinking and product development, Intellectual property, Open innovations and interaction with industry, Modern technology trends, Business and financial modeling, Venture investments, Project presentation and communication skills, Team building, Learning-by-doing mixed team education.

Most of the corporate Open Innovation programs are taught in a purely corporate environment, without "reaching out in the field" and launch of practical interaction with the outside world of independent developers. On the other hand, most tech innovation entrepreneurship educational programs, albeit involving some elements of interaction with industry in the form of demo-days and road shows, do not imply regular, day to day industrial communication practice.

Recent approaches involve simultaneous education, community building and project acceleration based learning-by-doing approach. In such a program, comprehensive teams, including both industrial and entrepreneur representatives, join together in acceleration/education programs and work together on real-life projects generated within the program. The principal aim of such programs is to achieve real life tangible results (traction) for the mixed student teams' projects in the form of deals with industry and/or venture capital. This aim becomes realistic exactly because the student teams represent both the developers and their potential clients (industry).

Practical sources

https://oi-net.eu/m-oinet-network/m-oinet-key-topics/m-wp5-common-curricula-framework/964-teaching-open-innovation-pedagogical-guidelines-for-open-innovation
http://www.esade.edu/executive-education/eng/open-programs/open-innovation-corporate-entrepreneurship
http://openinnovationacademy.com/
http://www.issip.org/about-issip/community/open-innovation-program/
https://www.insead.edu/executive-education/digital-transformation-innovation
https://execed.hec.edu/en/executive-certificates/entrepreneurship-innovation
https://www.esmt.org/innovation

Public Sector Technology Commercialization Education and Training

In the case of public sector technology commercialization, education and training occurs both "on the job" and through courses provided by domestic technology commercialization organizations. The

background of technology transfer professionals (TPPs) or other technology commercialization experts varies but some generalizations can be made:

- Usually have a technical degree in their field together with an understanding of public sector research practice
- Usually have private sector experience in business
- May have an MBA, a legal background, or company start-up experience as an entrepreneur

In order to further the development of TTPs in their careers, TTOs and other related institutions across the globe provide training programs to assist with the professional development of their members. Training programs are generally in module form varying from one day to many days in length and usually include case studies on topics such as:

- IP protection strategies
- Licensing basics
- Advanced Licensing
- Company start-ups
- Marketing strategies
- Improving industry engagement

For more information see the US (AUTM) and Australian (KCA) organizations' web-sites:

https://www.autm.net/resources-surveys/careers-training/
https://www.kca.asn.au/trainingcourses

These organizations were both instrumental in setting up the basis of a more rigorous certification system for TTPs in technology transfer in 2010. The system is also based on continuing education in the field and allows TTPs to achieve Registered Technology Transfer Professional (RTTP) status. The system operates under the auspices of the Alliance of Technology Transfer Professionals (ATTP) and for more details, see:

http://attp.info/

Appendices

Appendix 1: Glossary of Useful Acronyms, Technology Commercialization, and Venture Capital Terms

Account of profits	Account of profits is an order by a court requiring the infringing party to deliver profits made from unauthorised use of rights.
Acquiescence	Acquiescence is a legal doctrine where permission or acceptance is deemed to be given by silence or passiveness.
Acquisition	When one company buys controlling stake in another company. Can be friendly (agreed upon) or hostile (no agreement)
Agile	A philosophy of software development that promotes incremental development and emphasizes adaptability and collaboration.
All rights reserved	All rights reserved is a notice usually found on copyright works. An 'all rights reserved' notice indicates that all rights granted under copyright law are retained (including the rights to take legal action if there is any infringement).
Alternative dispute resolutions (ADR)	ADRs are non-litigious methods of resolving disputes, such as informal settlement conferences, mediation or arbitration.
Angel Investor	Individual who provides a small amount of capital to a startup for a stake in the company. Typically precedes a Seed Round and usually happens when the start-up is in its infancy.
Anton Pillar Order	Anton Pillar Order is an order by a court authorising the search of premises for the purpose of seizing infringing articles that are likely to removed or destroyed by the infringer is notice of alleged infringement is given.
Arbitration	Arbitration is where a neutral third party ('arbitrator') acts as a private judge in a closed court to make a decision on the dispute which the parties agree to be bound by.
Artistic works	Artistic works is one of the categories of works that is protected by a Copyright Act. Artistic works include photographs, drawings, paintings, sculptures, architecture, graphs and computer icons.
Assignment of Rights	This occurs when IP rights are sold or bequeathed to someone else.
AUTM	Association of University Technology Managers, US based organisation for the promotion of public sector technology transfer
B2B	Business to business. This describes a business that is targeting another business with its product or services. B2B technology is also sometimes referred to as enterprise technology. This is different from B2C which stands for business to consumer, and involves selling products or services directly to individual customers.
Benchmark	The process by which a startup company measures their current success. An investor measures a company's growth by determining whether or not they have met certain benchmarks. For example, company A has met the benchmark of having X amount of recurring revenue after 2 years in the market.

Board of Directors	A group of influential individuals, elected by stockholders, chosen to oversee the affairs of a company. A board typically includes investors and mentors. Not all start-ups have a board, but investors typically require a board seat in exchange for an investment in a company.
Bootstrapped	A company is bootstrapped when it is funded by an entrepreneur's personal resources or the company's own revenue. Evolved from the phrase "pulling oneself up by one's bootstraps."
Breach of contract	A breach of contract is where there is a failure by a party of the contract to comply with the terms and conditions set out in the contract.
Bridge loan	Also known as a swing loan. Short-term loan to bridge the gap between major financing.
Burn Rate	The rate at which a company requires additional cash to keep going.
Business negotiation	A process that affirms price, creates value and overcomes the obstacle, by which all parties of different economies determine possible business opportunities through various means such as communication, consultation, compromise, and for their own economic interests and for satisfying each other's needs.
Buyout	A common exit strategy. The purchase of a company's shares that gives the purchaser controlling interest in that company.
Carried Interest	The substantial share, often around 20%, of profits that are allocated to the general partners of a venture capital partnership.
Capital	Monetary assets currently available for use. Entrepreneurs raise capital to start a company and continue raising capital to grow the company.
Capital under management	The amount of capital, or financial assets, that a venture capital firm is currently managing and investing.
Capped notes	Refers to a "cap" placed on investor notes in a round of financing. Entrepreneurs and investors agree to place a cap on the valuation of the company where notes turn to equity. This means investors will own a certain percentage of a company relative to that cap when the company raises another round of funding. Uncapped rounds are generally more favorable to an entrepreneur/startup.
Circuit Layout Rights	Circuit layout rights automatically protect original layout designs for integrated circuits, and computer chips. While these rights are based on copyright law principles they are a separate, unique form of protection.
Circuit layouts	A circuit layout is a representation (i.e. mask) describing the layout of the design of an integrated circuit. For example, in Australia, the Circuit Layouts Act 1989 grants an exclusive set of rights automatically upon creation of an original circuit layout for a limited period of time.
Claims	Concise written statements that define the invention covered by the patent application. What falls within that definition is protected by the patent and anything outside it, is not protected.
Cluster	A geographically bounded concentration of similar, related or complementary businesses, with active channels for business transactions, communications and dialogue that share specialised

	infrastructure, labour markets and services, and face common opportunities and threats.
Co-investment	See syndication.
Collaborative Research Agreement (CRA)	CRA is a contract which defines the terms and conditions under which collaborative research will be undertaken
Commercialization	The process by which the outcomes of research are converted to marketable products or services resulting in a commercial return.
Committed Capital	Pledges of capital to a venture capital fund. This capital is drawn down over the life of the fund.
Common Stock	The equity typically held by management and founders. Typically, at the time of an initial public offering, all equity is converted into common stock.
Community model	It is typically built around a co-working facility located within corporate offices and constitutes a single-location program with minimal infrastructure, allowing safe experimentation with startup collaboration.
Community Trade Mark (CTM)	CTM refers to a trade mark registered with the European Communities Trade Mark Office and is enforceable throughout the European Union.
Complete application	A complete application is a patent application for a standard or innovation patent that includes a full and complete specification and claims of the invention.
Complete Specification	This is the basis for the patent. It must describe the invention fully, detail the best way of putting the invention into effect and include at least one claim.
Competitive Advantage	Advantage gained over competitors by offering consumers greater perceived value, either through lower prices or greater benefits. In a science and research context such enablers of activity include infrastructure, centres of excellence, intellectual property, human capital and access to funding contribute which all contribute to an economy's competitive advantage.
Confidentiality Agreement (CDA)	Also known as a NDA or Non-Disclosure Agreement. This agreement binds either party (or both) to confidentiality for a set period of time when confidential information is exchanged.
Confidential information	Confidential information is information and materials of a confidential nature (and may include information of a personal or commercial nature) that is not readily available to the public.
Consolidation	A private equity investment strategy that involves merging several small firms together and exploiting economies of scale or scope.
Convertible Debt	A form of debt when a company borrows money with the intent that the debt accrued will later be converted to equity in the company at a future valuation. This allows companies to delay valuation while raising funding in the early stages.
Copyright	Copyright protects the original expression of ideas, not the ideas themselves. It is free and automatically safeguards the original works of

	art, literature, music, films, broadcasts and computer programs from copying and certain other uses.
Corporate Venture Capital	An initiative by a corporation to invest either in fledgling firms outside the corporation or units formerly part of the corporation.
Cost approach	An approach to IP valuation that values the IP by calculating the savings on costs an organisation would expect to make as a result of acquiring an IP asset instead of creating it from scratch.
Cross claim	A cross claim is a claim made in response to another claim, such as where a defendant brings a claim against the plaintiff in the same lawsuit.
Damages	Damages are monetary compensation that an infringer is required by a court to pay the owner for loss suffered as a result of the infringing act.
Debt financing	This is when a company raises money by selling bond, bills, or notes to an investor with the promise that the debt will be repaid with interest. It is typically performed by late-stage companies.
Defensive insurance	Defensive insurance is a type of insurance where funding is provided to cover the costs of legal proceedings brought against the insured for IP infringement owned by a third party.
Designs	See ‘Registered design’.
Digital Rights Management (DRM)	DRM refers to the management and protection of copyright material in the digital environment using technological protection tools.
Disruption	Also known as disruptive innovation. An innovation or technology is disruptive when it "disrupts" an existing market by doing things such as challenging the prices in the market, displacing an old technology, or changing that market’s customers.
Distressed Debt	A private equity investment strategy that involves purchasing discounted bonds of a financially distressed firm. Distressed debt investors frequently convert their holdings into equity and become actively involved with the management of the distressed firm.
Divisional application	A divisional application is a patent application filed to separate two inventions described in one earlier patent application, without losing its priority date.
Domain names	Domain names are sequences of words which are translations of numeric internet protocol addresses.
DPI	See realisation ratios.
Due diligence	An analysis an investor makes of all the facts and figures of a potential investment. Can include an investigation of financial records and a measure of potential ROI.
Early Stage Capital	Capital for a company that has commenced trading but has not moved into profitability or proved its commercial viability. The term ‘Early Stage' also is used generically to describe investments that are of a ‘seed' or ‘start-up' nature.

Earn out	Part of the price of a transaction, which is conditional on the performance of the company following the deal.
Economic rights	Economic rights are a set of exclusive rights granted to a copyright owner by the Copyright Act 1968 (Cth), which may be assigned or licensed.
Enterprise	The term enterprise typically refers to a company or business (i.e. an enterprise tech startup is a company that is building technology for businesses).
Entrepreneur	An individual who starts a business venture, assuming all potential risk and reward for his or herself.
Entrepreneur in residence (EIR)	A seasoned entrepreneur who is employed by a Venture Capital Firm to help the firm vet potential investments and mentor the firm's portfolio companies.
Equity financing	The act of raising capital by selling off shares of a company. An IPO is technically a form of equity financing.
Estoppel	Estoppel is a legal doctrine under which a person is prevented from asserting or denying a fact because of the person's previous acts or words.
Exclusive licence	An exclusive licence is where the licensee is the only person who has the right to deal with the licensed rights to the exclusion of all others, including the licensor.
Exercise Price	The price at which an option or warrant can be exercised.
Exit	The method by which an investor and/or entrepreneur intends to "exit" their investment in a company for commercial gain. Usually via an IPO or buyout by another company. Entrepreneurs and VCs often develop an "exit strategy" while the company is still growing.
Experimental use	The use of an invention for the purposes of determining how it works, determining the scope of patent protection, or for seeking an improvement of the invention, may in some economies, be exempt from patent infringement.
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Fair Basis	The invention as claimed must be supported by or be consistent with the detailed description provided in the specification.
Fair dealing	Fair dealing refers to categories of acts that do not constitute copyright infringement. Fair dealing includes use of copyright works to report news, for research or study, for criticism and review, and for professional advice given by a lawyer, patent attorney or trade mark attorney.
Freedom to operate	Freedom to operate refers to being able to freely use a product without infringing registered or pending IP rights.
Frugal Innovation	In essence, it is innovation that is focused on producing low cost and simplified solutions and products.
Filing date	Filing date refers to the date an application for registrable IP is lodged with the relevant domestic IP office. A filing date may be the same or different to a priority date.
Final injunction	Final injunction is an order by a court requiring the infringing party to permanently cease the infringing act.

Firm	The partnership which manages a venture capital fund. One firm might manage more than one fund.
First Closing	The initial closing of a fund.
First Fund	An initial fund raised by a venture capital organisation.
Follow-on Fund	A fund that is subsequent to a venture capital organisation's first fund.
Follow-on Offering	See seasoned equity offering.
Float	In a public market context, the percentage of the company's shares that is in the hands of outside investors, as opposed to being held by corporate insiders.
Flotation	To obtain a quotation or IPO on a domestic stock exchange, such as the Australian Stock Exchange or the NASDAQ.
Fund	A pool of capital raised periodically by a venture capital organisation. Usually in the form of limited partnerships, venture capital funds typically have a ten-year life, though extensions of several years are often possible.
Fund of Funds	A mutual fund that invests in other mutual funds.
Gatekeeper	See investment adviser.
Gearing, debt/equity ratio or leverage	The total borrowings of a company expressed as a percentage of shareholders' funds.
Globalization	Globalization is primarily an economic process of integration that has social and cultural aspects. It involves goods and services, and the economic resources of capital, technology, and data.
Goodwill	Goodwill is the reputation acquired from use of a particular registered or unregistered trade mark. A passing off action prevents others from trading on the goodwill acquired by a particular mark.
Grace period	An extended period during which an act may be done, when usually the act could not be done. For example, a disclosure of the invention before filing a patent application will usually prevent a valid patent being granted, but in certain economies there is a grace period of 12 months from the date of first disclosure by an inventor.
Ground floor	A reference to the beginning of a venture, or the earliest point of a startup. Generally considered an advantage to invest at this level.
In the Money	Any option or warrant that would have a positive value if it was immediately exercised.
Incubator	An organization that helps develop early stage companies, usually in exchange for equity in the company. Companies in incubators get help for things like building their management teams, strategizing their growth, etc.
Income approach	The income approach to IP valuation values IP by calculating the expected future income stream (or cost savings) to be generated by an IP asset.
In escrow	In escrow refers to the holding of items by a neutral third party until certain conditions are met to release them.

Industrial Design	Design refers to the features of shape, configuration, pattern or ornamentation which can be judged by the eye in finished products. Design registration is for manufactured products and NOT artistic designs. In other words, registered designs protect the way manufactured products look.
Infringement	Infringement occurs when someone willingly or unwillingly uses your intellectual property without your permission.
Innovation	The application of ideas that are new, regardless of whether the new ideas are embodied in products, processes or services, or in work organisation, management or marketing systems.
Innovation Patent	An innovation patent is a form of protection available in Australia for comparatively minor innovations and improvements. Protection is available for up to eight years. For suitable subject matter, innovation patents require only novelty and an 'innovative step' to be valid.
Innovative Step	Innovative step is one of the requirements for innovation patent registration under the Patents Act 1990 (Cth)
Intellectual Capital	The sum of 'hidden' assets of a company. It comprises human resources, knowledge, intellectual property and stakeholder relationships.
Intellectual Property	Intellectual property represents the property of your mind or intellect. Types of intellectual property include patents, trade marks, designs, confidential information/trade secrets, copyright, circuit layout rights, plant breeder's rights etc.
Interim remedies	Interim remedies are types of remedies granted temporarily until the court has heard the full case to grant permanent remedies.
Interlocutory injunction	Interlocutory injunction is an order by the court restraining an infringing party from continuing the infringing act until conclusion of the relevant trial.
Intra-company Technology Sharing	Refers to technology transfer within the company. For example, after two technology companies merge there will be internal technology transfer in the new entity or alternatively if a company begins manufacturing in a new location.
Inter-company Technology Transfer	Refers to technology transfer between companies. For example, whenever products or services are licensed between two commercial entities.
Invention Disclosure	Invention disclosures are made to technology commercialization offices when something new and useful has been conceived and developed, or when unusual, unexpected or novel research results have been achieved that may have commercial value. The disclosure enables the TTO to determine whether to protect the IP and commercialize the invention.
Inventor	Anyone whose involvement and contribution was essential to the development of the invention.
Investment Adviser	A financial intermediary who assists investors, particularly institutions, with investments in venture capital and other financial assets. Advisers assess potential new venture funds for their clients and monitor the progress of existing investments. In some cases, they pool their investors' capital in funds of funds.

Involuntary Exit	Where the company goes into receivership or liquidation.
IP Implementation Plan	An IP Implementation Plan is a document setting out a system on an operational level to implement the IP Policy within an organisation.
IP inventory	An IP inventory audit is an exercise identifying all existing IP assets held by the organisation.
IP Policy	An IP Policy is a document setting out an organisation's aims and objectives for the management of IP created or held by that organisation.
IP valuation	IP valuation is an assessment of the value of a particular IP asset. IP valuation may be quantitative or qualitative in nature. There are a range of methods to value IP.
IPO	Initial public offering. The first time shares of stock in a company are offered on a securities exchange or to the general public. At this point, a private company turns into a public company.
IRR	Internal Rate of Return The following three versions of the internal rate of return are often used - the arithmetic average, the capital weighted average, and the pooled average. The arithmetic average IRR for a sample would be the sum of the IRRs for the individual funds in the sample divided by the number of funds in the sample. The capital weighted average IRR is calculated in a similar manner, except the individual IRRs are weighted by fund size and affect the average in proportion to their size. Therefore, this average for the sample is skewed towards the larger funds. A pooled average IRR isn't actually an average, but one average calculated for the entire sample. In other words, instead of using the cash flows of the funds to calculate IRRs for each fund, the sample (and all of the accompanying cash flows) is treated as one fund and one IRR is calculated for it.
Joint Ownership	Joint ownership refers to when two or more individuals or organisations develop an IP asset together as a collaborative effort.
Joint Venture	A contractual arrangement whereby two or more parties undertake an economic activity that is subject to joint control.
KCA	Knowledge Commercialisation Australasia, an Australia and New Zealand-based organisation promoting public sector technology transfer
Know-How	Know-How is a term describing tacit knowledge on how to do or accomplish something. It usually cannot be covered by a written description.
LBO	Leveraged buyout, the acquisition of a firm or business unit, typically in a mature industry, with a considerable amount of debt.
Lead investor	A venture capital firm or individual investor that organizes a specific round of funding for a company. The lead investor usually invests the most capital in that round. Also known as "leading the round."
Letter of demand	A letter of demand is a letter setting out certain demands to a person suspected of infringing IP rights issued by the owner of those IP rights.

Leveraged Buyout	When a company is purchased with a strategic combination of equity and borrowed money. The target company's assets or revenue is used as "leverage" to pay back the borrowed capital.
Loan Capital	Loan capital ranks ahead of share capital for income and capital. Loans typically are entitled to interest and are usually, though not necessarily, repayable. Loans may be secured on the company's assets or may be unsecured. A secured loan will rank ahead of unsecured loans and certain other creditors of the company. A loan may be convertible into equity shares. Alternatively, it may have a warrant attached which gives the loan holder the option to subscribe for new equity shares on terms fixed in the warrant. They typically carry a higher rate of interest than bank term loans and rank behind the bank for payment of interest and repayment of capital.
Lock-up	A provision in the underwriting agreement between an investment bank and existing shareholders that prohibits corporate insiders and private equity investors from selling at the time of the offering.
Licensing of Rights	Licensing of rights gives the licensee the right to use (but not own) the rights.
Liquidation	The process of dissolving a company by selling off all of its assets (making them liquid).
Madrid System	The Madrid System refers to the Madrid System for the International Registration of Marks established under the Madrid Agreement 1891 and the Madrid Protocol 1989. It is administered by the World Intellectual Property Organisation granting trade mark protection in economies party to the Madrid Union by filing one application directly in their own domestic or regional trade mark office.
Management Fee	The fee, typically a percentage of committed capital or net asset value, that is paid by a venture capital fund to the general partners to cover salaries and expenses.
Manner of Manufacture	Manner of manufacture is one of the requirements for patent registration under the Patents Act 1990 (Cth).
Mareva injunction	Mareva injunction is an order by the court freezing the infringing party's assets so they cannot be consumed or transferred out of jurisdiction before the conclusion of trial.
Market approach	The market approach to IP valuation values IP by assessing the comparable prices or royalty rates that could be achieved by similar technologies or IP in the market.
Mediation	Mediation is where a neutral third party ('mediator') assists and facilitates the negotiation between parties in dispute.
Metadata	Metadata is information that describes a particular piece of content being held digitally.
Mezzanine financing	A form of hybrid capital typically used to fund adolescent and mature cash flow positive companies. It is a form of debt financing, but it also includes embedded equity instruments or options. Companies at this level, which are no longer considered startups but have yet to go public, are typically referred to as "mezzanine level" companies.
MTA	Material Transfer Agreement or MTA is an agreement used when test materials are transferred from one entity to another for test or research

	purposes. The MTA describes the basis on which the IP and other rights are offered.
Moral rights	Moral rights are personal rights granted to the creator of a copyright work protecting the integrity and right of attribution of their work. These rights cannot be assigned or licensed.
NDA	Non-disclosure agreement. An agreement between two parties to protect sensitive or confidential information, such as trade secrets, from being shared with outside parties. See also CDA above.
Non-exclusive licence	A non-exclusive licence is where the licensor retains the right to grant an unlimited number of licences to third parties.
Novelty	Novelty is one of the requirements for patent registration under any economy's Patent Act
Object code	This is the machine-readable code of a software program.
Offensive insurance	Offensive insurance is a type of insurance where funding is provided to cover the costs of legal proceedings where IP rights are being enforced by the insured against a third party infringer.
Open Innovation	The concept of open innovation stems from the notion that no entities can do all the necessary research and development as well as product development work to bring new products to the marketplace solely and in isolation.
Open source	Open source refers to any software program whose source code is made available for use, modification and redistribution to any user.
Option	The right, but not the obligation, to buy or sell a security at a set price (or range of prices) in a given period.
Ordinary Shares	These are equity shares that are entitled to all income and capital after the rights of all other classes of capital and creditors have been satisfied. Ordinary shares have votes. In a venture capital deal these are the shares typically held by the management and family shareholders rather than the venture capital firm.
Paris Convention application	patent protection in other Paris Convention-signatory economies whilst A Paris Convention application allows an invention to be granted retaining the priority date of the first filing of a complete patent application in a Paris Convention-signatory economy.
Passing off	Passing off is a common law tort action that protects the reputation or goodwill of unregistered marks.
Patent	A patent is a right granted for any device, substance, method or process, which is new, inventive and useful.
Patent of addition	A patent of addition is a patent application filed to protect an improvement or modification of an invention set out in an earlier patent application.
Patent attorney	A patent attorney is a professional qualified in a scientific discipline and qualified to act in the obtainment of patent and design registrations.
Patent term extension	The "term" or life of certain pharmaceutical patents may be extended for up to 5 years to compensate the patentee for loss of patent life the

	patentee experienced while obtaining regulatory approval for the pharmaceutical.
PCT	PCT stands for Patent Co-operation Treaty. You can file an International Application with the Patent Office of IP Australia under the PCT (Patent Co-operation Treaty). In your application, you should select or designate the economies in which you want a patent.
Pivot	The act of a start-up quickly changing direction with its business strategy. For example, an enterprise server start-up pivoting to become an enterprise cloud company.
Portfolio company	A company that a specific Venture Capital firm has invested in is considered a "portfolio company" of that firm.
Performers' rights	Performers' rights are personal rights granted to the performer of a copyright work by the Copyright Act 1968 (Cth) protecting against unauthorised recordings and broadcasting of performances.
Person skilled in the art	A person skilled in the art is a legal term referring to a person who has the ordinary level of skills and knowledge in the relevant field of an invention.
Permanent remedies	Permanent remedies are remedies granted by the court at the conclusion of a trial.
Placement agent	A financial intermediary hired by venture organisations to facilitate the raising of new venture capital funds.
Plant breeders rights	Plant breeders rights is a form of intellectual property that protects a registered plant variety. In Australia, plant breeders rights are governed by the Plant Breeders' Rights Act 1994 (Cth) where an exclusive set of rights are granted to the registered owner for limited period of time.
Post-money Valuation	The product of the price paid per share in a financing round and the shares outstanding after the financing round.
Pre-seed funding	A generally defined as the funding required to prepare a start up company to develop and grow in order to later access venture capital.
Prior art	Prior art is a legal term referring to information previously disclosed to the public in any form relating to the invention before its priority date.
Priority Date	A priority date is established for your invention when you first file a patent application that describes the invention in detail. This is used to determine if your invention is new. If your invention is known to the public before this date, you are not entitled to patent it.
Pre-money Valuation	The product of the price paid per share in a financing round and the shares outstanding before the financing round.
Preference Shares	These are non-equity shares. They rank ahead of all classes of ordinary shares for income and capital. Their income rights are defined and they are usually entitled to a fixed dividend (e.g. 10 per cent fixed). The shares may be redeemable on fixed dates or they may be irredeemable. Sometimes they may be redeemable at a fixed premium (e.g. at 120 per cent of cost). They may be convertible into a class of ordinary shares.
Preferred Ordinary	These may also be known as 'A' ordinary shares, cumulative convertible

Shares	participating preferred ordinary shares or cumulative preferred ordinary shares. These are equity shares with preferred rights. Typically they will rank ahead of the ordinary shares for income and capital. Once the preferred ordinary share capital has been repaid, the two classes would then rank pari passu in sharing any surplus capital. Their income rights may be defined; they may be entitled to a fixed dividend (a percentage linked to the subscription price, e.g. 8 per cent fixed) and/or they may have a right to a defined share of the company's profits - known as a participating dividend (e.g. 5 per cent of profits before tax). Preferred ordinary shares have votes.
Preferred stock	A stock that carries a fixed dividend that is to be paid out before dividends carried by common stock.
Product liability insurance	Product liability insurance is a type of insurance where funding is provided to cover costs when a person has suffered damage as a result of a product manufactured, repaired or altered by the insured.
Proof of concept	A demonstration of the feasibility of a concept or idea that a startup is based on. Many VCs require proof of concept if you wish to pitch to them.
Pro rata rights	Also known as supra pro rata rights. Pro rata is from the Latin 'in proportion.' A VC with supra pro rata rights gives him or her the option of increasing his or her ownership of a company in subsequent rounds of funding.
Private Equity	Private equity includes organisations devoted to venture capital, leveraged buyouts, consolidations, mezzanine and distressed debt investments, and a variety of hybrids such as venture leasing and venture factoring.
Prospectus	A condensed, widely disseminated version of the registration statement that is also filed with the US Securities and Exchange Commission. The prospectus provides a wide variety of summary data about the firm.
Provisional Patent Application	A provisional application is an interim document in patent actions. It does not form the basis of the grant of the patent but is a document that precedes the complete application upon which the grant is based.
Public domain	Public domain refers to when expired copyright works are made available for unrestricted use to the public.
Public Sector Technology Commercialization	Technology commercialization emanating from government funded entities such universities, government laboratories or related entities receiving government research monies.
Ratchets	A structure whereby the eventual equity allocations between the groups of shareholders depend on either the future performance of the company or the rate of return achieved by the venture capital firm. This allows management shareholders to increase their stake if the company performs particularly well.
Realisation Ratios	DPI, RVPI, TVPI: DPI: Distribution to Paid-In ratio (a realization ratio). The DPI measures the ratio of distributions to the limited partners compared to the amount of capital contributed by the limited partners.
Recapitalization	A corporate reorganization of a company's capital structure, changing the mix of equity and debt. A company will usually recapitalize to prepare for an exit, lower taxes, or defend against a takeover.

Refinancing	The purchase of the venture capital investors' or others' shareholdings by another investment institution.
Registered design	A registered design is a form of intellectual property that protects the overall appearance of a new and distinctive design. It needs to be registered domesticly and it grants a set of exclusive rights to the registered designs owner to commercially exploit the design for a limited period of time.
Repurchase	The repurchase of the venture capital investors' shares by the company and/or its management.
Research & Development	Creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.
Reverse-engineering	Reverse-engineering is the process by which a finished product or innovation is examined in order to obtain information relating to its construction and intimate workings.
Roll-up	See consolidation.
Round	Startups raise capital from VC firms in individual rounds, depending on the stage of the company. The first round is usually a Seed round followed by Series A, B, and C rounds if necessary. In rare cases rounds can go as far as Series F.
Royalty	A royalty is a fee paid to the IP owner for the right to use their IP. Royalties may be calculated as a percentage of profit, as a fee per usage or as a lump sum payment.
RVPI	Residual Value to Paid-In ratio (a realization ratio). The RVPI measures the net asset value of the funds (unrealized gains), compared to the amount of capital contributed by the limited partners.
SaaS	Software as a service. A software product that is hosted remotely, usually over the internet (a.k.a. "in the cloud").
Seasoned Equity Offering	An offering by a firm that has already competed an initial public offering and whose shares are already publicly traded.
Secondary Offering	An offering of shares that are not being issued by the firm, but rather are sold by existing shareholders. The firm consequently does not receive the proceeds from the sales of these shares.
Seed	The seed round is the first official round of financing for a startup. At this point a company is usually raising funds for proof of concept and/or to build out a prototype and is referred to as a "seed stage" company.
Seed Capital	The provision of funding to develop a concept, or product idea, to the stage at which its practical and commercial viability can be assessed. [See Early Stage Capital]
Secondary public offering	When a company offers up new stock for sale to the public after an IPO. Often occurs when founders step down or desire to move into a lesser role within the company.
Sector	The market that a startup companies product or service fits into. Examples include: consumer technology, cleantech, biotech, and enterprise

	technology. Venture Capitalists tend to have experience investing in specific related sectors and thus tend not to invest outside of their area of expertise.
Series	Refers to the specific round of financing a company is raising. For example, company X is raising their Series A round.
Share Capital	The structure of share capital that will be developed involves the establishment of certain rights. The venture capital firm will try to balance the risks it is taking with the rewards it is seeking. It will also be aiming to put together a package that best suits your company for future growth. These structures require the assistance of an experienced qualified legal adviser.
Shares Outstanding	The number of shares that the company has issued.
Sharing Economy	It is based on the integration of decentralized social idle resources and the mode of enhancing resource utilization as the core, and it refers to "the sum of economic activities that utilize the modern information technology such as the Internet to share the vast amount of decentralized idle resources to meet diversified needs."
Spin-off/ Spin-out	A new company established to commercialise the knowledge and skills of a university or corporate research team. The UWA has a set of guidelines or protocols for the formation of such companies.
Staging	The provision of capital to entrepreneurs in multiple instalments, with each financing conditional on meeting particular business targets. This helps ensure that the money is not squandered on unprofitable projects. See tranches below.
Stage	The stage of development a startup company is in. There is no explicit rule for what defines each stage of a company, but startups tend to be categorized as seed stage, early stage, mid-stage, and late stage. Most VCs firms only invest in companies in one or two stages. Some firms, however, manage multiple funds geared toward different stage companies.
Startup	A startup company is a company in the early stages of operations. Startups are usually seeking to solve a problem of fill a need, but there is no hard-and-fast rule for what makes a startup. A company is considered a startup until they stop referring to themselves as a startup.
Syndication	The joint purchase of shares by two or more venture capital organisations or the joint underwriting of an offering by two or more investment banks.
Technology Commercialization	The commercialization of technology between organisations through licensing or marketing agreements, co-development arrangements, training or the exchange of personnel.
Term sheet	A non-binding agreement that outlines the major aspects of an investment to be made in a company. A term sheet sets the groundwork for building out detailed legal documents.
Tombstone	An advertisement, typically in a major business publication, by an underwriter to publicise an offering that it has underwritten.
Tranches	In venture capital terms this refers to specific amounts of money to be paid into a company usually on agreed milestones.

Trade Mark	A trade mark can be a letter, number, word, phrase, sound, smell, shape, logo, picture, aspect of packaging or any combination of these, which is used to distinguish goods and services of one trader from those of another.
Trade Sale	The sale of a company's shares to another company, often in the same industry sector.
Trade Secret	A trade secret is both a form of IP and a strategy for protecting your IP. It includes proprietary knowledge (know-how) and other confidential information.
Valuation	The process by which a company's worth or value is determined. An analyst will look at capital structure, management team, and revenue or potential revenue, among other things.
Venture Capital	Money provided by venture capital firms to small, high-risk, startup companies with major growth potential.
Venture Capitalist	An individual investor, working for a venture capital firm, that chooses to invest in specific companies. Venture capitalists typically have a focused market or sector that they know well and invest in.
Vesting	When an employee of a company gains rights to stock options and contributions provided by the employer. The rights typically gain value (vest) over time until they reach their full value after a pre-determined amount of time.
Vintage year	The groups of funds whose first closing was in a certain year.
Virtual incubators	They have no physical location and are built around IT platform services with the goal to increase the amount of content or lock-in future paying customers.
Wide and Narrow Collaboration Models	The wide collaborative model engages with start ups operating in strategically important domains. Narrow collaborative model is the model's focused approach using startups to solve clearly defined problems for the benefit of the company.
WIPO	World Intellectual Property Organisation
Yield	Calculated by dividing the gross dividend by the share price and expressed as percentage. It shows the annual return on an investment from interest and dividends, excluding any capital gain element.

Note and Acknowledgement:

The above terms are compiled from various sources however a significant proportion of terms were derived from the Glossary provided in the Australian **Biotechnology Intellectual Property Management Manual** (2008), ISBN 978-0-646-50349-3) which is gratefully acknowledged.

Appendix 2: Organizations Engaged or Supporting Technology Commercialization in selected APEC Economies

a. AUSTRALIA

Australian Government links on Innovation and Science

https://www.australia.gov.au/information-and-services/business-and-industry

https://industry.gov.au/Innovation-and-Science-Australia/Pages/default.aspx

IP Australia/Australian Patent Office

https://www.ipaustralia.gov.au

Related entities supporting public sector technology commercialization

Australian Academy of Technological Sciences and Engineering (ATSE)
https://www.atse.org.au

Commonwealth Scientific and Industrial Research Organisation (CSIRO)
www.csiro.au

Knowledge Commercialisation Australasia (KCA)
www.kca.asn.au

b. CANADA

Canadian Government links on Innovation and Science

https://www.canada.ca/en/innovation-science-economic-development.html

https://www.canada.ca/en/services/science/innovation.html

Canadian Patents

https://www.canadian-patent.com/

Canadian Intellectual Property Office

http://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/Home

c. CHINA

Chinese Government links on Innovation and Science

http://www.most.gov.cn/eng/

State Intellectual Patent Office of China

http://www.sipo.gov.cn/

Related entities supporting public sector technology commercialization

International Strategic Technology Alliance (ISTA)
http://www.ista-net.net/

International Technology Transfer Network (ITTN)
http://ittn.com.cn

d. JAPAN

Japan Science and Technology Agency

http://www.jst.go.jp/

Japan Patent Office

http://www.jpo.go.jp/

Related entities supporting public sector technology commercialization

University Network for Innovation and Technology Transfer (UNTT)
https://unitt.jp/

Japan Technology Group (JTG)
https://japantechnologygroup.com/

e. KOREA

Korea Government links on Innovation and Science

http://english.moe.go.kr/

https://eng.kist.re.kr/kist_eng/main/

Korean Intellectual Patent Office

http://www.kipo.go.kr/

Related entities supporting public sector technology commercialization

Delta Tech Korea (DTK)
https://www.deltatechkorea.com/en/

Korea Invention Promotion Association (KIPA)
www.kipa.org

The Korea-US Innovation & Entrepreneur (KOUSE) Center
https://kouse.org/

f. NEW ZEALAND

Ministry of Business, Innovation and Employment

http://www.mbie.govt.nz/

Intellectual Property Office of New Zealand

https://www.iponz.govt.nz/

Related entities supporting public sector technology commercialization

Building Clever Companies (BCC)
https://www.thebcc.co.nz

g. PAPUA NEW GUINEA

Papua New Guinea Patent Office

http://ipopng.gov.pg/

h. RUSSIA

Russia Government links on Innovation and Science

Ministry of Science and Higher Education Russia
https://xn--80abucjiibhv9a.xn--p1ai/

Russian Venture Company
https://www.rvc.ru/en/

Rusnano Corporation
http://en.rusnano.com/

Fund (Federal) for Assistance to Small Innovative Enterprises
www.fasie.ru

Skolkovo Foundation
www.sk.ru

IP Russia/Russian Patent Office

http://www.rupto.ru

Other useful links

Association of Brokers of Innovation and Technology
https://www.abit-russia.com/

Internet Initiative Development Foundation
www.iidf.ru

Analytical reports on the state of innovation in Russia
https://www.rvc.ru/en/analytics/

Russian Technology Transfer Network
http://www.rttn.ru/index.php/en/

Technology Development Agency
https://tech-agency.ru/en/

i. SINGAPORE

Singapore Government links on Innovation and Science

https://www.dsta.gov.sg/

https://www.a-star.edu.sg/

IP Singapore / Singaporean Patent Office

https://www.ipos.gov.sg/

Related entities supporting public sector technology commercialization

GovTech Singapore
https://www.tech.gov.sg/

j. UNITED STATES

American Government links on Innovation and Science

https://www.whitehouse.gov/ostp/

https://science.energy.gov/

IP America/American Patent Office

https://www.uspto.gov/

https://www.uspto.gov/patent

Related entities supporting public sector technology commercialization

Association of University Technology Managers (AUTM)
http://autm.net/

Appendix 3: Commentary on Domestic Innovation Metrics in China

The 2018 Global Innovation Index makes the following specific comment on China and its improving innovation ecosystem and performance:

In this context, China's rise in the GII rankings over the last few years has been spectacular. Since 2016 China has featured in the top 25 group and has consistently moved upward in the rankings to 17th this year. The only middle income economy that continues to edge closer to the top 25 is Malaysia (35th).

China's innovation prowess becomes evident in various areas. It shows some of its greatest improvements in global R&D companies, high tech imports, the quality of its publications, and tertiary enrolment. In absolute values, and in areas such as R&D expenditures and the number of researchers, patents, and publications, China is now 1st or 2nd in the world, with volumes that overshadow most high income economies

Indeed, China presents an impressive example for other middle-income economies to follow as they seek to join the echelons of high-income economies. With this success in mind, China's attention is now turning to the quality and impact of innovation.

Generally speaking, the level of scientific and technological innovation in an economy is manifest in the following three areas:

- investment in scientific and technological research and development
- achievements of scientific and technological research and development, including outputs such as the number of patent applications and licenses
- transformation of scientific and technological research and development achievements into commercial benefits.

Below we look at this closer.

Investment in Science and Technology Research and Development in China

China has continued to invest strongly in research and development over recent decades:

- 12.543 billion yuan in 1990
- 153.96 billion yuan by 2003
- 1.7 trillion yuan by 2017.

In addition, by the end of 2017, a total of 503 domestic key laboratories, 131 domestic engineering research centers, 217 domestic engineering laboratories and 1276 domestic Enterprise Technology centers had been built in China. As of February 2018, there were 168 domestic high-tech zones in China. In 2016, the number of scientific and technological human resources in China continuously increases, and reached a total of 83.27 million people. The total number of R&D people increased to 3.878 million. The total number of R&D researchers reaches 1.692 million person-years, which is still the largest amount in the world. With the implementation of a series of policies and measures of science and technology, the work plan of technology transfer, and the increase of government investment in science and technology, the development level of science and technology in China have been greatly promoted.

However, from the view of the structure of science and technology investment, the expenditure of experimental development at approximately 70% of the total, is much higher than that of basic research which is approximately 5% of the total. The rationality of applied research and science and technology investment structure needs to be improved.

Status of patent applications and licensing in China

Most indexes measuring innovation strength place considerable emphasis on patents as an important index in evaluation of the scientific and technological competitiveness and technological innovation capability of an economy.

China's 'The Outline of Medium-long Term Planning on Science and Technology Development (2006-2020)' plan explicitly lists the amount of invention patents licensed to residents as an important indicator for evaluating the process of building an innovative economy. From the perspective of the trend of total

patent volume, the number of patent applications and licensing in China has been increasing year by year. In 2017, there are 3.698 million patent applications both inside and outside the economy, and 1.836 million patents have been licensed. From the level of technical content, the amount of patent and licensing has been growing at a high speed. In 2017, the number of patent applications in China is 1.382 million, which shows growth of 14.2% on a year-on-year basis. The number of patent licensing is 420 thousand.

According to the Patent Law of China, patents can be categorized into three types namely invention patent, practical patent and design patent, among which invention patent is the most technical and innovative category.

However, compared with other economies in the world, the proportion of successful inventions licensed in China is still low and needs further improvement.

Transformation of scientific and technological innovation achievements in China

After the stage of R & D and accomplishment of an achievement, scientific and technological innovation needs to be put into the market, so as to further complete its duty in innovation through direct or indirect technology transfer. On a general level, technology market is actually the sum of all exchange relationships that trade scientific and technological achievements as commodities and then turn them into direct productivity, including the whole process from technology development to technology application and transfer.

The scale of China's technology market is continuously expanding. According to domestic technology market statistics, as of the end of 2017, a total of 367,586 technical contracts were signed nationwide with a turnover of 202.34 billion US dollars, an increase of 14.71% and 17.68% year-on-year. The domestic technology market continues to maintain a medium-high growth momentum. In China, there are more than 1000 technology trading markets operating in different modes. According to data of science and technology authority, there are 141,397 technology seller enterprises, 709,951 technology buyer enterprises, 453 domestic technology transfer demonstration organizations, 19 domestic independent innovation zones, 156 domestic high-tech zones, 4293 maker space, and 3255 science and technology business incubators

Moreover, there are about 500,000 professionals engaged in technology transfer in China technology market, but the total number and quality of technology transfer personnel are still far from keeping up with the demand of China technology market. Education is the basis for strengthening the ability of domestic scientific and technological innovation. China has issued a series of important policies and regulations in order to cultivate innovative technology transfer talents who can meet the requirements of the new situation

Recently, China relevant science, technology and innovation institutions are trying to process forward demo practices of technology commercialization training modes. The training projects of technology commercialization are supposed to be designed to match the requirements of both full- and part-time workers in the field. From the overview lessons for awareness to specific skills for professionals, those projects are operated as five classes below:

Class 1. Technology Commercialization Awareness
Period: 12 Hours
Goals: Facilitate potential practitioners to get the initial capacities of technology commercialization, to be able to work with professionals on technology commercialization and transformation deals.

Class 2. Technology Transfer Juniors
Period: 30 Hours
Goals: Facilitate practitioners to be basically able to response for technology commercialization cases independently.

Class 3. Technology Transfer Professionals
Period: 30 Hours
Goals: Facilitate practitioners to be excellently able to response for technology commercialization cases independently.

Class 4. Chief Technology Officers
Period: 3-6 Months
Goals: Based on the abilities above, facilitate practitioners to be able to occupied as full-time officers according to knowledge and skills of technology commercialization, which would be in public sector organizations and enterprises.

Class 5. MSc in International Management and Innovation Entrepreneurships
Period: 10-18 Months
Goals: Collaborating with academia, to push the education of technology commercialization to the level of master degree.

Appendix 3: Materials of APEC Workshops for the Handbook

List of Presenters

- Cross-border peer-to-peer technology transfer in APEC with ITTN, Igor Rozhdenstvenskii, Martal Spb
- Chengdu APEC Talk - Andy Sierakowski
- Austrade LP Presentation- Selina Yuan from Austrade
- APEC – International Technology Seminar – STI & Connectivity ITT Professional Training Manual by Kulala Mulujng
- International Technology Transfer and Activities of the JST by Hidekazu Chayama from JST
- Practice & Trend of Technology Transfer in China by Chang Linzhao National Technology Transfer Zhengzhou Center of China
- Technology Transfer Program of Korea by Dr. Sang Keun Lee from Dongshin University
- Information Paper of the PPSTI Workshop on “Development of Domestic Innovation Systems and Networks” by Jeffrey Noro
- BPPT’S INNOVATION DEVELOPMENT by Dr. Erlan Rosyadi from Agency for Assessment and Appliation of Technology of Indonesia
- China's domestic programs for international connectivity of STI young professionals- Yu Qianwen from CSTEC
- Korea's Industrial Technology ODA Programs by Dr. Sang Keun Lee from Donshin University
- Strategic IP Utilization Planning- Benefiting from ITRI's Experience- by Elsie Huang from ITRI
- Technology Transfer Offices Consortium by Ms. Alba Sanchez from CONACYT
- The Role of IP in the Technology Transfer and Innovation Collaboration Singapore Domestic R&D Framework by Jack Cheng from IPOR
- TECHNOLOGY TRANSFER AND COMMERCIALIZATION PHilMech Setting by Roderic Verena from PhilMech
- Technology Commercialization of Korea by Dr. Sang Keun Lee from Donshin University of Korea
- INSTITUT TEKNOLOGI BANDUNG TOWARDS ENTREPRENEURIAL UNIVERSITY Challenges, Opportunities and Efforts- by Prof. Tatacipta Dirgantara from Bandung University of Indonesia
- APEC Technology Transfer Workshop by Dr. Jet Shu from Chinese Taipei
- Learning- by- doing or Doing- by- Learning by Dr. Igor Rozhdenstvenskii from Martal Spb, Russia
- Practical Methods Tech Transfer Success by David Melander from Discovry Neos Capital LLC
- Suggestions for Cross border Technology Transfer from Activities of the JST by Chayama Hidekazu from JST
- INNOVATION, TRANSFER AND COMMERCIALIZATION INITIATIVES PHILIPPINES by Roderic Vererna from PhilMech
- The Knowledge Transfer System in the US by Ashley J. Stevens from US
- Valley of Death by Mr. Carl Rust from Gerogia Institute of Tech of US
- ITTN Russian cross-border tech transfer by Dr. Igor Rozhdenstvenskii from Martal SPb. from Russia
- Innovation Entrepreneurship in Japan by Mr. Chayama Hidekazu from JST
- KCA Introduction- by Dr. Erin Rayment from University of Southern Queeesland of Australia

- Xi'an Sailest Biomedical Investment Consulting Co. Ltd by Xin Bu from China
- Strategic Value Creation from Scratch - Mr. John McEntire from US
- Techbeidges Venture- Dr. Ho Woon Yee from China
- A Discussion on Difficulties in Technology Transfer from Industry Side- Ms. Wenbo Yuan from China
- International Technology Transfer and APEC– an Australian Perspective by Dr. Andy Sierakowksi from Australia
- Technology Transfer from University to Industry by Dr. Alexander Kevashnin from Novosibirsk State University of Russia
- Australian initiatives to build collaboration For innovation by Dr. Matt Wenham from the Australian Academy of Technology and Engineering (ATSE) of Australia
- The University of Texas at Dallas by Mr. Steven Liln from UT Dallas from US
- International Technology Transfer Practice and Economic Inclusive Growth in APEC Zone by Marcus Wade Fulghum from US
- Commercialization at the University of Waterloo by Ling Loerchner from University of Waterloo from Canada
- The Intellectual Properety Office of the Philippines (IPOPHL) by Roderic Verena from PhilMech of the Philippines
- APEC International Technology Transfer Cooperation and Industrialization Workshop by Mr. Kim Sum Wook from Nam&Nam Law Firm from Republic of Korea
- University's Role in Economic Development of DFW by Christopher John Bhatti from UT Dallas of the U.S.
- International Cooperation to Enhance Entrepreneurial Competitiveness by Eugine Krentsel from U.S.
- Innovation Development Mode by TANG KOK MUN from Genesis Incubation Centre from Malaysia
- Case and Commercial Practice of APEC Regional Knowledge by edResearch from Republic of Korea
- Entrepreneurial Trends by Bryan Chambers from Blackstone Launch Pad of US
- Some Examples of Technology Transfer related to the JST Activities by Chayama Hidekazu from JST
- Tech-Demand Based Business Creation Project in Korea by Ms. Ha Kwei Rye from Nam&Nam Law Firm of Republic of Korea
- Introduction about Innovation Management and Entrepreneurship Service in Germany- Hong He from Helmholtz of Germany
- Trial applcations in technology commercialization by APECTT- Mr. Yizhong Lu from APEC Center for Technology Transfer

NOTE

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