**Academic Intellectual Assets Map**

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The Academic Intellectual Assets Map was prepared under the direction and management of Ms. Olga Spasić (Project Leader) and authored by Mr. Steven Tan and Dr. John Fraser.

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This publication is part of the **WIPO IP Toolkit for Academic and Research Institutions[[1]](#footnote-1),** which alsoincludes:

* IP Policy Template for Academic and Research Institutions: A compendium of key issues that are essential in an IP policy. Authors: Ms. Lien Verbauwhede Koglin, Mr. Richard Cahoon, Mr. Mohammed Aljafari, Ms. Hagit Messer-Yaron, Mr. Barthelemy Nyasse, Ms. Maria del Pilar Noriega Escobar and Ms. Tana Pistorius.
* Guidelines for the Customization of the IP Policy Template: An explanatory guide to adapt the IP Policy Template to the varied legal frameworks, cultural contexts, and local ecosystems in which institutions operate. Authors: Ms. Lien Verbauwhede Koglin, Ms. Kerry Faul and Mr. Richard Cahoon.
* IP Policy Writers’ Checklist: Practical guidance and step by step information on the different stages the process of creating or improving an IP Policy usually involves. Author: Ms. Lien Verbauwhede Koglin.
* Model Agreements: Compilation of agreements for knowledge and technology transfer transactions. Prepared under the direction and management of Ms. Olga Spasić (Project Leader). Author: Mr. D. Patrick O'Reilley.
* Case studies: Five Hypothetical Case Studies, which correspond and make reference to several of the Model Agreements. Prepared under the direction and management of Ms. Olga Spasić (Project Leader). Authors: Ms. Hagit Messer-Yaron and Dr. Keren Primor.

Summary

 This Section is developed specifically for universities and research institutions that are relatively new in the knowledge transfer/technology transfer practice and that want to set up or have recently established a Technology Transfer Office (TTO).

 Academic Assets (AI) are defined as a tangible or intangible resource that can be owned or controlled by an institution, managed and utilized in collaboration with another party for the purpose of generating societal and/or economic value. This document takes a very broad view of Academic Assets, beyond the usual perception in the academic technology transfer/knowledge transfer field. Its role is to broaden the conversation of how universities and research institutions can contribute to improving society and the lives of its citizens. A wide range of classifications of Academic Assets exist. Academic Assets can be separated into **Intellectual assets** and **non-intellectual assets**. Both categories are divided into several classes and sub-classes:

* Intellectual assets
	+ Intellectual property (created, identifiable and protectable by law, after review and approval by government, such as patents, copyrights, etc.);
	+ Knowledge assets (protectable and identifiable by contract, commercial or criminal law, such as trade secrets, know-how, expertise, etc.).
* Non-intellectual assets
	+ Collections
	+ Infrastructure & human capacity
	+ Financial assets
	+ Operational assets
	+ Strategic assets

	The document Map is a **comprehensive and inclusive framework** for the utilization of **Academic Intellectual Assets.**It Map describes three **methods** for utilization of Academic Assets:
* Commercialisation
* Application
* Dissemination

 In order to implement one of the utilization methods the document Map provides a set of **actions** that can be deployed separately or in sequence:

|  |  |
| --- | --- |
| * Secure
 | * Explore
 |
| * Share
 | * Transfer
 |
| * Collaborate
 | * Venture
 |

 The Toolkit is filled with specific transaction Agreements and Guidelines for their use at various points along the Academic Intellectual Assets documentMap. A table is provided linking the Toolkit contents to the current material Map.

 This document finishes with nine pathways/examples illustrating real life knowledge transfer/utilization cases.

Background & Context

 As part of its mission and objectives WIPO offers support and technical assistance in the field of intellectual property (IP) to its Member States (Article 3. and 4.V. of the WIPO Convention). WIPO has been invited to provide such assistance to developing and emerging economy states in the emerging field of the transfer of academic knowledge and associated IP to the private sector and to society, a process called “Knowledge Transfer.”

 In this context, WIPO took the initiative to develop this comprehensive set of documents and tools entitled ‘IP Tool Kit for Academic Institutions’ (i.e. universities and research and development (R&D) organizations), consisting of two volumes:

1. ***WIPO Institutional IP Policy Template and Guide (“IP Policy”)***, a set of documents related to institutional IP policies for Academic Institutions (i.e. universities and research and development (R&D) institutions). This is referred to as Volume 1; and
2. ***WIPO / FIT Australia Tool Kit (“Toolkit”)***, consisting of a set of tools and a Map on the strategic use of different assets owned or controlled by the Academic Institution, a set of IP commercialization strategies for bringing research results into the market and a set of models of knowledge / technology transfer transaction agreements (with Guidelines) – aimed at strengthening the capacity of Academic Institutions to implement their Institutional IP Policy.

 One of the objectives of the Toolkit is to assist Academic Institutions and national IP Offices to provide capacity-building training to their scientific and innovation stakeholders in the area of IP policies and knowledge transfer. Thus, the content of the Toolkit includes presentations and hypothetical cases addressing challenging issues related to the subject matter.

 During the development of the Toolkit it became apparent that the IP of academic institutions is a subset of a much broader set of academic assets that are suitable for collaboration and utilization between Academic Institutions and the private sector. Thus, it was concluded that the process of knowledge transfer – in particular IP and technology transfer – cannot be considered in isolation from the process of utilization of other academic assets – such as research infrastructure or libraries and collections of information.

 For that purpose, WIPO has developed the Academic Intellectual Assets documentMap, a comprehensive and inclusive framework for the utilization of academic assets.

Purpose of the Academic Intellectual Assets Map

 This Map Map is developed specifically for universities and research institutes that are relatively new to the technology transfer / knowledge transfer practice and that want to set up or have recently established a Technology Transfer Office (“TTO).

 The document Map applies the inclusive concept of “knowledge transfer” that is much broader than the traditional concept of “technology transfer” which is understood primarily as transfer of IP through patent licensing. Because of its broader definition, this Map is applicable to the implementation of knowledge transfer in all academic disciplines, including social sciences, humanities and the arts. In addition, the Map can be used to identify other non-patentable, but very useful, assets that can be used by Academic Institutions in collaborations with others to address real societal problems.

Structure

 The Map provides:

* An overview of all/most conceivable assets that an Academic Institution has, or may have, at its disposal and that are suitable for utilization by other academic institutions, the private sector and other organizations in society;
* An overview of different *methods* for utilization of academic assets;
* An overview of *actions* that can be applied to academic assets for the purpose of utilization;
* A set of examples or *pathways* of frequently used strategies and actions for the utilization of certain academic assets; and
* A table linking specific template agreements and guidelines in the Toolkit to actions described in this document Map.

Instructions for Use

 The Map can be used both top-down and bottom-up.

 In the top-down approach, the Map serves as an analytical tool and guideline for the creation of an inventory of academic assets, the assessment of knowledge transfer potential, the development (or improvement) of an IP policy and the implementation of a comprehensive and inclusive knowledge transfer activity, to be undertaken by the mandated organization of the academic Institution – such as the Knowledge Transfer or Technology Transfer Office (KTTO or TTO).

 In the bottom-up approach, the Map can be used as a hands-on manual to initiate and execute a specific knowledge transfer project for a concrete asset or set of assets based on an end user or specific utilization in mind at the beginning. The Map can provide structure and guidance to such a project.

 It is important to acknowledge that knowledge transfer is part of the innovation process and cannot be seen in isolation of the people involved. Innovation is highly dependent on the knowledge, experience, creativity and motivation of the associated individuals as well as the group dynamics between the individuals and the sociocultural aspects of the innovation environment. Innovation and knowledge transfer is, to a large extent, a very social process.

 In order to implement an effective knowledge transfer practice, the Map urges Academic Institutions to take this “people perspective” into account, i.e. while there is a process, it must be implemented by actual people.

People Perspective

 While the Map is process oriented, this section will focus on people, without whom the knowledge and intellectual property would not exist and without their active participation no transfer would occur successfully.

 Researches are very busy building their own research careers – to create knowledge to advance a field of endeavour, to educate people and receive the proper attribution for their work. Most will also be intrigued by the idea of using their research to help solve a real societal problem. They will be interested in the services of the TTO staff only to the extent that such services will advance their careers. TTO staff must show how this can be done by discussing the purpose of the TTO. The following is a good example of a modern Mission Statement of a technology transfer office / commercialization activity:

“*To assist the University to achieve its Goals of education, research and community service, by growing University-Industry relationships particularly in the area of research collaborations in order to bring results of research and creative works of researchers to the benefit of Society in the form of new products and services which save lives, improve the quality of life and increase corporate competitiveness and productivity.”*

 Researchers can easily understand how this will advance their own research careers. No mention is made of Patent, License, Agreements or any of the particular jargon of the field.

 A brief discussion with researchers by TTO staff of the strategy of ‘Intellectual Property’ and ‘Knowledge asset utilization’ will show that a well-defined, successful process exists to make this happen.

 North American and European experience shown that ten percent (10%) of academic STEM researchers will be intrigued enough to be involved over time. Evidence is emerging that another ten percent (10%) of researchers in non-STEM areas can get involved when the assets utilized are software, creative works, collections and materials (e.g. bio- and nonbio-) and other assets.

 Turning now to the motivations of TTO staff. Staff needs to be self-motivated and prepared to take initiative often. Every day is different depending on the variety of projects across campus which the staff needs to take the initiative to find and assist with.

 Staff needs to communicate constantly the progress they are making on projects that help build the institution’s research base as the activity is unfamiliar to most researchers, administrators and leadership. What success looks like is unknown to most on-campus. What others on-campus do understand is that the TTO staff are spending money on IP protection and advancing projects, but they need to be assured that concrete tangible progress to a goal is being made, as it may be a year or more before royalties or other project compensation comes onto campus.

 Staff must be motivated to work with others on campus collaboratively to build the research base and thus enhance the university or research institute’s reputation.

 The best staff over time show characteristics of: patience; modest ego; the ability to collaborate with many intelligent people who have very different agendas; paying attention to detail; taking initiative and having the ability to sell a concept of ‘what might be’ if the utilization works.

Academic Assets

 In financial accounting, an asset is any tangible or intangible resource that can be owned or controlled by an entity to produce positive economic value. Simply stated, assets represent something that can be converted into a financial benefit.

 In a research environment, an “academic asset” refers to a tangible or intangible resource that can be owned or controlled by a university or research institution and that can be utilized with a third party, (both public and private), for the purpose of generating societal and/or economic value. Simply stated, academic assets represent something that can be converted into a societal benefit and/or cash.

 It is important to acknowledge that in the financial accounting definition the value of an asset is related to the owner of the asset, whereas for an academic asset, its value is related to the party that utilizes the asset and/or the value to society as a whole.

Value of Academic Assets

 For intellectual or other property to become an asset for academic institutions, it is necessary that the asset be identified and has certain properties to be of potential utilization value to an external interested party, either public or private. For example:

* The asset must have a perceived or potential **application of value** to an interested party; and/or
* The asset is **novel, non-obvious, creative and/or available exclusively** in order to enable the interested party to invest in it to improve its products or services and increase its competitiveness by capturing a large part of the ‘added value’; and/or
* The asset is **reliable, credible and reputable** in order to enable the interested party to make investment decisions and actions that affect its reputation; and/or
* The asset is **comprehensive and coherent** to a specific field or domain. In the context of knowledge transfer, an external party would be less interested in isolated, small and discrete pieces of IP or knowledge, but would look for a reliable, competent and comprehensive knowledge provider/collaborator to help address its needs in a specific field of interest.

Classification of Academic Assets

 A wide range of classifications of such assets exist. They can be separated in two main categories:

1. Intellectual assets; and
2. Non-intellectual assets.

 Both categories are divided into several classes and sub-classes. An overview is provided in figure 1.

**Overview of academic assets**

1. **Intellectual assets**
	1. **Intellectual property** (created, identifiable and protectable by law, after review and approval by government)
		1. Patents
		2. Industrial design rights
		3. Copyrights and original works, including software
		4. Database rights and databases
		5. Layout designs (topographies) and integrated circuits
		6. Plant breeders’ rights and new plants varieties
	2. **Knowledge assets** (protectable and identifiable by contract, commercial or criminal law)
		1. Trade Secrets and Know-how
		2. Expertise
		3. Information
		4. Proprietary information, including
			1. Unpatented inventions
			2. Ideas & concepts
			3. Theories & rationales
			4. Results & observations
			5. Instructions & solutions
2. **Non-intellectual assets (more tangible assets)**
	1. **Collections**
		1. Data
		2. Objects
	2. **Infrastructure & capacity**
		1. Human capital
		2. Equipment
		3. Labs
	3. **Financial assets**
		1. Patent fund
		2. Proof of concept fund
		3. Venture/(pre-)seed fund
	4. **Operational assets**
		1. Technology transfer office
		2. Collaboration support organisation
		3. Clinical trial desk
	5. **Strategic assets**
		1. License(s) – certification to practice
		2. Access to patients
		3. Access to public funding and subsidies
		4. Reputation
		5. Entrepreneurial culture

Intellectual Assets

 For the purpose of knowledge transfer, intellectual assets are defined as any data, information, knowledge or skill, explicit or tacit (understood or implied without being stated), that is a consequence of human exploration, perception, cognition or creativity.

 Typical intellectual assets are ideas, inventions, theories and artistic works, but also data, information, know-how, methods, algorithms (a process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer), etc.

 Intellectual assets can be divided into two classes:

1. **Intellectual property (“IP”)**

WIPO definition of IP[[2]](#footnote-2): Intellectual property is a category of intellectual assets that can be protected by law, such as patents, designs and copyright. Because of this legal protection, IP can be owned and sold/assigned. The use and exploitation of IP by third parties can be controlled.

1. **Knowledge assets**

Knowledge assets are a category of intellectual assets that by national IP laws and regulations cannot be protected in certain countries, but their use is often regulated by other categories of legal regulations (criminal law, commercial law, etc.) or by contracts. Examples are know-how, ideas, concepts, information, expertise, etc. Very often knowledge assets are kept confidential in order to control ownership and use.

 The two classes and their respective subclasses are covered in detail below.

**Intellectual Property (IP)**

 Definitions (those intellectual assets that are created and protectable by national IP laws).

***Patents***

 A patent is an exclusive right granted by a sovereign state for an invention, which is a product or a process that provides, in general, a new way of doing something, or offers a new technical solution to a problem. To obtain a patent, technical information about the invention must be disclosed to the public in a patent application. Patents are a form of [intellectual property](https://en.wikipedia.org/wiki/Intellectual_property). Patentable inventions are not protected under patent law unless applications are filed, and patents issued.

 The patent laws require that, for an invention to be patentable, it must be:

* [Patentable subject matter](https://en.wikipedia.org/wiki/Patentable_subject_matter), i.e., a kind of subject-matter eligible for patent protection
* [Novel](https://en.wikipedia.org/wiki/Novelty_%28patent%29) (i.e. at least some aspect of it must be new)
* [Non-obvious](https://en.wikipedia.org/wiki/Inventive_step_and_non-obviousness) (in [US patent law](https://en.wikipedia.org/wiki/United_States_patent_law)) or involve an [inventive step](https://en.wikipedia.org/wiki/Inventive_step_and_non-obviousness) (in [European patent law](https://en.wikipedia.org/wiki/European_patent_law))
* [Useful](https://en.wikipedia.org/wiki/Utility_%28patent%29) (in U.S. patent law) or be susceptible of [industrial application](https://en.wikipedia.org/wiki/Industrial_applicability) (in European patent law).

***Industrial design rights***

 In a legal sense, an industrial design constitutes the ornamental or aesthetic aspect of an article. An industrial design may consist of three dimensional features, such as the shape of an article, or two-dimensional features, such as patterns, lines or color and is an intellectual property right. Industrial design rights (or design patents in the U.S.) require registration under national law.

***Copyrights and original works***

 Copyright (or author’s right) is a legal term used to describe the rights that creators have over their original works. Works covered by copyright range from books, music, paintings, sculpture, and films, to computer programs, software, databases, advertisements, maps, and technical drawings. Copyright is a form of [intellectual property](https://en.wikipedia.org/wiki/Intellectual_property). Some, but not all, jurisdictions require "fixing" copyrighted works in a tangible form. Generally, a copyright in a work exists upon creation but enforcement of the copyright may require registration under a national law.

***Database rights and databases***

 A ‘sui generis’ database right is considered to be a [property right](https://en.wikipedia.org/wiki/Property_right), comparable to but distinct from [copyright](https://en.wikipedia.org/wiki/Copyright), that exists to recognize the investment that is made in compiling a database, even when this does not involve the "creative" aspect that is reflected by copyright. ‘Sui generis’ is a [Latin](https://en.wikipedia.org/wiki/Latin) phrase, meaning " in a class by itself; unique".

***Layout designs (topographies) for integrated circuits***

 Layout designs (topographies) of [integrated circuits](https://en.wikipedia.org/wiki/Integrated_circuit) are referred to as ‘Mask Works’. In general, a right holder has the exclusive right to stop others from commercially using, importing, selling or distributing the protected layout designs. Enforcement of layout designs requires registration under national law.

***Plant breeder’s rights***

 Plant breeders' rights (PBR), also known as plant variety rights (PVR), are rights granted to the [breeder](https://en.wikipedia.org/wiki/Plant_breeding) of a new [variety](https://en.wikipedia.org/wiki/Plant_variety_%28law%29) of plant that give the breeder [exclusive control](https://en.wikipedia.org/wiki/Exclusive_right) over the propagating material (including seed, cuttings, divisions, tissue culture) and harvested material (cut flowers, fruit, foliage) of a new variety for a number of years. Plant varieties must be examined by a national office before rights are granted.

***Trade Secrets***

 Broadly speaking, any confidential technical or business information which provides an enterprise a competitive edge may be considered a trade secret. Trade secrets encompass manufacturing or industrial secrets and commercial secrets. Anything from manufacturing tolerances to a customer list can be a trade secret if properly maintained as a secret. The unauthorized disclosure or use of such information by persons other than the holder is regarded as an unfair practice and misappropriation of the trade secret. Depending on the legal system, the protection of trade secrets forms part of the general concept of protection against unfair competition or is based on specific provisions or case law on the protection of confidential

information. Protection of trade secrets may also arise under contract law. Trade secrets require relative secrecy; so long as the information is not generally known, a trade secret may be protected even though another person legitimately developed the same information as its own trade secret.

***Software***

 Computer software, or simply software, is a part of a computer system that consists of data or computer instructions, in contrast to the physical hardware. An application software program (app or application for short) is a [computer program](https://en.wikipedia.org/wiki/Computer_program) designed to perform a group of coordinated functions, tasks, or activities for the benefit of the user (e.g. a [word processor](https://en.wikipedia.org/wiki/Word_processor), a [spreadsheet](https://en.wikipedia.org/wiki/Spreadsheet), an [accounting application](https://en.wikipedia.org/wiki/Accounting_software), a [web browser](https://en.wikipedia.org/wiki/Web_browser), a [media player](https://en.wikipedia.org/wiki/Media_player_%28software%29), an aeronautical [flight simulator](https://en.wikipedia.org/wiki/Flight_simulator), a [console game](https://en.wikipedia.org/wiki/Console_game) or a [photo editor](https://en.wikipedia.org/wiki/Photo_editor)). The [collective noun](https://en.wikipedia.org/wiki/Collective_noun) ‘application software’ refers to all applications collectively. This contrasts with ‘[system software](https://en.wikipedia.org/wiki/System_software)’, which is mainly involved with running the computer. The intellectual property protection of computer software has been highly debated at the national and international level.  In some jurisdictions, protection by patent is permitted, in others, protection by copyright or by both is permitted.

**Knowledge assets**

 The second class of intellectual assets are knowledge assets.

 The Oxford Dictionary defines “knowledge” as:

1. *Facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject; and*
2. *Awareness or familiarity gained by experience of a fact or situation*

 Knowledge assets, in contrast to IP, are often not protectable by IP laws and therefore cannot be subject of a public monopoly. It is important to acknowledge that certain forms of knowledge such as databases, creative expressions or trade secrets are regarded as a property in certain jurisdictions.

 Effective protection can be achieved by means of confidentiality, non-disclosure or by contractual agreements. Permanently not disclosing knowledge is not feasible in an academic environment as it conflicts with academic ethics and practice.

 A non-exhaustive list of the most relevant types of Academic Institution knowledge assets that are suitable for utilization by private parties is provided below.

***Know-how***

 Know-how is defined as practical knowledge of how to accomplish something, often through accumulated experience. Know-how is often tacit knowledge, typically contained in the minds of people, which means that it is difficult to transfer to another person by writing it down or verbalizing it. In the context of technology transfer, IP and know-how are usually complementary assets. While some national laws raise trade secrets to the status of IP, often trade secrets are considered a more defined, valuable subset of know-how.

 The legal status and treatment of know-how differs by country. However, know-how held by an individual cannot be treated as a formal property, in principle. In commercial or

manufacturing settings, know-how can be more valuable than IP because it can reduce the time or cost to market. In know-how transfer, the written contract is critical to protect the value of the know-how.

***Expertise***

 Expertise can be defined as the knowledge of an “expert”, someone who has a prolonged or intense experience through practice and education in a particular field and whose judgement and opinion on specific topics within that field is widely accepted by peers.

 While an expert is seen as an individual, for all practical purposes of the Map, a group of people, e.g. a research group or department, can also be considered an expert and expertise can be viewed as the collective expert knowledge in a specific field of that group.

 A know-how transfer often includes technical assistance that is provided by an expert for an additional fee.

***Information***

 Information is a very broad and somewhat ambiguous term that has many definitions. The Oxford Dictionary defines information as “*facts provided or learned about something or someone*”. Merriam-Webster defines information as “*(1.) knowledge obtained from investigation, study, or instruction (2) intelligence, news (3) facts, data.*”

 Information often relates to facts/data and/or intelligence/knowledge, where facts/data represents objective values attributed to the real world, and intelligence/knowledge signifies understanding, conception or abstraction of the real world that requires a cognitive (and subjective) observer.

 Use the term “information” with prudence, as its meaning can be confusing and misunderstood. Preferably, the term is not used at all, or used an explicit written definition of what is meant by such information: i.e. what specific data, databases and/or knowledge (including expertise and know-how) is included.

***Proprietary information***

 Proprietary information is a term that is often used to indicate “confidential information”.

 As noted above, the term information is ambiguous and is comprised of facts/data and/or intelligence/knowledge. Data can be a property in certain jurisdictions (including the EU) if it takes the form of a database. In some jurisdictions, a data base as such is not a property, but the selection and arrangement of the information in a database is considered a creative expression that is protected under copyright.

 Information in the form of intelligence or knowledge is often perceived as “property” and “proprietary” by the holder. However, this is not correct in the legal sense. Such information should be regarded and treated as “confidential” knowledge or know-how. An exception is proprietary information in the form of Trade Secrets that can be protected by law in certain jurisdictions.

 It is advisable to minimize the use of the term “proprietary information”, but instead make a separation between IP (protected by law, including databases and trade secrets) on the one hand and confidential knowledge on the other hand.

***Ideas & concepts***

 Ideas and concepts are broad and philosophical notions of knowledge that will not be covered in this document.

***Theories & Rationales***

 Theories and rationales are broad and philosophical notions of knowledge that will also not be covered in this document.

***Results & Observations***

 Results and observations in the context of knowledge transfer mean any and all outcomes of an academic study or research collaboration. In research contracts this typically uses the legal term “Foreground Knowledge” or improvements on ‘background knowledge’ contributed to a collaboration by one or both parties during the collaboration. Be aware that some foreground knowledge may include both protectable and non-protectable knowledge.

***Methods, Instructions & Solutions***

 Methods, instructions and solutions refer to detailed and explicit descriptions or protocols of how something should be done or operated in order to achieve a desired result.

 In the context of knowledge transfer, this typically refers to a protocol used by a researcher or lab technician that enables him or her to operate a state-of the-art machine or custom-built piece of equipment, perform specific computations, acquire specific data or produce a specific physical component, chemical compound or biological construct in a reproducible manner. Sometimes this involves non-obvious or unexpected actions or the use of specially designed tools.

 Ideas & concepts, theories & rationales, results & observations and methods, instructions & solutions do not generally rise to the level of patentable inventions but if retained as secret or confidential, can be of value and transferred for payment. In the context of an Academic Institution, however, the individual scientists and researchers may see more value in publishing or academic collaboration than secrecy.

Non-Intellectual Assets

 The category of non-intellectual assets is quite diverse and encompasses five main classes:

1. Collections
2. Research infrastructure & capacity
3. Financial assets
4. Operational assets
5. Strategic assets

 Each class has several sub-classes. A description of the various classes and sub-classes is provided below.

**Collections**

 Researchers throughout history have been engaged in building collections for the purpose of collecting interesting material to study. Such academic collections are often referred to as “libraries” (from the Latin “liber”: book and “librarium”: bookcase) because the early researchers collected books. Building collections is still a common practice in all scientific disciplines whether it be blood, historic objects, samples, tissue samples, plant material, chemical compounds, soil samples, bird species, minerals, etc. In some cases, the collection is referred to as a “cohort” if it concerns a group of individuals who are the subject of a study and are linked because they have something in common. It they have a certain disease in common they form a “patient cohort”.

 Scientists perform studies on their collections in order to generate and collect data. The generated results are a collection of data in itself. However, researchers also use data generated and/or collected by others, such as meteorological data, population date, etc.

 In most cases collections of objects consist of a combination of objects and of data (about the object, including metadata). (*Metadata* summarizes basic information about data, which can make finding and working with particular instances of data easier).

 Collections can be of great value to external parties, including governmental and non-profit organizations. Good examples are bio banks, antibodies, vectors, plasmids, cell lines (plants/animals), compound libraries, data bases, questionnaires and polls.

 Any collection of patient materials should be handled with care, as in most jurisdictions there are strict regulations about the use of patient material. In most countries, the material remains the property of the patient and the institution that collects it acts only as the custodian. Also, patients must typically provide prior written approval, the so called “informed consent”, to the institution to allow use of the material for scientific and/or commercial purposes. This also applies for patient material that would normally be disposed of, such as material from surgery, body fluids, urine and faeces.

**Infrastructure & capacity**

 Research infrastructure consists of the laboratories (cleanrooms, lab benches, etc.) and the equipment for manipulating, measuring and testing. The equipment can be simple and standard but also unique, very expensive and state of the art (such as the large Hadron Collider at CERN). Also, the equipment can be anything between an off-the-shelf computer to a custom-made apparatus.

 Research capacity consists of the skilled people that are able to perform complex and specialized tasks in the research infrastructure and are able to handle and control the advanced equipment.

 A lab must be fully equipped with all the required infrastructure, equipment and skilled people in order to be able to conduct research in a specific field. This can be a unique and potentially valuable asset to external parties, that may not have the resources to build and operate such a lab or that do not have enough work to keep the lab fully occupied.

 Another type of this human capital is the teachers' corps that provides educational capacity (together with the educational content, which is intellectual property of the institution). This capacity can be of interest to external parties for the purpose of customized training and professional development of their employees.

 Finally, one cannot overlook the value of the student corps. This is an important and unique strategic asset of a university.

**Financial assets**

 IP, in particular inventions, must be protected by means of a patent application prior to publication to be an IP asset. As the initial drafting and filing of patent applications is costly, it is of great value that the university or research institution has a patent fund that can cover initial patent costs.

 In many cases, the academic assets, in particular IP, are scientific and as yet not validated and are therefore not robust enough to be of interest to third parties. A university or research institution can have specific financial resources, such as a proof-of-concept fund, for the purpose of enabling such assets to be further developed, extended or validated in order to de-risk the asset and make it more attractive for utilization by third parties.

 Sometimes the best or preferred utilization strategy of such assets is commercialization by a spin-off company that is specifically established for that purpose. Some universities and research institutions have financial resources to provide (pre-)seed capital or venture capital to such spin-off companies.

 Sometimes the management of such (pre-)seed and venture funds is outsourced to private fund managers in order to isolate the investment decisions from the politics within the institution.

**Operational assets**

 In order to facilitate and streamline the collaboration between universities and research institutions it is important to have a support organization that facilitates the collaboration between the institution, its researchers and staff on the one hand and the external parties (government(s), non-profit organization, corporations and SMEs) on the other hand.

 Typical support organizations/facilities are:

* Technology transfer offices (focused on the utilization of IP)
* Knowledge Transfer offices (focused on IP and other Assets)
* Collaboration support organizations (focused on the utilization of research infrastructure, including contract research)
* Clinical trial offices (focused on the access to patients and research infrastructure)
* Education centers (focused on utilization of education capacity).

**Strategic assets**

 A university or research institution has several strategic assets available that are often overlooked and can, in combination with other assets, provide considerable value.

***License(s) – certification to practice***

 Academic institutions often are allowed, under strict internal regulations, to use non-certified products or engage in regulated practices. For example, an institution may have a

license to conduct animal studies or to study dangerous pathogens, toxic compounds, nuclear materials or genetic constructs. An academic hospital may use a medical device or diagnostic tool that is not yet CE or FDA certified. All these certificates are hard to attain or simply not available to companies.

***Access to patients***

 The same holds for patients. Academic hospitals treat patents, companies cannot treat patients.

***Access to public funding and subsidies***

 Certain grants and subsidies for the collaboration with companies are available to universities and research institutions. By collaborating, companies can get access to such resources and lever their own financing.

***Reputation***

 The reputation and authority of an institution, research group or key-opinion leaders can be of tremendous value to an external party because, if done correctly, the association can add weight, credibility and prestige to that party or its products and services. Clearly, procedures must be in place to protect one’s reputation.

***Entrepreneurial culture***

 The overall attitude and drive towards entrepreneurship, innovation and collaboration with external (parties are needed for the effectiveness of the knowledge transfer practice. Without such attitude and drive not much will happen. *You can bring the horse to the water, but you cannot make it drink.* This relates to the “people perspective” as described earlier.

Methods of Utilization

 Three methods exist for the utilization of Academic Assets:

1. Commercialization by a third party;
2. Application on behalf of a third party;
3. Dissemination into the public domain.

 The methods are elaborated below.

**Commercialization of Academic Assets**

 In principle, this occurs through the action of private companies as research institutions or universities are not willing or able to undertake product development in response to market needs. As it applies to an academic setting, commercialization is the process of:

* identifying Intellectual Assets such as arise due to on-campus research or creative works, or other University Assets;
* assessing them for generating potential societal and/or economic value,
* seeking IP Protection as appropriate, then
* seeking a commercial partner in the private sector who will complete the commercialization process by undertaking the risky product development and assessment of the market, introducing the product into the market and supporting sales.

 If the commercialization process is successful, a small portion of sales (royalties) or some other compensation (suitable to the extent of risk taken) will be provided to the originating university ensuring there is a reward for sharing the risk.

**Application of Academic Assets**

 Applied research is a form of [systematic inquiry](https://en.wikipedia.org/wiki/Scientific_method) involving the practical application of research results (science, engineering, medicine, psychology, sociology, humanities, etc.). It accesses and uses some part of the research communities' accumulated theories, knowledge, methods, and techniques, for a specific, often government-, [business-](https://en.wikipedia.org/wiki/Commerce), or [client-driven](https://en.wikipedia.org/wiki/Customer) purpose. In a few words, it means that certain Assets can be used by the institution with and on behalf of the private sector without the need to transfer the asset. In an academic setting, this may take the form of research collaborations or a larger scale consortium of people focused on working together on a defined project to create new knowledge about a problem to better understand how to solve the problem. Discoveries or Inventions designed to solve the problem (or part of the problem) may arise from such work and be transferred for commercialization activities. In addition, certain intellectual assets or research facilities may be directly accessed by the private sector to undertake research to address a problem of interest to the company. Here, transfer of the asset is not required, but access to the knowledge created is available in some negotiated manner.

**Dissemination of Knowledge Arising from Academic Assets**

 To disseminate, means to [broadcast](https://en.wikipedia.org/wiki/Broadcast) information to the public without an expectation of direct [feedback](https://en.wikipedia.org/wiki/Feedback). In an academic setting, this may take the form of publication, lectures, poster sessions, open source or creative commons licenses, etc. The purpose is to provide the information to others who can use it for any legitimate purpose. By disclosing the assets to the public, one enables public use of the asset, perhaps also outside the realm of science. Dissemination of IP can be done via ‘open source’ or ‘creative commons’ licenses. Knowledge assets can be disclosed in various media.

 In intellectual property terms, such dissemination can be used as a strategy to disclose information and make it known to others but by so doing, prevent anyone from seeking intellectual property protection for the disseminated information, because it is no longer novel (i.e. unknown).

**Actions**

 While the three basic models for utilizing an academic asset are listed above, there are six discrete actions regarding an asset or set of assets that one can take (separately, in sequence or in combination) in order to execute one of the utilization strategies. These actions are:

* Secure
* Explore
* Share
* Transfer
* Collaborate
* Venture

**Secure**

 Prior to actual utilization of an asset it must be secured by taking action to describe the asset and to establish ownership, create freedom to operate and/or control over the asset.

 To secure an asset requires two steps:

* Step 1. Document the asset
* Step 2. Control the asset

**Document**

 The first step of securing is to properly identify, document and analyze the asset and establish its type, quality and status, including ownership and freedom to use. For example, if the asset is an invention, an Invention Disclosure Form must be filled in and facts verified. If the asset is a piece of software, the authors must be identified, the applicable license to use it must be checked and the software must be fully identified and then checked for open source components. This is also required for all intellectual assets. If the asset is a creative expression, such as a text or design, authorship must be established.

 For most non-intellectual assets, this authorship verification step can be skipped as they are indisputably owned and controlled by the institution. However, this may not be the case with collections, which can contain objects that are borrowed or held in custody for the rightful owners. This is in always the case with collections containing patient materials. Also, special care has to be taken to comply with privacy regulations when personal materials and/or information are involved.

 Not all knowledge assets can be adequately described and documented because of their tacit nature. The same holds true for certain abstract non-intellectual assets, such as reputation and entrepreneurial culture.

**Control**

 Once the asset is properly documented and analyzed it can be brought under control in various ways. Control of intellectual properties can be achieved by requesting permission from the rightful owners and then claiming exclusivity by patenting (inventions) or registration (trademarks, copyright, designs, etc.). Intellectual properties that are creative expressions are controlled by copyright which is automatically assigned to the creators at the moment of creation, but permission needs to be obtained to seek registration on behalf of the owners. At this point, institutional IP Policies need to be reviewed to ensure correct ownership. Authorship of a piece of software created by generations of students presents a particular challenge.

 Knowledge assets can only be controlled by ‘not-disclosing’ or by maintaining confidentiality. ‘Not-disclosing’ is not really feasible in an academic environment as it is in conflict with academic ethics and practice. Also, some research funding agencies demand full public disclosure of results, but with proper attribution.

 Collections, in particular collections containing patient materials, need written consent of the patient/owner that authorizes the institution to utilize the entries/object(s) in the collection for stated purposes, in order to obtain proper freedom to operate.

 Finally, it is important to control the reputation of the institution. In the context of knowledge transfer the control over the reputation requires extra attention. Unless properly handled, collaboration partners of the institution may be tempted to misuse the name and reputation of the institution for their own benefit, putting the good name of the institution at risk. Special clauses in contracts can prevent or remedy detrimental use of the reputation.

**Explore**

 The potential to utilize the assets can be assessed prior to the asset being adequately secured, but it cannot be fully used until it is properly secured. In the case of patents, it is customary to explore the potential of an invention prior to patenting in order to assess the potential return on the patent cost/investment.

 Assets can be explored individually or in a pooled fashion. One typically starts with a specific asset that is considered to be of high potential for a particular use and look for other assets that may complement or improve the value of the asset for that particular use. A good example of this is a patent. The typical commercialization use is by a transfer of rights (e.g. license) of the patent to a company that will develop a new product for their customers. Assets that may add to that use could be the availability of results from a ‘proof-of-concept’ fund; a research group with specific know-how and expertise that is keen to collaborate with companies; availability of specific lab equipment that is needed to test prototypes, etc.

 Alternatively, one can cluster assets into a combination or pool based on a common theme or field without a predefined use. For example, one can pool assets related to Alzheimer disease, a theme with high societal and economic relevance. In a particular academic medical center this could result in the pooling of assets such as: its strong reputation in Alzheimer research; the presence of a certain entrepreneurial key opinion leader; the existence of a body of knowledge related to a certain recently discovered receptor that is associated with the disease; the existence of a well-organized experienced clinical trial office; the availability of advanced neuroscience labs; the access to specific charity funding grants from the Alzheimer community, etc. In this use case, the beneficiaries are Alzheimer patients. The interested third parties are pharma/biotech companies that are interested in fundamental, applied and clinical research in the field of Alzheimer disease. One can then develop possible use cases of such a pool of assets.

 The initial evaluation of the asset or combination of assets can be performed using the following criteria:

* **Uniqueness**
Is the asset novel, non-obvious, creative and/or exclusive in order to enable the interested party to improve its product or service and increase its competitiveness?
* **Credibility**
Is the asset reliable, credible and reputable in order to enable the interested party to make investment decisions and actions that affect its own reputation?
* **Comprehensiveness**
Is the asset comprehensive and coherent to a specific field or domain?
* **Value**
What is the perceived or potential value (economic and/or societal) of the utilization of the asset?
* **User**
Who is the (end-)beneficiary of the utilization of the asset and which external party or parties can have an interest in the utilization of the asset?
* **Utilization method**
What is the most feasible and/or effective utilization method for the asset?

 Clearly, the clustering of assets, the recognition of value to a beneficiary, the identification of potentially interested parties, the selection of the optimal utilization strategy and the evaluation of the assets is not a linear one-time process. It is an iterative process that is partly intuitive and creative. In many cases, ideas for use cases or interesting thematic approaches are presented by the researchers involved, then developed and then tested. The Map provides a tool to focus the exploration and prioritize actions.

**Share (“One-to-Many”)**

 Assets can be shared with as many interested parties as possible or with the general public at large with the purpose to maximize utilization. Some examples are presented below.

***Open Source***

 An IP asset that is protected by copyright, such as software, can be shared by disclosing the copyrighted IP and at the same time providing an open source or creative commons license that defines how the IP can be used and what the consequences are of modification and integration of the IP. Many different types of open source licenses exist, all with subtle but critical differences.

***Non-Litigation Pledge***

 Patents do not lend themselves to be shared because a patent is essentially a right of the holder to prevent others from utilizing the patented invention. Patents are not normally meant to be shared in a ‘one-to-many’ manner. But, two ways that a patent can be broadly shared is by pledging that you will not prevent others from using the patented invention, and by offering easy access, non-exclusively to a patent pool. Recently, Tesla Motors, Inc. (a US based car manufacturer) has made such a pledge by announcing that it will not take legal actions against anybody that uses its patents in “good faith”.

***Disclose***

 A knowledge asset, not protected by law, can be shared by publication in a scientific journal or in any public media, including a contribution to a discussion program on TV, a letter to a newspaper, etc.

***Timesharing***

 In case the asset is a physical asset, such as a piece of equipment, a laboratory, a collection of objects, etc., the asset is usually not used 100% of the time (24/7/365) by the institution itself. In that case, one can utilize such an asset by time-sharing: allowing the interested party to use the asset during the time that the asset is not regularly used by the institution itself. Depending on the asset, the interested party can come into the institution to use it (ensuring that proper liability and property insurance is in place), or in certain cases, users can use the asset remotely via the internet. Alternatively, the actual use of the asset can be performed by the institution on behalf of the interested party.

**Transfer (“One-to-One”)**

 Assets can be utilized by one interested party or by a select group of interested parties on a one-to-one basis. Some examples are presented below.

 In the case where the asset is an intellectual property, the asset can be assigned to, or the right to utilize the asset can be granted to, an interested party. This action is typical in technology transfer and is well documented and understood.

 A non-exclusive grant to several parties should not be confused with “sharing”. A non-exclusive license is a one-to-one transaction and therefore should be considered an action of “transfer”.

 In case the asset is an explicit (non-tacit) knowledge asset, the asset can be transferred by maintaining confidentiality of the asset and only disclosing it to the interested party under a confidentiality agreement. In an academic environment, this is usually not desirable, due to the difficulty of maintaining confidentiality over a period of time in an institution where the dissemination of knowledge is given high priority.

**Collaborate**

 In the case where the asset is a tacit knowledge asset, the tacit knowledge can be made available or transferred for utilization by means of collaborative activities, including education and consultancy, between the holder(s) of the tacit knowledge and the party that wants to acquire the tacit knowledge. This can be done’ one to one’ or ‘one to many’ in a large research consortium.

**Venture**

 In some cases, there is an asset with a use case of high potential value but (i) it is not possible to find an interested commercialization partner and/or (ii) the researchers that are directly involved with the asset have expressed an interest to commercialize the asset themselves, via a start-up company. This is increasingly the case with inventions, patents and software. However, it can also be the case with a novel service or product concept.

 In that case, the institution may decide to facilitate the establishment of a dedicated company for the purpose of utilizing the asset(s). In most cases, the employees of the institution that are involved with the asset have a well-defined position and role in this new venture.

 In some cases, the use case of the asset provides a high value to the public at large, but not necessarily a high financial/commercial benefit to the company. In some countries, it is possible to establish a social enterprise that aims to maximize societal value by means of business methods by the enterprise (as opposed to maximizing shareholder value in the case of a traditional enterprise).

How to Use the Map?

 The Map (see also the later Section) is a descriptive and practical framework for the utilization of academic assets. This chapter provides pragmatic instructions about how a new (or young) TTO can use the Map.

**Inspiration**

 The Map can be used as a source of inspiration and reflection. Sometimes one needs to take a step back from the day-to-day business and look at knowledge transfer at a higher level.

 Also, traditionally, knowledge transfer is focused on patenting, licensing to existing companies and licensing to spin-offs that is most relevant for the STEM areas - sciences and engineering. The Map can inspire a TTO to identify other interesting opportunities that are applicable to social sciences, humanities and the arts.

**Knowledge Transfer Policy**

 The Map can serve as a tool to develop an institutional or faculty/ departmental ‘knowledge transfer policy’ and activity that matches its ambition to generate societal and economic impact. This can form the basis for a strategy and action plan for a TTO.

**Scouting & Screening**

The Map can assist a TTO in developing an inventory of academic assets. It is not necessary to be exhaustive but can be started by reviewing what you known within each administrative unit of the Institution, (those organized by discipline and those by administrative function). A brief email and follow-up call with the head of each will yield the information. Other excellent sources of information will be the head of the office which handles external financing of campus research and the Chair of any internal committee with a responsibility to encourage and financially support research. The inventory should be reviewed yearly to add significant new activities.

 Such discussions can often tell you what the value and use case of the asset is, and if there is or could be a concrete utilization potential. Moreover, you can assess if they are truly motivated to partner and work collaboratively with you. As mentioned before, you need their commitment to get anything done.

**Asset Evaluation**

 Having created the inventory, you can make an initial assessment of the assets and identify the most probable utilization projects and most motivated researchers.

**Selection of Utilization Model**

 Because a young TTO has limited capacity, you should prioritize projects. A young TTO is typically relatively inexperienced, has little capacity (e.g. one or two staff) and it therefor advised to initially select projects that have a similar utilization model, i.e.:

* Commercialization (e.g. licensing, spin-off, etc.); or
* Collaborative (consultancy, contract research, public private partnerships, etc.).
* (Dissemination can be disregarded as researchers do not need the support from the TTO).

 After this, you choose projects that are feasible, have a high potential impact and are driven by the most motivated researchers. This way, the TTO can initially focus on one model only, develop skills and gain experience, improve its processes and - most importantly – create successful projects that act as show cases. This selection is a strategic decision that should be consistent with the culture and strategy of the institution and should be discussed with, and approved by, the leadership of the institution.

 Occasionally, researchers will approach the TTO with the name of a company which has already expressed interest in collaboration. This should be given the highest priority, as a satisfied researcher is the very best endorsement for the TTO.

**Learn, Improve and Expand**

 Based on the experiences from initial projects, the TTO can expand its activity in any direction dependent on the ambition and commitment of the university leadership.

Model Agreement Matrix

**Introduction**

 WIPO has developed the WIPO / FIT Australia Toolkit (“Toolkit”), consisting of a set of model agreements related to knowledge transfer.

 The Map provides a comprehensive and inclusive framework for the utilization of academic assets, describes various utilization strategies and concrete actions to accomplish such strategies.

 The Model Agreement Matrix below provides a complete overview of the model agreements in the Toolkit and relates them to the five utilization actions: Secure, Explore, Share, Transfer, Collaborate and Venture. (The ‘Secure’ action is subdivided into ‘Document’ and ‘Control’). The matrix shows which Model Agreements in the Toolkit is relevant and applicable to which Action.



**Pathways**

 The following are Pathways (examples) of the variety of use cases of academic assets.

***Pathway 1*: Classic Technology Licensing to an Existing Company**

***PipeScan***

 This story combines many of the Intellectual Assets described earlier in the text and is typical of a classical technology license where university expertise recognizes a problem, invents a prototype, which impresses a company in the industry who sees an unmet need. Together they gather the financial and human resources to develop an engineering prototype, test it in the real world then manufacture and sell the product. The product succeeds and is improved as market sales increase.

***Pipe-Scan: Radar System Sees through Underground Pipes to Detect the Potential for Sinkholes which Weaken the Pipes***

 Using an electromagnetic scanning technology developed at Louisiana Tech University, USA, Florida-based CUES Inc. is able to help municipalities identify infrastructure most in need of repair and prevent catastrophic failures in underground systems by detecting voids around buried water pipes used for drinking and waste water.

 Mr. Erez Allouche, Ph.D., P.E., joined the faculty of Louisiana Tech in 2003, just two years before Hurricane Katrina devastated parts of Louisiana. “*When Hurricane Katrina happened there was much discussion about the above ground damage, but I had great concern about the damage done to the buried infrastructure that would only come to light ten years later*,” says Mr. Allouche, associate professor of civil engineering and director of the Trenchless Technology Center.

 With no existing technology available to detect sinkholes before they break through the surface, Mr. Allouche and his colleagues Mr. Arun Jaganathan and Mr. Neven Simicevic set out to develop a system that could “see through” pipes to assess the conditions around them. The project dovetailed perfectly with the mission of the Trenchless Technology Center, which is dedicated to rehabilitating underground infrastructure without excavation.

 In CUES Inc., Mr. Allouche found a natural commercial partner for developing the technology. CUES, the world's leading manufacturer of closed circuit television video inspection, rehabilitation and pipe profiling equipment, was already an industry sponsor of the Trenchless Technology Center.

 Mr. Rich Kordal, Director of the LTU OTT says CUES was interested in the project, but knew it would require more research and development funding than the company could provide. So, Louisiana Tech and CUES joined forces with Department of Defense contractor Niitek and applied for funding through the National Institute of Standards and Technology (NIST), which held a competition to award grants specifically for next-generation infrastructure assessment technologies in 2007.

 The team was selected, receiving an award of $3.2 million. Additional money from the state of Louisiana and a $400,000 Major Research Instrument Grant from the National Science Foundation also boosted the development of the technology.

 The technology development team grew to ten full-time engineers and technicians working simultaneously on various components, from mechanical design and electronic components to mathematical algorithms. Years of hard work and many, many iterations were followed by testing at the university’s indoor and outdoor test beds and, finally, in cities across the United States.

 Louisiana Tech applied for and received a US patent on the technology entitled Pipe Survey Method Using UWB Signal (US 8,350,570, issued in January 2013). The technology transfer office helped negotiate the sponsorship agreement and intellectual property plan required for the NIST grant, as well as the exclusive licensing agreement with CUES.

 Today, CUES is refining the radar system to make it simple, easy to use and “industrial-hardened.” The company is working with its early adopter clients in the United States and Canada to test the new inspection system, called FutureScan.

“*By monitoring the growth of the voids over time, cities can better plan for repairs and only fix what really needs to be fixed*,” says VP of CUES Purtell. “*We’re anxious to get FutureScan out there to help communities better predict and plan for their capital expenditures*.”

**Acknowledgement**

 This case study is a summary of a comprehensive case study that was published in the Better World Project of AUTM[[3]](#footnote-3).

**Map**

 The utilization Map is summarised below:

|  |  |
| --- | --- |
| **Intellectual assets** | **A patent, owed by LTU.** |
| **Knowledge assets** | Trade secrets, software and know-how related to scanning and displaying results. |
| **Infrastructure & capacity** | Laboratory expertise of the LTU Trenchless Technology Center (TTC). |
| **Financial assets** | Patent, government development funding.  |
| **Operational assets** | CUES market presence and credibility. |
| **Strategic assets** | Access to public funding and subsidiesEntrepreneurial culture of TTC and CUES. |
| **Utilization method** | Commercialisation |
| **Actions** | * Secure
* Transfer
 |

***Pathway 2: Classic Technology Licensing to a Spin-off Company***

***Tide Microfluidics B.V.***

 Tide Microfluidics B.V., a Netherlands-based medical device company, uses a new microfluidic technology to make ultrasound images 20 times better. The technology, which is based on the efficient production of monodisperse medical microbubbles, is changing the market by providing a safer and cheaper option for medical imaging.

 Tide Microfluidics was founded in 2011 as a spinoff of the MESA+ Institute of Nanotechnology of the University of Twente. It was established to develop, manufacture and commercialize the patented microfluidic technology that was developed within the University of Twente in the Netherlands and the University of Sevilla in Spain.

***From Research to Spin-off***

 The microfluidic technology of Tide Microfluidics was discovered when founder Mr. Wim van Hoeve investigated the principles underlying microbubble formation as part of his PhD-thesis at the University in Twente. The technology works by enabling the controlled creation of micro particles—either bubbles or droplets—in a highly controlled environment. Such an environment ensures that gas bubbles are produced one at a time and in the same repeatable manner, giving same-sized bubbles each time. The University of Twente and the University of Sevilla jointly own the patent protecting this technology, with an exclusive license granted to Tide Microfluidics to develop and commercialise the technology.

***Technology and Product***

 In order to work as contrast agents, microbubbles are made to resonate by the high frequency sound wave of the ultrasound equipment. The size of each microbubble plays a crucial role as resonance is only accomplished when the size precisely matches the operating frequency of the ultrasound equipment.

 ‘This uniformity, or monodisperse nature, is something that our patented technology is able to produce,’ says Mr. Van Hoeve. To efficiently apply the microfluidic technology, Tide Microfluidics created an innovative laboratory apparatus called the Microsphere Creator.

 The apparatus, launched in January 2015, can manufacture UCAs at the bedside of patients. The Microsphere Creator enables ultrasound researchers to produce their own UCAs on demand. It also allows them to become familiar with microfluidic technology and develop new products based on monodisperse microbubbles.

***Awards and Grants***

 In its early days, the company was awarded a NanolabNL voucher of MESA+ Institute of Nanotechnology of the University of Twente. This voucher, worth EUR 7,500, provided the company with 50 - 75 hours of independent use of the clean room facilities of NanoLabNL, the Dutch national facility for nanotechnological research. NanoLabNL has eight labs at five locations in the Netherlands and offers the widest possible spectrum of nanotechnology facilities for researchers there.

 The company also won both the first prize of US$ 5,000 and the public prize of US$ 500 at the Young Technology Award at the Commercialization of Micro- and Nanotechnology conference in Salt Lake City, Utah in the United States. The company has also received a European Union Horizon 2020 SME Instrument Phase 1 Grant of EUR 50,000.

***Societal Impact***

 Making superior medical imaging more accessible and affordable is crucial in building a sustainable healthcare sector. According to the European Science Foundation, medical imaging contributes to improved outcomes for patients and cost-efficient healthcare for all major diseases, Mr. Van Hoeve says.

 Of all the medical imaging techniques being used today, he says ultrasound is the safest because it is non-invasive; it is also the most-cost effective as it is available in almost every hospital in the world. Furthermore, ultrasound is not influenced by factors such as calcified body areas (bones and hardened arteries), body size, and the skill of the person performing the scan.

 The only downside to ultrasound is the low contrast of the images produced, making medical diagnoses more difficult. Tide Microfluidics is changing this by magnifying the smallest structures and organs in the human body so that the quality of ultrasound images is improved by 20 times.

 This allows ultrasound to compete with other imaging modalities, such as MRI or CT scan. With Tide’s products, the diagnostic capabilities of ultrasound can be drastically improved, resulting in more accurate and earlier diagnosis.

***New Applications***

 Microfluidic technology can also be useful to the pharmaceutical, food and cosmetics industries by dramatically boosting the stability of dispersions and emulsions. By increasing monodispersity, the technology enables the creation of more uniform foams and emulsified structures.

 Mr. Van Hoeve says that Tide Microfluidics has been able to continue the development of the microfluidic technology into commercial products with the support of the two Universities.

***Acknowledgement***

 This case study is a summary of a comprehensive case study that was published in the “Impact Report for Europe 2015” of ASTP Proton[[4]](#footnote-4). The report is publically available and can be downloaded at the website of ASTP Proton.

***Map***

 The utilization Map of Tide Microfluidics is summarised below:

|  |  |
| --- | --- |
| **Intellectual assets** | **A patent, jointly owned by University of Twente and University of Sevilla** |
| **Knowledge assets** | Trade secrets and now-how related to control the production of monodisperse medical microbubbles. |
| **Infrastructure & capacity** | NanoLabNL is the Dutch national facility for nanotechnological research.  |
| **Financial assets** | Patent Fund of the TTO of the University of Twente EUR 7,500 NanolabNL voucher offering 50-70 hours access to lab facility |
| **Operational assets** | Novel-T, the Technology Transfer Office of the University of TwenteNanoLabNL program office, an organization that supports SMEs to make use of the NanoLabNL facilities |
| **Strategic assets** | Access to public funding and subsidies (SME instruments of EU)Entrepreneurial culture of University of Twente |
| **Utilization method** | Commercialization |
| **Actions** | * Secure
* Transfer
* Venture
 |

***Pathway 3: Collaboration***

 Following an intensive search throughout Asia, the town of Los Baños, Laguna, Philippines was chosen as the location for the headquarters of the International Rice Research Institute (IRRI). See <http://irri.org/>.

 Founded in 1960 and with 17 country offices today, IRRI had its first campus built inside the University of the Philippines Los Baños, a top educational institution and the country’s hub for agricultural science.

 Based on an evaluation conducted by the Australian Centre for International Agricultural Research (ACIAR), IRRI’s longstanding partnership with the Philippines has contributed to the country average annual gains of USD 52 per hectare from 1985 to 2009.

 IRRI works closely with the Department of Agriculture (DA) and its agencies, particularly the Philippine Rice Research Institute (PhilRice) that IRRI helped establish in 1985. IRRI and PhilRice have since collaborated on more than 50 research projects to help improve rice production. IRRI also collaborates with other national agencies, local governments, NGOs, universities, and experts in the country.

 IRRI invests about half of its total budget in the Philippines in local staff salaries, equipment, supplies, duty travel, and other mission-related expenses. IRRI employs more than 1,000 Filipinos at its headquarters and an additional 750 contract farm workers.

 The institute works with the local community by donating computers to public schools, delivering emergency response training and information seminars, and carrying out livelihood projects. IRRI has also provided scientific training to some 3,400 Filipino trainees and scholars.

***Key Achievements***

* **Better Varieties**

As of 2016, 123 IRRI-bred varieties suited to irrigated, rain fed, upland, low-temperature, and saline environments have been released in the Philippines. Mestiso 68, a hybrid rice variety, was slated for release in 2015, and next, IR10M300, a micronutrient-dense variety, is recommended for release.

* **Higher Farmer Income**

Filipino rice farmers are earning an additional PHP 2,184 per hectare annually using IRRI-bred rice varieties. The country benefits by about PHP 8.5 billion a year.

* **Super Bags Commercialized**

IRRI’s air-tight Super Bags that protect stored rice grain from pests and moisture are now available in the market. GrainPro, Inc. reported sales of about USD 120,000 in the Philippines alone from 2013 to 2016.

* **Rice Crop Manager (RCM)**

The Philippines is the first country to get IRRI’s RCM, a tool that delivers site-specific recommendations on crop management to farmers via mobile phones. This has helped raise farmer income by about PHP 4,000 per crop per hectare.

* **Water-Saving Technologies**

The Philippine government has adopted water-saving technologies—particularly, the IRRI-developed alternate wetting and drying technique—that can reduce water use by up to 30% and greenhouse gas emissions by up to 50% while maintaining yield.

* **Pinoy Rice Knowledge Bank (PRKB)**

IRRI and PhilRice have harmonized training materials to upgrade the PRKB, a rich source of online information for farmers and farmer-intermediaries to improve their crop management practices.

* **Genetic Diversity Conservation**

IRRI’s International Rice Genebank contains the world’s largest collection of rice types—more than 127,000 as of June 2016—from all over the world. It has 7,861 from the Philippines, including IRRI-developed materials.

***Acknowledgement***

See [www.irri.org](http://www.irri.org)

***Map***

 The utilization Map is summarised below:

|  |  |
| --- | --- |
| **Intellectual assets** | **Expertise of a team of experts at IRRI** |
| **Knowledge assets** | Know-How |
| **Financial assets** | Access to public funding |
| **Operational assets** | Major research facilities and field trial acreage  |
| **Strategic assets** | Access to public funding and subsidies  |
| **Utilization method** | Commercialization |
| **Actions** | * Secure
* Transfer
* Venture
 |

***Pathway 4: Collaborative Research***

 This story of is a typical example of collaborative research also known as a research consortium.

***Introduction***

 This project of ‘Contracting-out Welfare Services’ is led by chief investigators Professors Jenny Lewis and Mark Considine of the Faculty of Art’s School of Social and Political Sciences and Dr Siobhan O’Sullivan of the University of New South Wales, Australia.

 The project began in 1998 and compares Australia, the UK, and the Netherlands to understand how governance of the sector has changed, how policymaking is understood and reformed, and the degree to which the state is involved in delivery of services or in regulating private delivery. It emphasises the experiences of frontline staff within employment agencies and how reforms have affected their delivery of services.

 The project is based on data compiled across the last two decades, particularly through surveys of 1,000–2,000 frontline staff in 1998, 2008, 2012, and a fourth survey to be conducted in 2016. These surveys are, in Professor Lewis’s words: “*one of the backbones of the project*”.

***The Collaboration***

 The chief investigators have been complemented by international collaborators in the United Kingdom and the Netherlands and local researchers.

 They deliver an understanding of the caseload of frontline staff, their work pressures, and how they see their role.

 The 2016 study focussed on Australia and the UK. The research to date has shown that the Australian and British systems have become more similar, but with one key distinction: ‘Australia and the UK look to each other … but there is the main difference that Australia no longer has a public provider,’ said Professor Lewis. Hence there is mutual influence but inevitable divergence.

 A series of Australian Research Council grants have supported the project. The most recent, a Linkage Grant (see below), involves two peak private employment service organisations and one service provider: Jobs Australia (which encompasses the not-for-profit sector), National Employment Services Authority (which covers all commercial providers), and Westgate Community Initiatives Group (a private service provider in Melbourne’s inner west). These organisations value a long-term perspective on staff trends and facilitate the involvement of frontline staff in the research.

***Impact***

 The project has had a number of significant outcomes. Most recently, Oxford University Press published Getting Welfare to Work in 2015, a book authored by the three chief investigators in Australia and their Dutch colleague, Associate Professor Els Sol, which brings together all the research conducted since 1998. Professor Considine and Dr O’Sullivan also oversaw an edited collection, Contracting-out Welfare Services, published by Wiley in 2015. The project will continue into the future, analysing welfare reform in real time. Professor Lewis emphasises that this is possible on account of the strength of the partnerships with industry partners.

“*It’s really an unusual thing. Most research projects you do, you do for a number of years and then move on. It’s a testament to this being an interesting area and to us having strong relationships with our partners. They really see the value of what we are doing, and so they do not have to have their arm twisted to participate”,* Professor Lewis said.

***The Linkage Program***

 The Linkage Program of the Australian Research Council (ARC) promotes national, and international, collaboration and research partnerships between key stakeholders in research and innovation including higher education institutions, government, business, industry and end-users. Research and development is undertaken to apply advanced knowledge to problems, acquire new knowledge and as a basis for securing commercial and other benefits of research.

 The Linkage Projects scheme provides funding to public research organisations to support R&D projects which:

* are collaborative between higher education researchers and other parts of the national innovation system
* are undertaken to acquire new knowledge, and
* involve risk or innovation.

 Proposals for funding under the Linkage Projects scheme must include at least one Partner Organisation. The Partner Organisation must make a contribution in cash and/or in kind to the project. The combined Partner Organisation contributions for a Proposal (i.e. the total of the cash and in-kind contributions of the Partner Organisations) must at least match the total funding requested from the ARC.

 The objectives of the Linkage Projects scheme are to:

* support the initiation and/or development of long-term strategic research alliances between higher education organisations and other organisations, including industry and other research end-users, in order to apply advanced knowledge to problems and/or to provide opportunities to obtain national economic, commercial, social or cultural benefits
* provide opportunities for internationally competitive research projects to be conducted in collaboration with organisations outside the higher education sector, targeting those who have demonstrated a clear commitment to high-quality research
* encourage growth of a national pool of world-class researchers to meet the needs of the broader Australian innovation system
* build the scale and focus of research in the national Science and Research Priorities.

 The Linkage Projects scheme provides project funding of AUD 50,000 to AUD 300,000 per year for two to five years. Project funding may be used for: personnel, for example, research associates or assistants and technicians and stipends for higher degree by research students; teaching relief; access to research and infrastructure facilities and technical workshop services; essential field research; expert third party services; equipment and consumables; publication and dissemination of outputs and outreach; specialised computer equipment and software; travel costs essential to the project; web hosting and development; workshops, focus groups and conferences; and essential support costs for researchers who are carers or who themselves require care.

***Map***

 The utilization Map of this collaborative research project is summarised below:

|  |  |
| --- | --- |
| **Intellectual property** | **Surveys of 1,000–2,000 frontline staff in 1998, 2008, 2012**  |
| **Knowledge assets** | Know-how, Expertise, Information in the field of labour market and welfare policies |
| **Infrastructure & capacity** | Pool of experienced lecturersRepresentative training facilities at VU Campus |
| **Financial assets** | Access to the Linkage Program  |
| **Utilization method** | Dissemination |
| **Actions** | * Share
* Collaborate
 |

***Pathway 5: Contract Research***

 The most common type of contract research is a Phase II or III human clinical trial where a pharmaceutical company tests the efficacy of a new experimental drug on a group of patients.

 For the purpose of the Map it is not necessary to present a specific case study for such a trial. In almost all of the cases, the trials are set up according to a very strict and uniform protocol that is dictated by the regulatory bodies for drug certification, such as the FDA and the EMA.

 A trial involving patients can only be conducted by a hospital because only hospitals can select and treat patients. Furthermore, in order to be able to conduct clinical trials a hospital must have the appropriate licenses and procedures in place to conduct treatments with experimental drugs. Ethical issues and patient safety must be taken into consideration with great seriousness.

 Therefore, in many cases the clinical trials are conducted in academic medical centres/hospitals. This is particularly the case with clinical trials for rare diseases. Patients with such rare diseases typically visit an academic clinician who specialises in the rare disease. In some cases, this specialist researcher/clinician is a so called “Key Opinion Leader” (KOL) and a positive outcome of the trial will become even more convincing because of the involvement and association of the KOL.

***Map***

 The utilization Map of this clinical contract research is summarised below:

|  |  |
| --- | --- |
| **Knowledge assets** | **Know-how, Expertise Information in the field of a particular decease**  |
| **Infrastructure & capacity** | Facilities for treatment of patientsDoctors and nursesDiagnostic equipment and labs to monitor treatment and analyse outcomeProcesses and procedures to conduct clinical trials |
| **Operational assets** | Clinical trial desk (if available)Medical-ethical committee |
| **Strategic assets** | License to treat patientsAccess to patientsReputation of academic hospital and KOL |
| **Utilization method** | Commercialization |
| **Actions** | * Transfer
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***Pathway 6: Shared Facility***

 The story of the Helmholtz Energy Materials Foundry (HEMF) is a typical example of an academic shared facility center.

***Introduction***

 The Helmholtz Energy Materials Foundry (HEMF) is a large shared facility in Germany and was envisaged as a large-scale collaborative research-and-development environment dedicated to the synthesis of new and improved materials for energy conversion and storage applications.

 HELF consists of state-of-the-art laboratories and equipment that are distributed over the six participating Helmholtz Centres:

* **German Aerospace Center** (Deutsche Zentrum für Luft- und Raumfahrt, DLR)
* **Jülich Research Center** (Forschungszentrum Jülich, FZJ)
* **Helmholtz Center Berlin for Material and Energy** (Helmholtz-Zentrum Berlin für Materialien und Energie, HZB)
* **Helmholtz Center Dresden-Rossendorf** (Helmholtz-Zentrum Dresden-Rossendorf, (HZDR)
* **Melmholtz Center Geesthacht** for material and costal research (Helmholtz-Zentrum Geesthacht für Material- und Küstenforschung, HZG)
* **Karlsruhe Institute of Technology** (Karlsruher Institut für Technologie, KIT)

 The HEMF platform operates as an international user facility. The laboratories are available to research teams from universities, non-university research institutions, and industry.

The coordination of user operations is performed by HZB and uses a web-portal that informs the users of the capabilities, availability and tariffs of the facilities offered by the HEMF platform. About 3,000 external personnel visit HELF to conduct research.

 The scientific focus of HELF is on materials and applications in the field of solar cells, solar fuels, fuel cells, batteries, thermo-electrics and thermochemistry, with catalysis as an overarching theme that is important to all these topics.



**Figure 1: Schematic outline of HEMF**

***Impact***

 The HEMF platform strengthens the Helmholtz Association’s competence in materials synthesis and complement the existing Helmholtz Energy Materials Characterization Platform (HEMCP) infrastructure which has a strong focus on materials characterization. The large scale of this combined effort and the opportunities for synergy between the centers and between internal and external users, combined with the strong focus on energy materials enables the Helmholtz partners, both academic and business, to operate at the international forefront of energy research.

“*HEMF will augment the Helmholtz Association’s expertise in synthesis of raw materials indispensable for the energy transition. The participating Helmholtz Centres will be able to add their research capabilities to this shared infrastructure so that we can make the energy we will need in the future available for use in a safe and simultaneously environmentally friendly way. At the same time, the platform will draw attractive collaborating partners who are pursuing the same goals*”, says Prof. Anke Kaysser-Pyzalla, Scientific Director of HZB.

***About Helmholtz***

 The Helmholtz Association of German Research Centers was created in 1995 to formalize existing relationships between several renowned independent German research centers. The Helmholtz Association distributes core funding from the German Federal Ministry of Education and Research (BMBF) to its, now, 18 autonomous research centers and evaluates their effectiveness against the highest international standards.

 The mission of the Helmholtz Association is to contribute to solving grand challenges facing society, science and industry by conducting top-rate research in the fields of Aeronautics, Space and Transport, Earth and Environment, Energy, Health, Matter, and Key Technologies.

***Map***

 The utilization Map of HEMF is summarised below:

|  |  |
| --- | --- |
| **Intellectual property** | **A pool of IP in the field of to the synthesis of new and improved materials for energy conversion and storage applications owned by the participating institutes and available for licensing to third parties.** |
| **Knowledge assets** | A pool of knowledge assets in the field of to the synthesis of new and improved materials for energy conversion and storage applications owned by participating the participating institutes and available for licensing to third parties. |
| **Collections** | Large collection of data and materials in the field of to the synthesis of new and improved materials for energy conversion and storage applications owned by participating the participating institutes and available for licensing to third parties. |
| **Infrastructure & capacity** | Human capital, Equipment, Lab facilities of the participating institutes. |
| **Operational assets** | TTO at each of the participating institutesWeb-portal for information and access to facilities |
| **Strategic assets** | Access to public funding and subsidies, both nationals and EUStrong scientific reputation of Helmholtz |
| **Utilization method** | CommercialisationApplicationDissemination |
| **Actions** | * Secure
* Explore
* Share
* Transfer
* Collaborate
* Venture
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***Pathway 7: Academy for Training Lawyers***

 This story of is a typical example of a professional development service.

***Introduction***

 Academic education is not exclusively geared towards the needs of bachelor, master or PhD students. In many professional areas, education remains essential to keep up with current developments and new insights.

 Professional development, also known as post-graduate education, is therefore important. Professionals, ranging from accountants to dentists and from lawyers to managers, can take short, targeted courses or in-depth education programmes developed and provided by the academic lecturers and offered on a commercial basis.

 VU University Amsterdam in the Netherlands offers a wide range of professional development modules in accountancy, dentistry, governance, law, medicine, management and organisational sciences.

***VU Law Academy***

 The VU Law Academy offers professional development services for legal professionals in the Netherlands. Law is not static but is very much alive and under development. New laws and case law require legal professionals to stay up-to-date and professional development is essential in that respect. According to Dutch Law and internal regulations of the Netherlands Bar, a registration in the Netherlands Bar requires that a lawyer obtains 20 study points per year from an accredited education provider.

 VU Law Academy is education provider accredited by the Netherlands Bar. The VU Law Academy offers 200-300 courses and 20 specialization tracks, enrolling around 3,000 participants on a yearly basis. Lawyers make up the majority of the participants, but the VU Law Academy also serves legal counsels and notaries. The courses vary from four-hour updates to in-depth specialisation programmes. These specialisation tracks are closely related to the legal areas that the VU Faculty of Law excels in, such as pension law, contracting law and mergers and acquisitions.

 Professional development is an important way to utilize academic legal knowledge. Furthermore, it offers an effective channel to showcase academic expertise and it generates a considerable revenue stream that benefits the academic efforts.

 Although the competition is fierce, the VU Law Academy is able to be a preferred education provider for many lawyers because of the academic quality of its training, the strong relation with research and the energetic and stimulating atmosphere of the VU Campus.

***Map***

 The utilization Map of the VU Law Academy is summarised below:

|  |  |
| --- | --- |
| **Intellectual property** | **Course material and educational content**  |
| **Knowledge assets** | Know-how, Expertise, Information in the field of law, in particular pension law, contracting law and mergers and acquisitions |
| **Infrastructure & capacity** | Pool of experienced lecturersRepresentative training facilities at VU Campus |
| **Strategic assets** | Accreditation by the Netherlands BarReputation |
| **Utilization method** | Commercialization |
| **Actions** | * Share
* Collaborate
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***Pathway 8: Professors Taking Part in Public Debate***

 Following public events to promote the SAPEA (Science Advice for Policy by European Academies) project on ‘Food from the Oceans’ in Bergen and Cardiff earlier in the year, a third public event was hosted in the city of Hamburg, Germany on October 5th.

 In co-operation between SAPEA and the Union of German Science Academies, a public debate on how to extract more food from the oceans in a sustainable manner took place at the Hamburg Academy in the centre of Hamburg. In spite of atrocious weather conditions, 120 members of the public attended this event and there was a lively and informative debate. The evening event was opened by the President of the Hamburg Academy, Professor Edwin Kreuzer and then the Chair of the European Commission’s High-Level Group of Science Advisors, Professor Rolf-Dieter Heuer MAE ML, explained the work of the High-Level Group. The Director of the AE Cardiff Knowledge Hub and Vice-President of AE, Professor Ole Petersen MAE ML FRS outlined the SAPEA project and the role of AE.

 The Food from the Oceans debate itself was chaired by the Hamburg Science Journalist Angela Grosse and included valuable expert contributions from Professor Marian Paschke from the University of Hamburg, Professor Gesche Krause from the Helmholtz Centre for Polar and Ocean Research in Bremen, who is also a member of the SAPEA Working Group, and Professor Gerd Kraus, Director of the Thünen Institute for Ocean Fishery in Hamburg.

***Map***

 The utilization Map for Professors taking part in public debate is summarised below:

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| --- | --- |
| **Knowledge assets** | **Expertise of the participants** |
| **Infrastructure & capacity** | A public forum |
| **Strategic assets** | The willingness of researchers to engage in public debates |
| **Utilization method** | Dissemination |
| **Actions** | * Share
 |

***Pathway 9: Consultancy***

 This story of is a typical example of consultancy service of a university professor to a client.

Client: National Day Nurseries Association (NDNA) in Huddersfield, UK.

Consultant: Prof. Kathy Sylva of the Department of Education of the University of Oxford, UK.

***Background***

 National Day Nurseries Association (NDNA) is a national charity representing children’s’ day nurseries across the UK, giving them information, training and support, so they can provide the best possible care to young children. NDNA is the voice of the sector, an integral part of the lives of nearly one million children and their families.

***Project***

 Ms. Kathy Sylva is Professor of Educational Psychology at the University of Oxford, Department of Education. She is one of the leaders of research of the Department of Education of the UK Government on effective pre-school, primary and secondary education (EPPSE) and on the evaluations of the Graduate Leader Fund and the Early Learning Partnership Project. She was Specialist Adviser to the House of Commons Select Committee on Education in
2000-2001 and again in 2005-2009. She was awarded an Order of the British Empire 2008 for services to children and families.

 The Professor has been involved in consulting and supporting NDNA in a project entitled, ‘Exploring barriers and opportunities for parental engagement in childcare settings,’ which aims to identify best practice in nurseries and highlight innovative methods to engage families.

 The consultancy service of Prof. Sylva to NDNA was facilitated by the Consulting Services unit of Oxford University Innovation, the TTO of Oxford University. They supported both Prof. Sylva and NDNA to define the project including planning and budget. They acted in behalf of University of Oxford in the commercial and legal negotiating and contracting.

***Map***

 The utilization Map for consultancy is summarised below:

|  |  |
| --- | --- |
| **Knowledge assets** | **Know-how, Expertise, Information in the field of childcare practices in the UK** |
| **Operational assets** | Oxford University Innovation, Consultancy Services Unit  |
| **Strategic assets** | Reputation of both the University of Oxford and Prof. Sylva.Entrepreneurial culture of Oxford University |
| **Utilization method** | Application |
| **Actions** | * Share
* Collaborate
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1. The Toolkit provides a one-stop-shop for academic and research institutions that seek guidance in the course of shaping and implementing their institutional IP policies. A copy can be found on the [WIPO website](http://www.wipo.int/policy/en/university_ip_policies). [↑](#footnote-ref-1)
2. Source: WIPO website: www.wipo.int [↑](#footnote-ref-2)
3. www.betterworldproject.org [↑](#footnote-ref-3)
4. [www.astp-proton.eu](http://www.astp-proton.eu) [↑](#footnote-ref-4)