

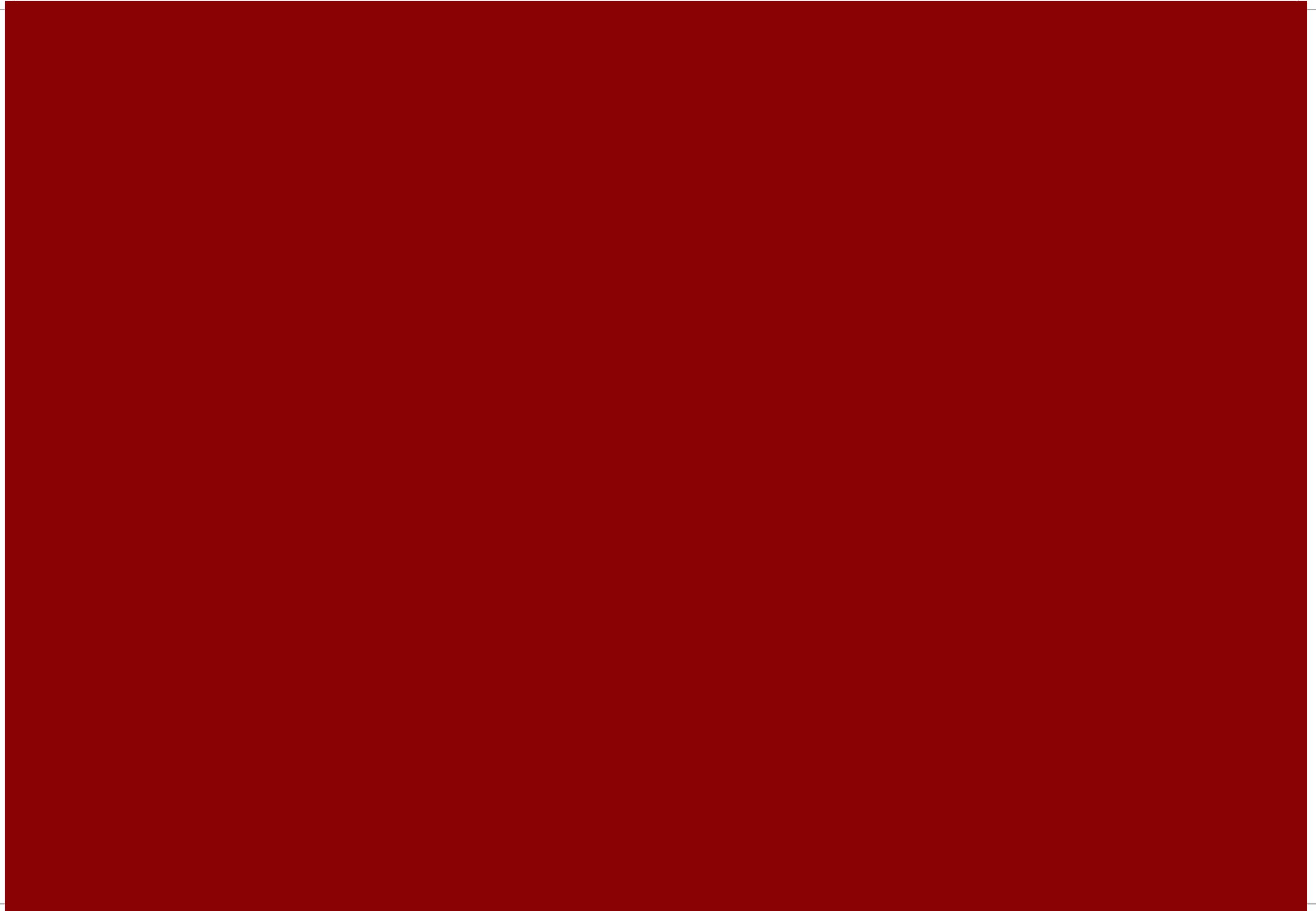
Innovation and Knowledge Transfer in Africa A Practical Guide

The guide **Innovation and Knowledge Transfer in Africa** aims to be a useful tool to contribute to the development of knowledge-based societies on the African continent. Its objective is to promote Innovation and Knowledge Transfer in Africa through the collaboration of its main players: universities, companies and governments.

Current socioeconomic changes place universities in a key position as the driving force behind innovation and territorial development. Going beyond the functions of training and scientific research, universities take on a notable social and economic function in the progress of society and the economy, more than ever. This guide hopes to offer information, tools and methodologies for promoting innovation and creating wealth and well-being, mainly aimed at African countries.

Innovation and Knowledge Transfer in Africa A Practical Guide has been prepared by the Associació Catalana d'Universitats Públiques (ACUP) within the context of its university cooperation programme with Africa. It has enjoyed the active participation of the African universities that are part of the Interuniversity Consortium of University Management (CIGU).

Innovation and Knowledge Transfer in Africa A Practical Guide



the 1990s, the number of people in the world who are poor has increased by 1 billion.

There are a number of reasons for this. One is that the world population has increased by 1 billion in the same period. Another is that the world's resources are being depleted.

There are a number of ways in which we can address these issues. One is to reduce our consumption of resources. Another is to improve the efficiency of our production processes.

There are a number of ways in which we can improve the efficiency of our production processes. One is to invest in research and development. Another is to improve the quality of our workforce.

There are a number of ways in which we can improve the quality of our workforce. One is to provide education and training. Another is to improve the working conditions of our employees.

There are a number of ways in which we can provide education and training. One is to invest in education. Another is to provide training opportunities for our employees.

There are a number of ways in which we can improve the working conditions of our employees. One is to provide a safe and healthy work environment. Another is to provide fair wages and benefits.

There are a number of ways in which we can provide a safe and healthy work environment. One is to invest in safety equipment. Another is to provide training on safety procedures.

There are a number of ways in which we can provide fair wages and benefits. One is to invest in employee benefits. Another is to provide a living wage.

There are a number of ways in which we can invest in education. One is to provide scholarships. Another is to invest in research and development.

There are a number of ways in which we can provide training opportunities for our employees. One is to provide on-the-job training. Another is to provide external training courses.

There are a number of ways in which we can improve the quality of our workforce. One is to provide education and training. Another is to improve the working conditions of our employees.

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There are a number of ways in which we can reduce our consumption of resources. One is to use energy-efficient appliances. Another is to recycle our waste.

There are a number of ways in which we can improve the efficiency of our production processes. One is to invest in research and development. Another is to improve the quality of our workforce.

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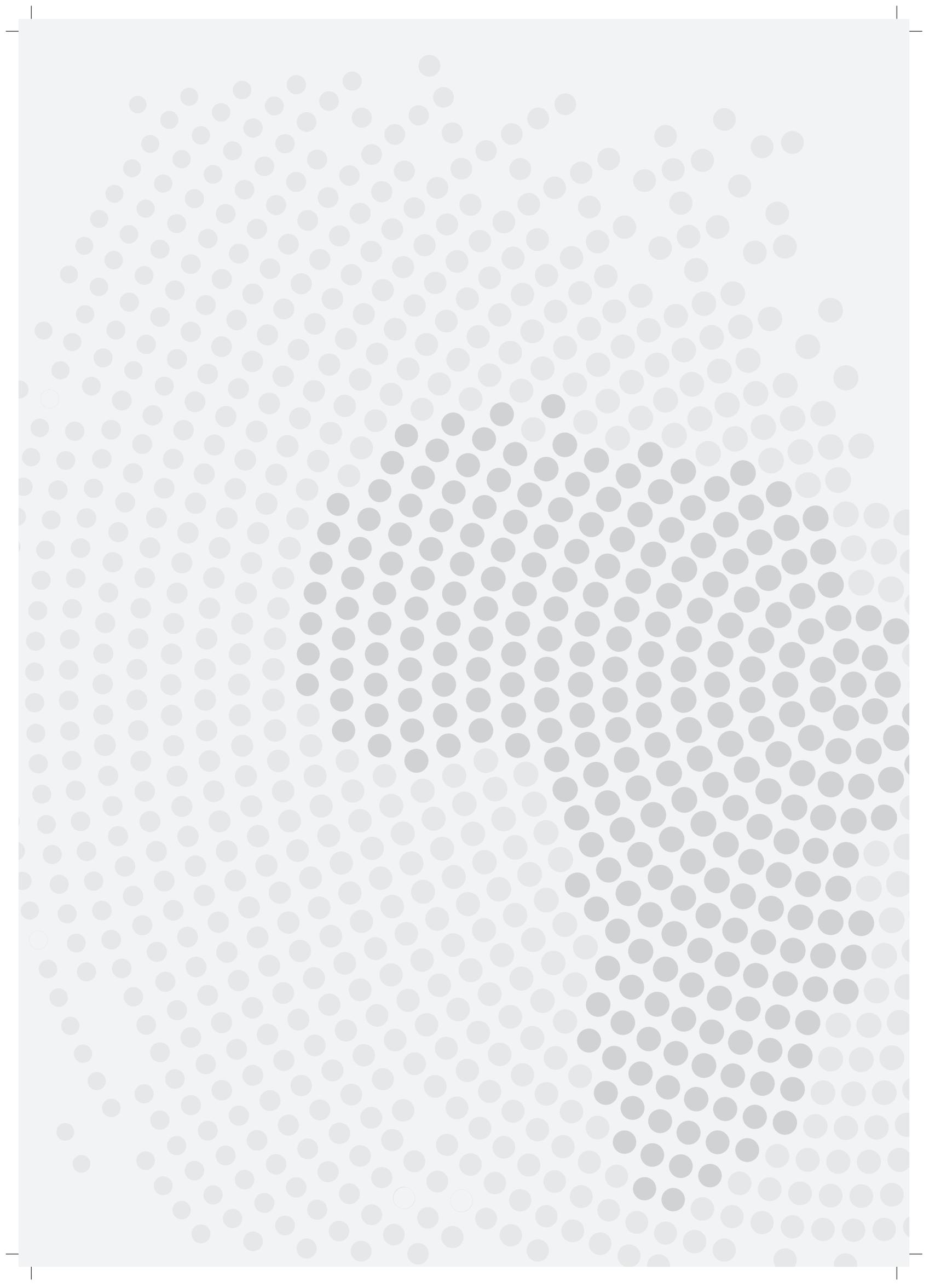
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Introduction

The publication of this practical guide for promoting Innovation and Knowledge Transfer in Africa is the result of a far reaching piece of collaboration between public Catalan universities, belonging to the Associació Catalana d'Universitats Públiques, and African universities that belong to the Interuniversity Consortium of University Management.

The guide is another step ahead in strengthening the existing links between the universities that belong to the consortium. It represents the consolidation of this collaboration environment for training and for exchanging experiences between Catalan and African universities. The results obtained so far within the context of the consortium, which are deeply enriching, represent a solid base for guaranteeing a future of collaboration. In this respect, as members of the consortium, we are aware -in a context such as today's, in which global interdependence is increasing- of the need to deepen the cooperation between universities.

The socioeconomic changes that have been taking place in recent years mean that the university's role as the driving force behind development takes on even greater relevance. This makes it even more necessary to carry on working to construct strong universities able to create knowledge that is relevant for their environment, as well as to transfer it to achieve a positive impact on society.

This guide hopes to contribute towards this objective and aims to be an initial step that will facilitate future collaborations between Catalan and African universities. It wishes to be an instrument that will help to analyse the situation in which universities, companies and public administrations are found, which are key factors in territorial innovation and in the knowledge transfer process. In this respect, it hopes to make the necessary tools to favour identifying weaknesses and opportunities for improvement in the area of innovation and knowledge transfer available to universities, governments and companies in Africa.

We are convinced that the joint commitment to promote innovation and to improve knowledge transfer in Africa will reach a significant milestone thanks to this publication, which will once again allow work in collaboration for the social, economic and cultural progress of our societies.

Francesc Xavier Grau Vidal

President of the Associació Catalana d'Universitats Públiques (ACUP)

1 About the Guide

History and geographical proximity have generated an intense relationship between the African continent and Catalonia. In the area of trade relations, the fact that Catalonia is the territory in Spain with the most intense flow of imports and exports with North Africa is particularly relevant. It should also be pointed out that these collaboration links are deeply rooted in civil society. In this respect, the humanitarian as well as development cooperation interventions that a whole host of Catalan associations have carried out over the years in various African countries should be highlighted.

Catalan universities have also been noteworthy for their commitment to development cooperation. The origin of this dates back to the 1990s, in the context of the social mobilisations which demanded the contribution of 0.7% of the GDP to development cooperation actions and to important changes in the discourse about development and cooperation. Even so, the awareness of Catalan universities about this area came much sooner in many cases, thanks to the work that was carried out in research departments and centres in areas such as development economics, the culture of peace, the defence of human rights or what was then known as tropical medicine. In this respect, in Catalonia, as well as in other countries, one has been able to observe a growing recognition of the role of universities as a driving force behind development.

Coinciding with the change of millennium, Catalonia has initiated a new dialogue to construct a strategic association that accelerates cooperation to integrate Africa into the economic globalisation and to favour improvements in the area of human rights and democracy. Catalonia, in keeping with the European directives of the first EU-Africa Cairo Summit, faced two main challenges in Africa: contributing to its sustainable development and favouring that the United Nations Millennium Development Goals should be achieved. Objectives which, as they cover a wide range of areas that influence human development -from health and education to aspects that, until recently, were not as well considered, such as gender equality and environmental sustainability- represent an unprecedented international commitment. Thus, one of the most notable transformations in recent decades has been the growing importance of recognition of the role of knowledge and of human capital in the social, economic and cultural development of societies. This can be found in the numerous reports and studies carried out by the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Organisation for Economic Co-operation and Development (OECD) and the World Bank, among others. It is in this context that the *Associació Catalana d'Universitats Públiques (ACUP)* is working on the *University Cooperation Programme with Africa*. The programme is part of the *Internationalisation Plan of the Catalan Public Universities 2010-2015* and of the *University Development Cooperation Plan 2011-2015*.

The main aim of the *University Cooperation Programme with Africa* is to create stable alliances which contribute to improving the abilities of Sub-Saharan African universities, as an essential feature to promote their institutional strengthening. In this way, it aims to have an influence on improving training, research and knowledge transfer actions as areas of action in the universities themselves. Since 2009, the programme has set up a framework for working which has already allowed several joint projects to be carried out, as well as bilateral collaborations between universities.

In this respect, we would highlight the *Interuniversity Consortium for University Management (CIGU)* the aim of which is to promote collaboration projects between African and Catalan universities in the area of university management. The Catalan universities that make up the consortium are members of the ACUP: the Universitat

de Barcelona (UB); the Universitat Autònoma de Barcelona (UAB); the Universitat Politècnica de Catalunya (UPC); the Universitat Pompeu Fabra (UPF); the Universitat de Girona (UdG); the Universitat de Lleida (UdL); the Universitat Rovira i Virgili (URV); the Universitat Oberta de Catalunya (UOC). The African universities that are members of the consortium are the Université d'Antananarivo (Madagascar), the Université Cheikh Anta Diop (Senegal), the Universidade Eduardo Mondlane (Mozambique), the Universidad Nacional de Guinea Ecuatorial (Equatorial Guinea) and the University of Yaoundé I (Cameroon).

For this purpose, CIGU has developed the programme *Technipedia - Innovation and Entrepreneurship in Africa* - with the aim of reinforcing the economic fabric of the African countries. As part of this programme, the virtual platform, *Technipedia*, was presented in Cameroon in February 2012. The meaning of this tool is to reinforce the economic fabric in African countries through improving knowledge transfer between universities and companies, promoting entrepreneurship, innovation and the creation of companies among young African people. This platform offers technological and economic information, as well as examples of good practices as a way to contribute to strengthening the technological culture, promoting entrepreneurship and fostering the creation of innovative companies. It also facilitates the exchange of information between entrepreneurs by connecting them through means of a network and it directly contributes to the densification of networks of small and medium enterprises.

In addition to the virtual platform, *Technipedia - Innovation and Entrepreneurship in Africa* has prepared the document *Innovation and Knowledge Transfer in Africa. A Practical Guide*, presented herein. The guide shares the same objective as the virtual platform: to contribute to reinforcing the economic fabric in Africa, but focusing its attention on facilitating the improvement of knowledge transfer between academic institutions, small and medium enterprises and governments. In this respect, the guide aims to promote networking between the various participants to then organise programmes about knowledge transfer, research, teaching, innovation and entrepreneurship. With this, it hopes to contribute to a planned, stable collaboration between the different organisations involved to detect joint opportunities.

The guide has an eminently practical approach. Its main purpose is to identify the most suitable "customised" strategy for each territory to improve knowledge transfer from universities to companies and to society. It does not aim to be a panacea of action but to set up a preliminary methodology to emphasise the features that facilitate knowledge transfer processes and to reflect on the critical points of a good strategic plan. It is a tool that will accompany the institution that uses it in its initial change process. The decision to support a continued flow of knowledge transfer involves an important change in the institution as a whole. This initial approach has been based on assuming that the knowledge transfer between people, companies or institutions, and its later consolidation, is a complex phenomenon. For this knowledge to transcend and have a positive, indirect effect on other people, companies or institutions which, at the same time, can use it for their own renewal (knowledge spill-over) is an even more complex phenomenon.

The guide consists of a first chapter: "The University in Africa", which is an approximation to the context in which it will be used. This is followed by other chapters: 3. "The Entrepreneur University"; 4. "Introduction of a Knowledge Transfer System"; 5. "Appraisal Process. Practical Recommendations"; 6. "Knowledge Transfer Offices"; 7. "Diagnosing the Innovation Ecosystem: Governments, Universities and Companies" and the final chapters "Bibliography and Resources" and "Acronyms".

Finally, we should add that the Associació Catalana d'Universitats Públiques (ACUP) has analysis tools to be able to develop the guide among diverse players (universities, government and companies) as well as its practical implementation. A programme and a technique that allow work to be done with greater efficacy through being able to count on multiple information that allows knowledge and procedures given in it (www.acup.cat) to be made the very most of. In short, the guide does not aim to replace the knowledge and intuition of those responsible for carrying out the strategic plan, but it does provide a highly practical checklist about the key questions in a knowledge transfer process which, with computer applications, can improve it and help it be carried out.

2 The University in Africa

1,000 million people live on the African continent, which is a significant part of the world population. At the moment, Africa is divided into 54 states in which frontier economies exist next to emerging economies. Thanks to the sustained growth during the last decade, positive results have started to be generated for the continent. However, while some of the Millennium Development Goals will be achieved, more than half the population continues fighting to survive in conditions of poverty or extreme poverty. The structural obstacles, such as the low level of infrastructures of any kind, the weakness of the institutions, the lack of development of democracy, the levels of adverse economic participation and the lack of regional economic integration, continue to slow down growth. The continual external demand for raw materials also tends to reinforce the distortion of the markets.

Strong institutions that provide security, fairness and employment are the way to guarantee lasting progress in social and economic development; generating conditions that permit the creation of infrastructures and the consolidation of private initiative and business investment. Unless an effort is made to promote internal economic growth through improving the conditions of innovation, Africa will not make the most of the potential of the demographic explosion represented by its young population. It is also necessary to stimulate technological progress, improve human abilities and promote conditions that foster the appearance of new business activities. In a suitable institutional context, the entrepreneurial spirit in small, medium and large enterprises has the ability to satisfy the enormous demand of the continent. The policies that are found with the perspective of innovating systems will also have a positive effect on the social cohesion, through reducing uncertainty and influencing the speed of change.

African countries are increasingly recognising the need to invest in science, technology and innovation to offer a response to the challenges they are facing. A common point of view which was clear in the framework of the *Declaration of Science, Technology and Scientific Research for the Development of Africa*, held in Ethiopia in 2007.

We, the Heads of States and Government of the African Union, ...recalling our millennium commitments to achieve sustainable development for our Continent, ...realizing that the achievement of these goals depends on our countries' abilities to harness science and technology for development and also an increased and sustained investment in science, technology and innovation, ...commit ourselves to promote and support research and innovation activities and the requisite human and institutional capacities.

The aim of the development cooperation programmes is to influence the reduction of factors that create poverty, providing the citizens of developing countries with the ability to improve their quality of life for themselves. Despite the economic growth of recent years, in some African countries an increase in the "growth with unemployment" phenomenon is observed, in which the growth figures do not generate improvements in the indicators of human development. This is why the gap between economic growth and human development is a fact in many African economies. A possible explanation is the division between objectives and instruments, between the process of growth and that of development. Most of the development measures are, generally, only expressed as those of economic growth. Their realisation is perceived as dependent on the correct implementation of the conventional tools of macro-economic policy, together with industrial and commercial policies. The focus of innovation systems for development should try to bridge this gap and propose the design of a new form of developing that is more in keeping with human development.

Most of the literature on innovation systems focuses on state innovation systems. The definition of the African states that determines the postcolonial map throughout the continent has implications on the feasibility of the innovation systems in Africa. Therefore, this construction needs to be transcended and a continental innovation system needs to be adopted that generates a regional economy that is more aimed at growth and development (Muchie, 2003; Scerri, 2003; Maharajh, 2008).

In the past, research & development & innovation surveys limited their analysis to the formal institutions directly related to the production, dissemination and absorption of technological innovations. A more recent focus has extended the definition of innovation to include organisational and institutional changes (OECD / Eurostat, 2005; Lundvall, 1992; Cassiolato, Lastres and Maciel, 2003).

Table 1: Sector share of change in real GDP for Africa (2002-2007)

Sector	Porcentaje
Resources	24
Wholesale and retail	13
Agriculture	12
Transport, communication	10
Manufacturing	9
Financial intermediation	6
Public administration	6
Construction	5
Real estate, business services	5
Tourism	2
Utilities	2
Other services (education, health, household services and social services)	6

* Government spending from resource generated revenue contributed an additional eight percentage points.

Note: 100% = 235.000 millions \$ EEUU

Source: African Innovation Outlook

In the African area, we should not forget the existence of a wide variety of informal institutions (in the way of establishing routines, practices and certain aspects such as decision-making processes), which must be taken into account when understanding and defining the innovation system in a broader way. Paradoxically, in this context, history becomes relevant for the analysis of the innovation systems. It is within the network that these formal and informal institutions make up that "tacit" knowledge is in fact acquired. The kind of knowledge that is considered difficult to transfer, unlike "explicit" knowledge. As an example: transmitting that Dakar is the capital of Senegal would be considered to be "explicit knowledge". However, transmitting the use of a language such as Wolof would be considered "tacit knowledge". This kind of knowledge usually requires direct personal contact between the expert and the learner for the transmission to take place. This will probably be one of the keys for generating added value in a highly competitive environment: tacit knowledge, system thinking. In other words, the overall vision of the problems of the system.

In an economic context, science, technology and innovation usually refer to diverse aspects of the technology and of the technological innovations. If the term is limited to technology, the definition of the institutions is limited to the formal institutions that are directly involved in producing technological innovations, such as the R&D departments in companies, the public sector, or the higher education sector. Based on this, the definition of "national innovation system" tends to be a synonym of "science and technology system". However, considering innovation systems as "economic" systems instead of "technological" ones has considerably increased the range of institutions and fields which must now be included in the category of the term.

Generally, the function of science, technology and innovation is now accepted as the basis of economic changes and development (Dosi et al, 1988; Freeman, 1993; Lundvall, 1992; Nelson, 1993; OECD, 1997; Cassiolato et al, 2003; Muchie, Lundvall and Gammeltoft, 2003; Maharajh, 2008). Until some decades ago, the typical progress path was usually based on the recommendations of the protectionist model. The introduction of this policy represented the appearance of the "Asian Tigers" and the industrialised economies in the 1970s.

Table 2: R&D personal by level of education (headcount)

	GIBID	PhD level	Theoretically based university studies	Other higher education	Subtotal Tertiary education	Others
Gabon	527	321	163	22	506	21
Ghana	2. 115	166	305	414	885	1. 230
Kenya	6. 799	1014	1. 202	2. 464	4. 680	2.119
Malawi	2.884	208	436	350	994	1. 890
Mali	2. 414	164	653	155	972	1. 442
Mozambique	2.082	36	349	104	489	1. 593
Nigeria	32. 802	6.498	18. 782	0	25. 280	7. 522
Senegal	7. 859	2003	5. 840	16	7. 859	0
South Africa	59. 344	19. 008	21. 712	18. 624	59. 344	0
Tanzania	3. 593	399	919	913	2. 231	1. 362
Uganda	1.768	156	947	0	1. 103	665
Zambia	2. 219	316	625	735	1. 676	543

* *Researches only*

Source: African Innovation Outlook

The size and the economic power of the Chinese economy and its constant reform process is a clear example of development based on the construction of local competence as a platform for global competitiveness. India offers a similar example: the appearance of a competitive giant at a worldwide level, after the liberalisation of the economy which has taken place since the 1990s, preceded by a long period of protected industrialisation. At present, in the era of global liberalisation without precedents in the flows of trade, investment, human capital and knowledge, the structuring and relation of states to be competitive worldwide, has new implications

for defining state innovation systems. Therefore, the protectionist option is no longer feasible for most of the African economies. Their underdeveloped industrial fabric limits their possibilities to develop sufficient local competences in the free trade era. Individually, the internal economies of most of the African states are too small and their institutions are not sufficiently developed or stable enough to offer tools for development.

However, if we look at the continent as a whole and from the perspective of innovation systems, we see possibilities to progress. The question of the entrepreneur spirit, for example, and its relation with the industrialisation process has focused its attention on growth and development strategies. However, the lack of debate on the meaning of the concept and the lack of understanding about its role in the evolution of innovation systems leads to errors in formulating policies. Often, an entrepreneur spirit is excessively considered to be "the element" of stimulation for the development of small and medium enterprises and as the panacea for the development problems of the countries. Despite this, it is true that innovation occurs in companies as a result of entrepreneurship.

Table 3: Researches by sector of employment (headcount) percentage shares

	Total	Business sector	Government sector	Higher education sector	Private non-profit organisations
Cameroon	100.0	3.4	6.5	90.0	.*
Gabon	100.0	N.A	NA	NA	NA
Ghana	100.0	13.8	61.8	24.4	.*
Kenya	100.0	3.1	30.7	63.0	3.2
Malawi	100.0	3.7	33.7	47.6	15.0
Mali	100.0	53.8	.*	46.2	.*
Mozambique	100.0	.*	97.3	.*	2.7
Nigeria	100.0	.*	10.7	89.3	.*
Senegal	100.0	0.2	2.1	96.4	1.3
South Africa	100.0	20.8	9.3	69.2	0.7
Tanzania	100.0	.*	21.8	72.6	5.6
Uganda	100.0	4.7	50.2	45.1	.*
Zambia	100.0	5.7	32.4	59.8	2.1

* Sector no surveyed

Source: African Innovation Outlook

And that to specify entrepreneur initiative in innovation and sustainable industrialisation requires the existence of a large base of highly qualified entrepreneurs (Coase, 1937). In addition to this critical mass, reality has also shown us that the transfer of the entrepreneur initiative to general well-being requires a suitable framework of regulations and the existence of real support to the development of human resources and the creation of value. This is achieved, not so much by promoting the entrepreneur spirit, but by establishing a solid institutional base on which the entrepreneur spirit can stimulate the industrial process necessary for regional and state development.

Taking into account the history of Africa and its peculiarities, we find that most of the state innovation systems have feasibility difficulties. For example, there is a need to reflect on the possible benefits of the integration of the African economies into a systematic base. From an innovation systems approach, this involves the need to transform the region based on a set of different state innovation systems in a conglomerate of larger areas. The first stage of this transformation would require greater mobility of people, resources and information across current borders. A second stage would require greater levels of integration.

Bearing in mind that innovation includes the innovation of products and processes, as well as organisational innovation and marketing, it is found that innovation is present in almost all the countries in Africa, in small and large enterprises. The client/user is the main source of ideas for external innovation, meaning that user experience and ethnographic techniques take on particular importance. In some cases, the competitors were also sources of ideas. Surprisingly, public institutions such as universities and technical institutes, governments and public research organisations barely feature on the list of external sources of ideas. The innovation of products -including goods or services- and of processes is mainly carried out by the company and the main innovation activity is the acquisition of machinery, equipment and software, followed by R&D, which is done by the company. In most countries, the main impact of innovation is translated into a better quality of the products and services offered, followed by flexibility in production, a greater variety of products and an increased ability to produce. The most commonly mentioned obstacle against innovation is the lack of resources in the company and its cost. The dominance of the market by established companies and lack of information about technologies and markets is also relevant. The lack of qualified personnel is also a significant obstacle. It is also seen that innovation activities are related to the size of the company: the larger it is, the more likely it is to innovate.

In addition, the production of science depends on a wide range of systematic, institutional and individual strengths. The impact of historical influences on science, in particular colonial legacies, is a reality in Africa. Nevertheless, there have been other influences of a historic nature: the science systems in the old, well consolidated universities (such as the case of South Africa and Egypt) have a clear advantage over systems in universities which were only established four or five decades ago. Despite this, and independently of the size of the country, knowledge production is dominated by the work of academics and researchers from the most important universities. The size of the country and of the sector of higher education only affects the number of universities that participate in scientific production. In the smaller systems, science often depends to a great degree on the role and the contribution of the public universities as the main knowledge producers. In countries such as Namibia, Botswana and Swaziland, there are no important research centres outside the state universities and 80-90% of the research results of these small countries is generated by academic personnel in these institutions. This also applies to countries in which one university dominates science production, such as in Angola (Universidade Agostinho Neto), Lesotho (National University of Lesotho), Mali (Université de Bamako) and Mozambique (Universidade Eduardo Mondlane). This pattern is repeated even in systems characterised by their medium-sized universities; for example, scientific production in Ethiopia is dominated by Addis Ababa University and the production in Uganda by Makerere University.

A few countries (Kenya, Ghana and Senegal) have a broader set of scientific institutions, which include a certain number of public universities financed by the government, laboratories and institutes and international organisations. In the largest science systems (South Africa and Egypt) the situation is quite different. Although Cairo University is the most productive university in Egypt (and is, in fact, among the 500 best universities in the world according to the Shanghai ranking), there are significant contributions made by other universities. In South Africa, five universities (Cape Town, Stellenbosch, Pretoria, KwaZulu-Natal and Witwatersrand) produce 50% of the total in the country, but at second level, the niche research universities (the universities of the North and the West, Free State, Johannesburg, Western Cape and Rhodes) make a significant, growing contribution to science creation. If we add to all of this a sector of highly dynamic councils (including the Council for Scientific and Industrial Research (CSIR), Human Sciences Research Council (HSRC) and Mintek) and certain small, but highly productive, national research facilities in the areas of astronomy, biodiversity and space science, it is not surprising that South Africa leads the scientific production of the continent.

The bibliometric analysis illustrates how science reflects the economic and physical reality of a country. The scientific effort in Africa reflects the material reality and the challenges of three main areas: food security, disease control and industrialisation. Considering that agricultural research dominated the research agendas in the 1990s (above all in the English-speaking countries of Africa), today the dominant research area is medicine and other similar fields. In addition to the challenges of traditional tropical infectious diseases, the pandemic of HIV/AIDS and the lasting effects of tuberculosis have led to renewed efforts in R&D in these areas. There are still questions concerning food security in which the situation is not improving. South Africa, Egypt and Algeria could be described as semi-industrialised. There are industrialisation focuses in Nigeria, Kenya and Tanzania. These countries have developed a certain local ability in engineering sciences (especially in the sectors of metallurgy and mining engineering), chemistry and chemical engineering, and physics (such as nuclear physics and astrophysics). Together with growing experience in electronics, mathematics and computer sciences, it is not surprising that the form of knowledge production in these countries is notably different to that of the rest of the continent.

However, in the final instance, Africa's participation in scientific production at a world level continues to decrease. The few African countries in which scientific production is still considerable are not as productive as other developing countries in other parts of the world. Therefore, these countries do not have a specific weight on the general results. For Africa to be more competitive in scientific production, it would require a greater investment in developing human capital, strengthening the scientific institutions and better equipment, as well as significantly more important financing of scientific research.

Innovation activity has been related to economic growth and is considered as a potential creator of wealth and well-being. In Africa, innovation can contribute to advancing in achieving the Millennium Development Goals and strengthening the economies through creating jobs for the young African population. When economic systems or markets do not offer the necessary conditions for promoting innovation, governmental intervention is required. Statistic measurements are necessary to control and evaluate the progress of specific interventions and political learning is basically made through the assessment that leads to the improvement of the intervention, or abandoning it if it is not seen to be useful. The econometric process in the field of innovation is a complex process and Africa lacks a history of measuring and managing science and information technologies. Currently it does not have a suitable system of indicators that allow policies in matters of science, technology and innovation to be assessed, basically due to the use of traditional development focuses which ignore the impact of science and innovation activities on the socioeconomic transformation of the continent. Even in places such as South Africa, Nigeria or Uganda, in which diverse studies have been carried out (the Center for Science, Technology and Innovation Indicators - CeSTII) following the European Union methodology, they have come across problems defining the sample and the university, which has slanted the study and at the same time there are deficiencies in the registers/databases or a lack of response or even errors in the approach of the survey.

3 The Entrepreneur University

The competitiveness of the territory becomes a key feature of the progress of its citizens and increasingly depends on an environment which supports risk-taking and innovative ideas. Culture, knowledge, innovation, technology and entrepreneurship must be examined as a whole if we wish to generate integrating models that are efficient for the progress of the territory. In Africa, entrepreneurship and its relation with the industrialisation process have generated the interest of governments, although the question has not been debated with due depth. Based on the analysis of reliable data, it is a good idea to deal with the competitiveness of the territory and the true potential of the entrepreneurship, its limitations and the way of stimulating it by means of a synergic action between universities, the private sector and the government.

Among the various theories that have been developed around the relation between these three players and its impact on innovation and development, the Triple Helix theory (Etzkowitz and Leydesdorff, 1997) stands out. The Triple Helix model connects the traditional categories of the innovation economy with institutional evolution, grouping together the three main institutional sectors: public, private and academic. From this approach, reciprocal relations are set up between the three spheres which can be specified at different moments of the knowledge capitalisation process.

The Triple Helix model has been taken on in recent years as a paradigm of impulse to territorial development. The interaction between universities, companies and public administrations is aimed at encouraging the economic and social development of the territory. This synergy is obtained from the combination between the power of knowledge found in universities, the economic resources, the business experience and the markets the companies have, and the incentives and the development of public initiatives promoted by the administrations. This perspective leaves behind a static version of university knowledge transfer and provides a holistic approach to the concept of innovation applied to territorial development (Etzkowitz 2003).

The Triple Helix theory is inserted into the changing context of the concept of institutions that has arisen in recent years. In this respect, the functional differentiation of institutions is making way for the hybridisation of functions, in which civil society demands governments, universities and companies to organise themselves for efficient knowledge transfer in innovation.

All governments recognise micro, small and medium enterprises as the great generators of innovation and the driving force behind progress, and the 21st-century university has a greater role to play in offering continued support to the entrepreneur initiative. Entrepreneurism is one of the main factors of innovation in economy and in society. A competitive territory needs to achieve a critical mass of micro, small and medium enterprises able to compete internationally. However, in a knowledge society, it will be difficult to have a group of small and medium enterprises (SMEs) prepared to face global challenges without a synergic action between the players of which the Triple Helix is made up. The application of this model is offering good results by managing to generate higher levels of innovation, integrating bottom-up, top-down and lateral initiatives.

A competitive territory requires a broad reflection on how universities, in addition to teaching and research, develop their third mission as the driving force behind innovation and stimulation of development of the territory and how well they deal with the concept of "entrepreneur university" with a more active role in favouring creativity, innovative practices and the change in the cultural, ethical, scientific, technological and economic dimension. An "entrepreneur university" that makes science, technology and innovation accessible. A university that recovers the protagonist role in the innovation process, above all in the presence of technical-scientific

tools based on advanced knowledge. The "entrepreneur university" is a passionate concept that defines universities that provide opportunities, practices, culture and environments that are conducive to actively promoting entrepreneurship actions and studies. The "entrepreneur university" is not a university with courses aimed at entrepreneurs, it is a university that undertakes an orientation towards the concept of the entrepreneur individual and the entrepreneur institution in its strategy.

Entrepreneurship is gaining legitimacy as an academic field, organising its intellectual limits, establishing its own ontological and epistemological base, with a growth of an internal culture, of its knowledge base and of the exchange of experts in entrepreneurship in the community. Despite being a relatively new concept, it is a growing trend and hundreds of universities all over the world offer interesting proposals for developing entrepreneurship. In this respect, a large growth in entrepreneurship studies is envisaged to face the significant deficiencies in the entrepreneur spirit. Developing entrepreneur abilities in higher education has an impact on generating the necessary skills so that the territory can compete internationally, and on offering an entrepreneur, social and economic response to the pressures of uncertainty and complexity caused by globalisation.

Schumpeter's evolutionary model, which proposes recombining features to create new forms of economic organisation, is no longer sufficient to direct the evolution of current development and to offer a solution to the problems of the territory. The entrepreneur initiative must look beyond the economic world for multipurpose knowledge as a source for recombining and innovating features. This knowledge is basically produced in the university and in Triple Helix contexts. Therefore, we are seeing an evolution of the Schumpeterian entrepreneur concept, as a driving force behind industrial society -in which the changes of the social structure are produced by the interactions of individual entrepreneurs- towards the concept of the entrepreneur university as a driving force behind knowledge society.

The entrepreneur initiative consists of the aptitude to convert ideas into actions and therefore, is a key skill for all of them, which helps to be more creative and have greater confidence in oneself in any activity undertaken. It is a practice that is applied to many fields. It generates innovation and improves the effectiveness of the goods, services and institutions. It changes the way of working, communicating and living. The entrepreneur, taking a calculated risk, shows that the idea for a product, a process or a way of organisation can be efficient and profitable, benefiting himself and improving the economy and society. It is more than a business management; it is a way of thinking and acting that can be applied to any human being's field of effort. It merges vision and pragmatism, innovation and implementation and requires knowledge, imagination, perception, practical sense, persistence and attention to others.

In a provocative way, we could say that an entrepreneur method exists alongside the scientific method. Like music, entrepreneurship is a field of study that generates its own material. It creates what it studies. Entrepreneurs and musicians need an amateur population to complete their work. For musicians, this population is the audience, which values what the musician does; for the entrepreneur, it is the market. Like music, entrepreneurship is a competitive field and is therefore based on meritocracy. Entrepreneurship is open to everyone, not exclusively businessmen. The propensity to behave as an entrepreneur is not exclusive to just a few individuals. These behaviours, skills and attributes may be practised, developed and learnt and institutions designed in an entrepreneur way may stimulate them. In the same way that, in music, the composition department cannot convert a student into someone who is creative, if this person understands how great music is made, this will favour any degree of creativity that he possesses and help him to express it. Therefore, by making innovation intelligible, students may be helped to imagine and launch themselves into entrepreneur activities that they would not otherwise have considered.

In this context, our university is an entrepreneur one when:

- › It accepts the idea that it must integrate, share knowledge and learn from the other stakeholders in the territory.
- › It maximises the commercial potential of its ideas to create value in society and does not perceive it as damaging academic values.
- › It seeks new forms of financing, in addition to public funds, that guarantee its autonomy; it promotes the entrepreneur spirit maintaining the autonomy of the academic community.
- › It potentiates science parks, business incubators, technology transfer offices (TTOs) and the protocols for protecting patents, as a means of integration of the stakeholders.
- › It focuses on the use of interdisciplinary knowledge, promoting activities, departments and interdisciplinary research centres.
- › It accepts responsibility for the development of students with respect to future social experiences, careers and lifelong learning.
- › It is less specialised but more multipurpose and more interdisciplinary.
- › It creates prize systems beyond the criteria of research, publication or teaching.
- › It promotes teaching in entrepreneurship at all the faculties.
- › It promotes a close relation with the business community, incorporating entrepreneurs and leaders as collaborators.

To transform a university into an entrepreneur one not only requires changes in the organisation, but also an adaptation of the culture of the institution. In the field of research into entrepreneurship, there are a large number of pieces of work relating to the individual and the entrepreneur team (development of intellectual and human capital, types of entrepreneurs and non-entrepreneurs), forms of organisation (management practices, acquisition of resources, systems development, strategies and structures that allow a new opportunity to be transformed into a feasible product or service) and the environment (percentage of start-ups per population, cultural, economic or market factors that encourage or inhibit entrepreneurship). Nevertheless, there is very little research into the field of opportunities (interaction between the market and environment that generate new medium-end relations).

Entrepreneurship is a multilevel phenomenon and its study lies more in the complex connections between opportunities, individual or team entrepreneurs and ways of organising than in research into a separate field. These connections affect the decision-making theory, information processing, the network theory and the factors involved in the start-ups, among others, and contain the necessary synthesis to understand the entrepreneur phenomenon.

The entrepreneur university is found in the heart of the innovation system, generating technological advances and helping the dissemination of technology through intermediaries such as TTOs, the creation of networking mechanisms (business incubators, science parks) or licensing and the creation of new companies (spin-offs and start-ups).

As the interaction with the company increases, so the action of the university expands beyond its traditional fields. A transformation of research into innovations is produced, thus generating a value for society and an improvement in the financial income for the institution. This interaction with the environment creates feedback. It produces an institutionalisation of innovation with the appearance of R&D sponsored by companies, universities and governments and the birth of the scientific entrepreneur, who combines basic knowledge with an agenda of innovation, an epistemological perspective with an industrial one. We will increasingly see greater integration between new generic technologies, the NBICs (nano-bio-inflow-cognitive sciences). In other words, convergent technologies to improve human performance. In this respect, significant integration, rather than collaboration between researchers in different fields and between university and industry, a strengthening of the global role of a university (from basic sciences to innovation and production) less specialised but with a broader objective of disciplines.

In the field of the new sciences and of technological companies (particularly radical innovation high-tech ones), generally integrated into geographical clusters, innovation depends on research and technology transfer from the university to industry. For this kind of company, university knowledge and academic entrepreneurship are totally relevant for acquiring new technology. In a global economy based on science, marketable knowledge flow is the requirement for long-term success. Therefore, a trend towards the "entrepreneur university" is consolidated which seeks to highlight knowledge transfer. We should not forget that the great weakness, private funding, greatly values the institution's ability to make the research profitable when investing in joint programmes. In Europe, with more longer-term research, less success is obtained than in the United States, where shorter term research is rapidly transformed into product. In Europe, large-scale collaboration with industry is more difficult than in the United States, where universities are more entrepreneur and more aimed at industry, meaning that knowledge transfer through the generation of spin-offs achieves good results. Their later sale, by public offer or directly to the large company, generates a good return for the institution.

Despite this, it should be pointed out that not all entrepreneur activities contribute to economic growth with the same intensity. Several studies show that innovative companies with potential for high growth and internationalisation ability are a decisive factor affecting economic growth. Generating this kind of company depends on the economic environment (infrastructures, technologies and the presence of economic investment, among others) of the education of the entrepreneurs and also the territorial level of income. The number of these kinds of company is still low as there is a greater number of innovative companies that do not have a growth and internationalisation plan and that should be stimulated to do so.

4 Introduction of a Knowledge Transfer System

Knowledge transfer is the set of activities aimed at disseminating knowledge, experience and skills with the purpose of facilitating the use, application and exploitation of the knowledge and the R&D abilities of the university outside the academic area, whether by other R&D institutions, the economic sector or society at large. It is important not to confuse knowledge transfer with technology transfer, as a large part of the potential of the university would be lost by limiting the only form of innovation to technology. Within the overall concept of knowledge transfer, technology transfer would be included. This comes from the area of patent licences and of know-how between companies. Technology transfer does not consider non-technological areas, such as social sciences and humanities, which also generate useful knowledge. It is like this because public scientific research centres do not usually generate technology, but knowledge to be later converted into technology by companies.

The concept of knowledge transfer is also different to that of "knowledge transmission" because, in the case of transfer, the aim is to incorporate that knowledge into a value chain so that it generates an economic return, while in the case of transmission, only the publication, dissemination or teaching is being sought. In addition, although knowledge transfer has been happening in a one-off way in many universities, it is increasingly being generalised as one of the key aspects in the so-called "third mission" which includes the social and economic use of knowledge generated by and available in universities. In any case, there is not just a single transfer model. The model adopted in 2003 by the European Association of Technology Transfer Offices, ProTon-Europe, contemplates two environments; Open Science and Open Innovation. Both coexist to deal with knowledge transfer. The dominance of one or another environment will depend on the R&D capacities, on the knowledge management of the university and on the characteristics of the territory.

Definition

Technical Support and Consultancy

Technical support and consultancy are important aspects in knowledge transfer activities. In addition to allowing direct interaction between academics and non-academic professionals, it can lead to the development of these initial relations towards other longer-term knowledge transfer mechanisms, such as the collaboration in research contracts or licenses.

By "technical support" we understand work of a technical and professional nature, including the assessment, consultancy, design and specific training, offered for a price and that do not necessarily generate new scientific or technological knowledge. At the same time, the "consultancy" includes assessment services offered for a price, that do not generate new scientific or technological knowledge, even though they may promote organisational innovation. In addition, it covers a wide range of activities, from the solution of a one-off problem to the design of public policies.

4.1 Open Science Environment

The Open Science environment is usually associated to public research activities, which mobilise the R&D capacities of the university, whether for:

- › Generating knowledge with public financing that is openly disseminated by means of publications and congresses, among others (in this case without knowledge transfer). The main objective of the university and/or its researchers is the publication of the research results for public use.
- › Satisfying the demands for knowledge expressed by companies or other public or private bodies, which finance the R&D activities. The main objective of the university is to offer a response to the specific demands of companies in exchange for an economic consideration.

Definition

Contract Research

Contracted research consists of carrying out research activities and/or regulated experimental development by means of a contract between the parties. Unlike collaborative research, these cases are mainly focused on satisfying the needs of the external partner (client). The client defines the objectives of the work, finances its total cost at market price and the Intellectual Property Rights (IPR) tend to belong to the client. It is also known as research on demand.

Proof-of-Concept

It is often necessary for universities to actively participate in demonstrating the potential use of inventions before industry can incorporate them. The proof of concept deals with the constraints introduced by a change of scale, regulatory requirements or requirements for use. It may even not refer to the nucleus of knowledge that has been generated but to incidental aspects of it.

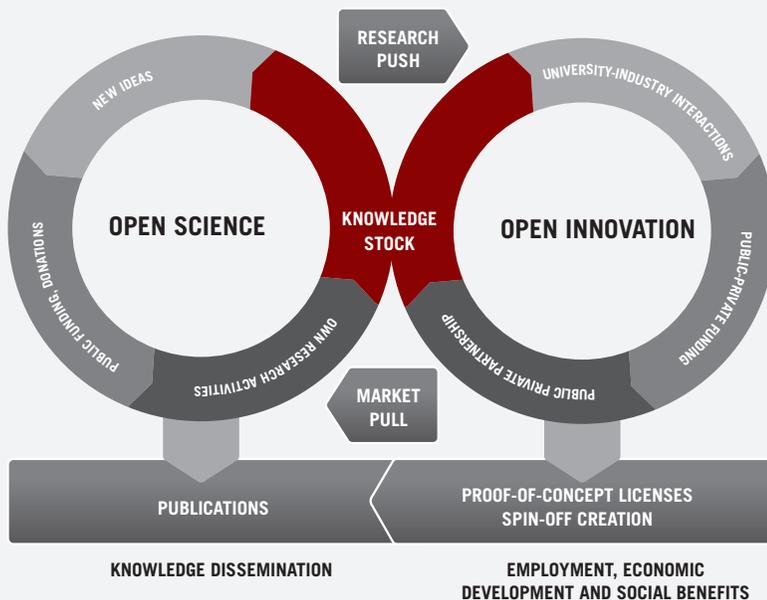
There are two main mechanisms to demonstrate the proof of concept: collaborative research and the creation of spin-outs.

In this environment, which would correspond to the traditional Market Pull linear model, the university tends to satisfy business people's demands, who obtained the property of the results, mainly through two mechanisms: technical and consultancy support or contract research; the basic activities are the relational activity (putting researchers in companies in contact with each other) and the management services activity derived from possible agreements between them (information, assessment, financial management, among others). As the results derived from these projects are usually the property of the company that contracts the services, specific management in matters of intellectual property rights (IPR) are not required. Nevertheless, the university must try to maintain the preliminary knowledge and the pre-existing IPR of the research contracted, as well as retaining the possibility to carry out future development based on this knowledge. To do this, it must be clearly stated what the knowledge area to be transferred consists of and for what it will be used and to reserve the possibility to carry out future research into the technology developed. There are companies that regularly publish offers and demands for specialist knowledge and that permit knowledge generated in universities to be applied to business problems.

4.2 Open Innovation Environment

Knowledge transfer can also be dealt with from an environment which, in the view of current innovation models, could be considered to be open innovation. This concept takes on a proactive role in the impulse of research results -in many cases the results of research financed with public funds- to convert them into innovations. This is an evolution of the licensing model. A model that arose in the United States as a result of the 1980 Bayh-Dole Act which, among other things, did not permit the control of intellectual property right to research carried out with governmental funds. This condition encouraged universities to establish the technology transfer function. By thus taking on a proactive role in favouring that the results of the research, in many cases as

a result of public financing, are converted into innovations. However, while Open Science and the Licensing Model can be considered to be linear models, Open Innovation corresponds, to a greater degree, to a systematic, more effective innovation model that generates greater interaction and feedback between academics and industry. For universities, going from Open Science to Open Innovation means a strategic and cultural change, a situation of maturity that must be dealt with in keeping with its capacities and its environment.



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Open Innovation is mainly developed based on assigning public funds destined to collaborative public-private research, in which the university and company share objectives, resources and IPRs. Collaborative research can be an important knowledge transfer channel between academics and industry, government and companies, in both directions and can lead to other knowledge transfer activities, such as licences or forming spin-offs. In this model, therefore, the rights of exploitation on the invention are transferred to a company or to a spin-off company, through a licence, which takes charge of the tests or developments that are still outstanding and for which resources that the research group does not have may be required. This does not mean that there is no help or assessment by the researchers.

Definition

Spin-off / Spin-Out

A company whose business is mainly based on knowledge or technology generated in universities. The aim of creating the company is to commercialise the results of the research. The technology is licensed to the new company in exchange for royalties and/or shares.

This new company is usually promoted and managed by the research team, and in some cases can be participated in by the university. On the whole, the first years of operations are dedicated to verifying the technical feasibility of the concept (Proof-of-Concept). These companies tend to remain in the immediate area of the university of origin and contribute to renewing the local economy.

Any licence agreement reflects the particular needs and expectations of a determined licensor and a determined licensee. Nevertheless, the success of a licence agreement depends on several essential factors. For example, when a licence comes to its end, the value of the patented technology needs to be determined. Unlike what happens with tangible goods, this is not an easy task, but various methods of evaluation exist which are applicable to the area of technologies.

Definition

Collaborative Research

The university looks for a business partner willing to collaborate in the proof of concept, in exchange for acquiring some exploitation rights on the invention. The objectives are joint ones, there are contributions of various kinds by both parties, there is usually collaboration in the work plan, and risks and benefits as well as results are shared. There is often public aid that supports this transfer route.

In view of all the above, in the case of Open Innovation, the correct management of the IPR is an essential requirement for knowledge transfer. In this way, the set of exclusive rights that will protect the generation of knowledge that may give rise to new products, new procedures or new designs are organised. This means the identification of transferable results and their protection, if relevant, taking into account a conception of their use, application, economic or business exploitation.

4.2.1 Management of an Open Innovation Environment - IPR Management

To optimise knowledge transfer and the benefits of the use of its intellectual property rights, the

university must set up its own management strategies, suited to its specific knowledge transfer model. In any case, the following considerations are fundamental in IPR management in collaborative research, development and innovation activities.

- › The knowledge transfer activity requires the development of a formal IPR management processes.
- › The commercialisation of the IPR may, potentially, generate significant stable benefits for the university, but this is not usually the case. Even the most successful universities in knowledge transfer only generate a small proportion of their income based on intellectual property rights.
- › To continue constructing on the knowledge, property policies should not only take care of the rights of obtaining commercial benefits, but should also focus on ensuring the right to publish, once the corresponding protection actions have been carried out, and the right to use this knowledge in future research.
- › IPR management in agreements with companies includes not only the knowledge generated but also the preliminary knowledge. This requires the identification of pre-existing know-how and, if relevant, setting the conditions for its use by the company when carrying out the project and when exploiting the results.
- › Ceding rights on knowledge generated can only be dealt with when the commission covers, as a minimum, the total cost of its development under a valuation of it at market prices. Public aid should not mean a reduction in this compensation.
- › The transfer that is made of knowledge generated and preliminary knowledge should take into account whether there are conditions derived from other rights, for example derived from material transfer agreements that have previously been made.
- › The obligation to inform about patents that are originated by the owner to the other party of the contract should be established, both in the application as well as the concession.
- › Conflicts of interest should be identified and channelled by reinforcing the transparency of the activity.
- › The communications system should be taken care of to construct a relationship of mutual trust.

4.2.2 Management of an Open Innovation Environment - Follow-up, Evaluation and Metrics

The regular assessment of knowledge transfer activities is an essential feature in following up on the activities carried out to determine whether they meet the objectives set. In addition, in this way it is also possible to carry out comparison exercises between the effort of our institution and of external institutions. This follow-up and assessment process allows, on the one hand, the successes achieved to be identified and highlighted and to be promoted internally and externally. On the other hand, it allows the activities which have difficulties in reaching the goals proposed to be identified and the corrective measures that should be taken. The reality of knowledge transfer is still difficult to measure, as it adopts a whole host of forms and only objective, partially verifiable information is registered. Measurements of features such as the economic and social impact of knowledge transfer are still under debate. Therefore, mainly because there has not been joint agreement on the measuring tools, up until now it has been difficult to measure the success with which universities participate in knowledge transfer activities.

To improve this situation, the parties involved need to find and agree on a common way of defining, quantifying and qualifying the effort of the universities' knowledge transfer activities. In this respect, the university must design and introduce clear systems for the follow-up and assessment of knowledge transfer processes and carry out, on at least a yearly basis, a compilation of the indicators related to the measurements concerning the IPR management and knowledge transfer. In addition, the efficiency of the follow up and register of activities may reinforce the efficiency of the intellectual property rights management and of the knowledge transfer. It can also allow an external view of the university as an institution that efficiently manages its IPR, contributes to identifying the problems and opportunities related to intellectual property right management and to its commercialisation and to supporting the necessary strategic changes to improve the management.

The *Metrics for Knowledge Transfer from Public Research Organisations in Europe* (2009) report, commissioned by the Directorate-General for Research of the European Commission and carried out by a group of experts in measuring knowledge transfer, add the aim of improving the coherence and convergence between existing knowledge transfer surveys based on public research bodies, including universities. The purpose is that the institutions and administrations with responsibility in this area will be able to improve the possibility of carrying out follow-up and comparing achievements in this field, identifying trends and supporting work on improvement, if necessary, so that the scientific production can be more accessible for cultural, social and economic development.

Definition

Licensing

This is a permit that is granted to exploit a knowledge or technology developed in the university. For this, the granting of licences is based on the exclusive rights that are given by a patent. It consists of the permission that the university, the holder of the patent, grants to a company to use the patented invention, in keeping with mutually agreed conditions. The licences may be exclusive (they exclude others from exploiting the IPR) or not, and they have diverse scopes (use, exploitation, distribution, sublicences) and characteristics. The university obtains income from royalties, which may be negotiated.

The licence of a technology plays an important role as a catalyst for the later development of the technology. In this model, the rights of exploitation on the invention are transferred to a company, which takes charge of the tests or developments that are still outstanding and for which resources that the research group does not have may be required. This does not mean that there is no help or assessment by the researchers.

In order to achieve harmonisation in its definition, this group of experts identified seven basic indicators currently used in several recent surveys:

- › Research agreements.
- › Intervention disclosures.
- › Patent applications.
- › Patents granted.
- › Licences.
- › Income generated by licences being exploited.
- › Spin-offs created.

This report provides other complementary indicators of effort:

- › Knowledge transfer with the participation of SMEs.
- › Knowledge transfer with national companies.
- › Knowledge transfer with local companies.
- › Technological areas of patents.

Example

Innoget

The innoget.com website is a connection tool between companies, research institutions and innovation professionals throughout the world. In it, organisations looking for innovation find organisations which generate it. Clients capture external knowledge (through publishing technology applications) and promote the knowledge generated in their organisations (through the Technology Offers). By knowledge we understand innovative technologies, products, methods, procedures and services.

Innoget offers a complete range of services related to acquiring, revaluing and commercialising technologies covering the research and development and innovation (R&D&I) needs. In an open innovation environment, innovation becomes yet another feature, at the service of companies, which can be bought, sold or acquired and which derives from ideas, products and technologies of other organisations. Innoget was created with the clear aim of helping our clients to acquire this innovation and of highlighting its most innovative technologies.

At the same time, the Spanish Network of University Knowledge Transfer Offices (Red OTRI) has spent more than 10 years supervising the activity and the effort of these units in Spain and has published a document: *La I+D colaborativa: buenas prácticas para la gestión de la IPR* (2010) in which it analyses the indicators that should be applied to knowledge transfer. It suggests setting up a model for this, defines terms that are sometimes confusing and proposes recommendations for the main difficulties that occur in obtaining data. The Red OTRI model, in addition to the seven basic indicators of the Knowledge Transfer Metrics Work Group, include some recommendations derived from the work carried out between network's Group of Indicators and the Spanish Ministry of Science and Innovation and follows up, at the same time, those which led to the recently published *Cuaderno Técnico sobre Indicadores de Transferencia de conocimientos*.

The indicators proposed by Red OTRI are grouped into input and output indicators and the ratio between them. They deal with absolute magnitudes as well as relative ones derived from them:

a. Input indicators

- › Expenses in R&D (total and broken down according to the origin of the funds).
This must be calculated following the criteria proposed by the OECD in its Frascati Manual.
- › R&D Personnel (full time equivalent - FTE).
This must also be calculated according to the Frascati Manual, which not only involves FTEs, but also differentiating the research function from the rest of academic functions.
- › Personnel in transfer of the units with transference functions.

b. Output indicators

- › Contracting collaborative R&D.
- › Contracting R&D&I activity.
- › R&D on demand.
- › Technical studies and consultancy.
- › Services (analysis, tests, etc.). They are usually small jobs that do not require being formalised by contract, either because there is no need to regulate various deliveries or payments (it is all solved in one) or because there is no need to establish conditions on intellectual and industrial property rights and their exploitation.
- › Communication of invention and other protectable results.
- › Application for priority patent and PCT extension.
- › Granting patents.
- › Number of patent licences, software and others.
Licences (licence contracts) are the usual way of transferring intellectual or industrial property rights. There are numerous types (options, licences for use, for exploitation, for commercialisation, greater or lesser exclusiveness, etc.) and they affect the different objects of the industrial property right (patents, software, data, know-how, brands, etc.). All these modalities are recommended to be counted independently. However, with the aim of having a reduced number of indicators, international practice recommends reporting the total number of licences and a breakdown with regard to the patents (the most significant ones), the software (bringing together the licences with small unitary value as one licence) and other licences.
- › Income for licences.
- › Number of spin-offs created.
A company is a spin-off company when it acquires the exploitation rights of the results of research, either when it is constituted, through the holder of these rights contributing them, or through a licence issued later.

c. Ratios in knowledge transfer:

- › Amount financed externally on R&D&I activities of the R&D expenses.
- › Income in knowledge transfer (KT) per FTE of teaching and research staff (TRS).
- › Percentage of income in knowledge transfer derived from licences.
- › Percentage of research staff in knowledge transfer activities.

This ratio identifies the level of spreading of knowledge transfer activities in the organisation and, in this way, determines how deeply rooted the third mission culture is in the university. It involves carrying out a register of the people who participate in the project, but it should also be considered that research staff are not just TRS, but also other kinds of staff who are contracted to carry out these activities.

- › Number of patent applications per €M of expenses in R&D of public funding.
- › Percentage of patents licensed of the total portfolio of patents.
- › Percentage of licences that are granted to own spin-off companies.

Example**RCIPS - University of Cape Town (UCT)**

As part of its activities, the UCT's Research Contracts and Intellectual Property Services (RCIPS) organises monthly seminars on protection, licenses and company creation:

<http://www.rcips.uct.ac.za/seminars/?month=All>

Isis Innovation - University of Oxford

The Isis Innovation website, the company responsible for managing the KT/TT of the University of Oxford presents its services in a clear, structured way, with its main lines of activity and news/notable links. It also publishes a quarterly magazine - Isis Insights - which informs about the latest KT/TT innovations, collaborations and activities.

The quantitative indicators showed offer a reference chart for the organisation's knowledge transfer and allow for an appraisal for directing the organisation's policies and, at a global level, the government's policies. Nevertheless, at a citizen level, these parameters do not reveal very much in as far as knowledge transfer activity is concerned. It is difficult to know whether a given value is a high one or a low one and, often, this creates confusion and erroneous information given by the mass media. Therefore, it is highly important to identify and disseminate specific examples of innovations that come about as a result of knowledge transfer activities. These innovations, which involve the successful introduction into the market of a new product or process, often occur several years after the transfer has been produced, and even more years after the research that gave rise to the results that were transferred. In addition, using a model of standardised indicators that analyse the basic aspects of the function of the transfer allows comparisons to be made with knowledge management office units in other countries. In view of the great disparity of size there is between universities, one of the main challenges in producing indicators that can be compared between institutions is finding a denominator at a relevant scale that allows the indicators to be standardised. For this, the previously mentioned group of experts proposes weighting according to the number of researchers or in keeping with the institution's expenses in R&D.

5 Appraisal Process: Practical Recommendations

The appraisal is based on the means used to adapt the knowledge, results and capacities acquired in the research units to fit in with the social or economic environment. In other words, the set of activities carried out with the purpose of increasing the value of the results of the research and, in general, improving knowledge. Therefore, during the appraisal process on the activity carried out, six phases can be distinguished.



Phase 1: Awareness creation

This involves informing and training the members of the university community, mainly researchers, about necessary aspects of innovation and entrepreneurship. Examples of this kind of activity could include the following:

- › **Awareness creation** (day courses, competitions for business ideas, awards) that contributes to creating a culture of innovation in the institution and to promoting the development of new transfer projects based on the knowledge/technology created. These actions also serve to offer assessment and training to participants as well as to encourage them to develop their projects.
- › **Training** (chats or meetings), the organisation of training is based on short seminars which have the aim of bringing up matters of interest for the members of the university community, mainly students and teaching-research staff. The objective is to complement the compulsory training (subjects) and offer tools to researchers so that they complement their knowledge with aspects related to knowledge transfer (KT) and technology transfer (TT), such as protection and licences and creation of companies, among others.

Example

AFCE - Universidad de Antioquia

The Area for Promoting Entrepreneur Culture (AFCE) offers information and guidance and develops awareness creation activities with the main aim of bringing participants closer to the business world and encouraging citizens to join the programmes and institutions that support entrepreneurship in the city, in keeping with the characteristics of their entrepreneurship, as well as exploring the possibilities of their own ideas.

These activities include informative chats, sectorial lectures, theme days, business spaces, business chats and a mobile point. They are aimed at students, teachers and employees of Higher Education Institutions (technical, technological and universities) of Medellín and of the Metropolitan Area. The Universidad de Antioquia also organises a yearly competition of creative and innovative ideas.

- › **Communication.** There are diverse tools that can be useful, such as:
 - › Creation of an e-magazine to disseminate news related to the KT/TT to all the university community in a pleasant, visual way, as well as information about new calls for bids/support programmes and activities envisaged.
 - › Creation of a website to maintain the entire community informed about the objectives and the importance of the knowledge transfer, which will also be a telematic tool in which research staff can find solutions to their concerns/doubts. As this is dynamic, it must allow interaction with the administrator by means of an intranet. Ideally, this intranet must be the same one that will allow the researcher to manage his projects. The basic information it could contain is:
 - › University support to the researcher in the transfer process.
 - › Transfer modalities.
 - › Research standards.
 - › Frequently asked questions.
 - › General Information about intellectual property.
 - › Information about patents.
 - › Other modalities of protecting technology.
 - › Information form about inventions.

The aim of this form is so that the researcher can inform the person responsible for the portfolio of projects that he has developed a technology and that he is interested in exploiting it. It may be focused as an e-mail address with a short explanation about what it should contain, or as a direct entry in a database of inventions.
- › **Promoting teaching** through projects. In a complementary way and with the aim of evolving towards a model of entrepreneur university, it is a good idea to propose a kind of teaching through projects, providing the students with skills in innovation and entrepreneurship, promoting, implementing and assessing projects that can be applied to the real world beyond the classroom (Blank, 1997; Dickinson, et al, 1998; Harwell, 1997). The main benefits of learning based on creating projects include:
 - › Preparing students for the labour market.
 - › Increasing student motivation.
 - › Facilitating the connection between university learning and reality.
 - › It offers collaboration opportunities to develop knowledge.
 - › It increases social and communication skills.
 - › It increases problem-solving skills.
 - › It enables students to see the existing connections between different disciplines.
 - › It offers opportunities to make contributions to the university or the community.



Phase 2: Identification

In this phase, the channels through which we will be able to detect and identify research results that are potentially exploitable and to compile all the necessary information in a coherent way must be defined (Invention Disclosure Report). These channels may be:

- › Via website.
- › Informal meetings.
- › Periodical meetings with the various research groups.
- › Specific meetings with researchers.
- › Follow up on projects with public or private financing.
- › Revising draft copies of scientific publications.

Example

Example of the content of an Invention Disclosure Report:

- › Name
- › E-mail
- › Technology data
 - › Title
 - › Inventors
 - › Technological code
 - › Market code
 - › Description of the technology
 - › Competitive or alternative products/processes
 - › References to the condition of the nearest technique
 - › Improvements and advantages concerning the state of the technique
 - › Has it been published? (attach media and date)
 - › Are there plans for it to be published? (attach media and date)
- › Financing / Agreements
 - › Financing funds
 - › Material acquired
- › Status
 - › Applications of the invention
 - › Type of potential uses of the technology (target companies, possible licensees or end-users)
 - › Status of the invention
 - › Are there improvement plans? (Which?)
 - › Have there been any shows of interest (Which?)
 - › Comments
 - › Additional documentation



Phase 3: Evaluation

This analysis aims to get to know the phase in which projects are found, their main obstacles and how to solve them, to be able to offer a way into the market. The different themes to be dealt with during the evaluation phase are:

› **Novelty of the knowledge / of the technology (product or service).**

› **Level of development.**

Depending on the phase of development in which the project is found, the activities to be carried out and the financing needs will vary. It often happens that the criteria of the functional prototype as envisaged by the researcher do not coincide with what the market considers to be reasonable. The former considers that some satisfactory tests are a sufficient proof of concept, whilst the market will ask for another type of external accreditation or at the least that external experts have verified its functioning.

It is also important to review other parts of the development that go beyond technology.

Apart from the intellectual-industrial property in the form of patent or register, one should also consider, for example, the contacts that have been made (market/sector) and the confidentiality agreements that may have been signed, as well as existing regulations and possible changes in this environment. What has already been done is just as important as what is still left to do. Overall, this is the base of the development plan that will enable it to move into the mature phase. One also needs to identify whether the work is being done by a single researcher or by a team, the level of participation, the expectations and the level of involvement of each of them, and finally the financing received and the commitments acquired.

› **Financing needs and sources.**

To develop any project, it is essential to be quite clear about the necessary resources and those that are available. For example: the necessary people (and their contracting: by the institution or subcontracting); the necessary equipment to be able to develop the technology; the intellectual-industrial property (assessment and protection); the external tests on the technology and the trials; the legal procedures and the financial requirements for constituting the company, if relevant.

› **Potential market.**

This is one of the key parameters that must appear in a preliminary feasibility study. It is not a matter so much of establishing figures, as carrying out a quantitative approximation that allows its dimension to be established, the percentage that it is expected to take and to appraise whether the researcher's proposal is realistic. One needs to know if the need exists or if it should be generated, what the selling price would be and what price clients would be prepared to pay. As well as the strategy to reach the market (marketing and distribution channels). It must also be decided whether the market will be local or international -this is important with a view to the patent extension strategy -and how clients will be reached. It will also depend on the limitations of a regulatory nature, as different countries have different laws and they add cost to technological development.

Finally, it is important to point out that the company that wishes to obtain the licence of another technology must justify the expected sales, as the price of the licence is based on envisaged income. The interested company, whether it is a spin-off or external company, must submit a market study that shows its position and what it is willing to pay for the knowledge/technology, to then negotiate with the university.

› **Alternative and competitive projects.**

It is also important that the document lists current and/or future alternative projects. This information can be extrapolated from the researcher's knowledge. This information can also be extracted from the patentability study, if it has been done by an external organisation. It is a good idea to draw up a table in which alternative developments appear and the competitive advantage of the new invention.

In addition to alternative projects, a study on the competition must be done. In other words, the owners of these developments and the state of protection of each of them. In this way, it can be seen whether a patent has expired or how long it has left. One must also see whether the competing company has regional offices and its level of market penetration. This point is important, particularly if one can contact users of the alternative proposals to analyse their level of satisfaction and to submit the project to them. This would be part of a brief market analysis by professionals in the sector.

› **Legal environment.**

Another of the points to be considered is the legal environment of the project. This is one of the points that is usually left to the end. However, it is particularly relevant that there is a clear knowledge of the restrictions that one may come up against right from the beginning. In some cases, the approval by committees or certification agencies in the respective countries may be necessary. These tests or regulations can affect things in two ways. On the one hand, they have a cost that must be added to the project planning, as, on the whole, they require more tests and subcontracting specific certification laboratories, which are expensive. On the other hand, the time factor should be considered. When the time to market is a decisive factor for the success of the project, a delay of a year in carrying out the tests may be critical; this should be taken into account during the planning. Before applying for a licence, the experience and the possibilities of the company requesting the licence must be studied, and whether it is willing to deal with the certifications (to save on the cost of the licence).

› **Developing team.**

Finally, the researcher or entrepreneur team that are promoting the project should be assessed. This point is particularly important when deciding or at the least when making a first approach to the sales channel: direct licence to the company or creation of a spin-off company (also with licence). When investing in the creation of a company, the first cause of failure is the developing team, either because they do not understand or share the aims and involvement or because one of the basic components fails: technology, funding or market.

The potential investors give priority to the analysis of the entrepreneur team, their complementarity and their involvement. Therefore, the developers need to ask themselves these questions:

- › Am I willing to stop being a researcher or technician in my institution to join the company full-time as a shareholder and a worker?
- › Am I willing to take on the risk that this decision involves, taking into account that I could lose everything I have invested or that I could have to wait quite some time without receiving any income?
- › Am I clear about the fact that a shared business adventure has more probabilities than the unipersonal one, particularly in the case of technological companies, and therefore it is highly likely that I will have to get rid of some of the shares of my company?

The participation in a company may have different degrees. The more radical option proposed in the previous questions may not be necessary. The alternatives that can be offered are:

- › Opting for a licence for the technology. With this option, and as explained in the commercialisation part, both the institution as well as the researcher will receive an economic return based on the sales generated by the technology. Work is done on the maturing process but once the technology has been licensed, the researcher does not need to carry on participating. The university takes care of the follow-up.
- › Creating the company, but only participating as a shareholder, without involvement in the everyday management, but taking part in the board of administrators and periodical follow-up meetings. In this case, the company created acts as a marketer and has a licence for the technology and also, perhaps, shares in the institution itself, as well as that of the researcher.
- › Working part-time in the institution and part-time in the company, becoming the scientific director or person responsible for the research area if the company contemplates this possibility and is not strictly a marketer. In this case, there are labour implications in the relationship with the institution.

Phase 4: Protection

Protection should be understood as one of the most important parts of the knowledge transfer process. Good protection enables real capacity on the knowledge generated to be available and its aim is to prevent third parties from exploiting it without our consent. Therefore, the objective of this phase is to decide on the protection mechanisms and the processes to be followed. The decision on whether to protect or not, on the type of protection and its scope will depend on all the information provided in the previous parts. Principally, on whether it can be protected or not, its scientific interest, its potential market, if there are interested companies that have been identified and the total cost of the operation.

Phase 5: Maturing

This phase has variable deadlines that depend on the level of development of the technology, the available financing, the dedication of the research team and of the envisaged sales channel. It consists of a development and project execution plan.

The project development plan must include three basic parts:

- › **Plan for exploiting the technology** or set of technologies.
It must contain information about possible purchasers, the prices at which it would be sold and/or the products of the competition.
- › **Operations plan.**
It must set the objectives, tasks, people responsible, resources, calendar, etc. It is important to be clear about the goals to be reached in each stage to be able to decide on the suitability of continuing to invest or supporting the project in each stage.
- › **Financial plan.**
It must establish the evolution of the investments and how they turn into results, internal and external financial needs, the treasury and the balances, among others.

The execution of the project, apart from the risk variability that is linked to any innovation project, must meet the objectives with the resources assigned in the estimated time; in the case of innovation, the same thing is required, but minimising the risk or at least managing it.



Phase 6: Commercialisation

The objective of this phase is to transfer it to the market, once the technology has been protected and the development plan has been carried out. This transfer of technology, product or knowledge may be done by means of a licence to an existing company or through the creation of a spin-off/spin-out company. A licence is the most common method of transfer in Europe and the United States. In other words, starting out with a company that is interested in a particular know-how, a technology (with or without patent) or a product developed by the staff of the institution; then, the interested company -which is not a spin-off of the institution -must agree on a licence contract (the knowledge, technology or product). The spin-off channel may be more effective, in that it transfers not only determined results, but also produces a transfer of the skills of the researchers involved. Nevertheless, it is also the most difficult, complicated route, as it involves not only exploiting the technology, but also managing an entire business.

In both cases, once it has been decided that the best way of commercialising the technology is through the creation of a company, one will need to study the technological and economic feasibility of the idea and support the creating of the company plan. If necessary, to also collaborate in seeking financing so that the project can become a company. The usual procedure to be followed in this case consists of the following phrases:

- › Assessment about the business idea and the feasibility of the project to obtain a diagnosis.
- › Support to carrying out the company plan as a basic tool for studying the business idea and planning the setting up of the company.
- › Assessment in seeking public and/or private financing (choice of the most suitable funding, processing the application for financing and presenting it).
- › Periodical follow-up on the company created, to support its consolidation and growth.

Definition

When to create a spin-off company

- › If there is previous knowledge of the market, of the market shares that can be reached, of the suitable processes and channels through having interacted with the market in the past. In this case, the company can start with a portfolio of clients and the risk decreases.
- › The technology or knowledge generated are too new for the market and its development needs to be done and validated (proof of concept). In this case, the company acts as an environment for product development and for attracting investors, taking into account that it will need financing before reaching the commercialisation stage.
- › There are no other companies that are well positioned for the exploitation. In this case, it is important to have, on the one hand, correct protection and, on the other hand, time to market as during the development process competitors may appear. The time required for commercialising the IPR by means of a spin out company is longer than if it is licensed to an existing company.
- › There is an entrepreneur team that will be able to exploit it under the best conditions. There is willingness by all the entrepreneurs to take on a greater risk in exchange for greater benefit.

How to finance a spin-off company

Seed capital. Seed capital is a financing instrument used in the earliest phases of creating a start-up company. It is usually provided by the founder members, friends, family or business angels. The amount of money is usually small, as the business is usually still an idea or concept and this is usually destined to initial operations, development and innovation activities, proof of concept and marketing activities, as the investors generally prefer to wait until the business is more mature before making large investments. This initial capital provided by the developers is usually seen by other investors as a statement of the desire to convert the business into a success.

Venture capital. To guarantee medium-and long-term financing it is usually necessary to attract the attention of venture capital. This is the kind of risk capital that is mainly aimed at launching and developing start-up companies with a prognostic of great long-term growth, rather than at mature businesses. This financial tool is very important in processes of business growth linked to innovation, due to the difficulty that these initiatives have in accessing the more standard financial markets. Although they represent a higher risk for investors, they also offer higher return. To manage this risk, the investors obtain a share in the company (equity). In addition to an economic injection, venture capital is usually accompanied by financial supervision and access to a network of contacts and experience in business management.

6 Knowledge Transfer Offices

The central mission of knowledge transfer offices (KTO) is to facilitate the transfer of university discoveries and inventions through new products and services for public use and benefit (Capart & Sandelin, 2004). Based on this definition, the constitution of a KTO must respond to specific purposes. These include, promoting regional economic growth and creating employment; rewarding, retaining and recruiting researchers and postgraduate students; generating and promoting relations with industry; generating income for the office itself, the inventors and the university. It should also attract new funds to the university through sponsored research, facilitate consultancy opportunities for the researchers and obtain donations of money or equipment; in addition to offering services to the university community in matters concerning intellectual property, including seminars and assessment when required. Finally, to actively facilitate the training of university students and setting up companies.

The basic functions of KTOs, in keeping with the previous chapter, should include contemplating help to lecturers and researchers in identifying the results of research that have a commercial value. They must also evaluate the commercial potential of innovations, select inventions that should be patented and their most suitable legal identification. They must also carry out market research to identify the possible licensees or partners, prepare marketing actions with possible industrial partners and commercialise the innovations. When there are industrial partners for an innovation, the legal contracts (licence contracts) need to be negotiated to transfer IPR in the innovation in exchange for royalties or other considerations. Other tasks that they must carry out are maintaining and managing the necessary administrative functions to guarantee the protection processes of intellectual-industrial property and technology transfer and to introduce a system to guarantee that others have the opportunity to adopt

Example

Createch - Chile / USA

Createch links innovations with business opportunities. With operations in Chile and the United States, its consultancy experts help the transfer of innovations in products and services for national and international markets, connect researchers, entrepreneurs and investors with commercial partners and promote protecting intellectual property as part of the commercialisation strategies. Its consultancy has been designed to guide innovations towards the market in any stage of development: from ideas or inventions to mature technologies. Createch offers its services to various national universities and Chilean business incubators.

Enterprise and Innovation Office, University of Leeds - United Kingdom

The Enterprise and Innovation Office offers commercialisation services and also identifies, protects and manages the experience and intellectual property of the University of Leeds so that, together with its partners, it maximises the impact of its research for the benefit of the institution, its staff and its students.

This office manages the university's budget for patents and works with external companies such as Techtran Limited, its main commercialisation services provider, though not exclusively.

protection measures and commercialisation when the KTO decides not to go ahead with protecting the intellectual-industrial property and the commercialisation of an innovation. If they decide to go ahead with it, to negotiate the terms and conditions of the licence or of the research collaboration agreements; to supervise the execution of the licence and carry out modifications to the initial agreements (addenda) as necessary. Beyond these basic functions, a KTO must define and inform about its list of services. In other words, negotiate and manage the collaboration agreements with industry, beyond licensing agreements, actively help in training university students linked to newly created companies -through preparing a business plan, access

to seed capital and contracting a company management team -and ensure access to investors. It must also provide access to specialist consultancy services on any matter related to intellectual property; take care of marketing operations and offer conferences and seminars about intellectual property matters. It must also work with researchers and students on matters of the intellectual property of their research projects, manage projects and deal with the accounting.

More dynamic offices may even set up divisions to create new spin-out companies and manage business incubators and investment funds. In fact, KTOs have adopted different organisation structures, in addition to the traditional independent unit or department in a public research body. Below, we offer various examples of offices with different organisational structures:

- › Service or consultancy contract with an external company to manage occasional innovations revealed by researchers. An external organisation, which may or may not be profit making, collaborates with the university to manage projects on an occasional basis. There are many examples of these organisations used in small research institutions worldwide.
- › A small company, which may or may not be participated in by the university, to partially manage its knowledge transfer services. For example, an internal office of the university could review, filter and classify the innovations and an external company could implement the commercialisation of the most promising opportunities.
- › An office or governmental agency that offers services to various institutions. A KTO for a consortium of various public research organisations in a region. This office may depend on the government (national/regional) or on a philanthropic institution as a KTO for various public research institutes.

Example

Technology Innovation Agency (TIA) – South Africa

The TIA was created with the aim of stimulating and intensifying technological innovation to improve the economic growth and the quality of life of all South African people through the development and exploitation of technological innovations.

This agency is a public organisation whose objective is to improve the country's ability to convert a greater proportion of local R&D into commercial technological products and services.

The TIA has the task of exploiting existing knowledge in universities and public research institutions and effectively channelling it to the development of technology-based companies.

Chinese Northern Technology Exchange Market (NTEM) - China

NTEM is one of the most important technology transfer centres in China, set up jointly by the Chinese Ministry of Science and Technology and the municipal government of Tianjin.

NTEM hopes to strengthen reciprocal cooperation with scientific and research institutions, companies and other technology transfer centres in the country and abroad to promote the efficient identification, management, development and commercialisation of marketable research and technologies.

Example

Australia

The public research organisations are responsible for financing their technology transfer activities. There are two main models:

- › Constitution of an external company. In which the income is generated from a variety of related business activities: consultancy, conferences and professional development courses. Also, to support the organisation's technology transfer function.
- › Establishing an institutional internal department/office. The organisation provides funds directly to the KTO, which is responsible for the central administrative functions of the organisation.

India

There are organisations that interact with industry. These are autonomous organisations created with seed funding provided by the state or thanks to the funds assigned by a board of governors of the university or a research institute.

In all these cases, this support is only provided for a limited time. The income comes from taxes imposed by business development activities. In addition, each centre generally receives a percentage of the income from royalties of the technology transfer transactions.

Japan

University KTOs are approved by the government. During the first five years, two thirds of the funds are provided by the government, and the rest by the university. This subsidy is extended to a portion of the operational costs of the technology transfer.

A certain number of Japanese KTOs have created profit-making associated companies to facilitate creating spin out companies in which the investment comes from members of staff, as part of an expansion strategy.

China

Most of the public research organisations in China have a KTO. Many of them function as associated private companies, which are the exclusive property of the corresponding university and received initial support of university funds.

The KTOs, often called technomarts; are highly active in business development services: the creation of business incubators, assessment on creating business plans and help in developing the requirements of the spin out companies. They also manage participation in university spin-out companies.

Example

South Africa

The Southern African Research and Innovation Management Association (SARIMA) was formed in 2005 to take on the main role in the national efforts to develop research and innovation capacities. SARIMA receives support from the government, from participating academic institutions and from philanthropic donors from the United States and Europe.

It also has an Innovation Fund to promote technological innovation (of the 100 projects in which it has invested, most have generated patents and spin out companies).

There is also the Innovation Fund Commercialization Office (IFCO), a central office that offers support in protection and commercialisation of intellectual property rights of all the public research organisations in the country. IFCO complements the existing KTOs.

United Kingdom

Various universities have created independent companies for commercialising intellectual property, above all innovations that they feel might have the potential to serve as a base for spin out companies.

Most universities also have internal KTOs that can closely collaborate in developing relations with industry. The growth and development of the KTOs has been stimulated, more recently, through direct financing by the government of the universities so that they can develop this activity, based on several criteria.

All the examples given above show the great variety of KTO models in different parts of the world. Each model has evolved to adapt to the cultural, political and economic conditions of the corresponding country. Despite the differences, there are two features that most of the models have in common: on the one hand, the KTO is usually assigned a percentage of the income for the commercialisation of the innovations and, on the other hand, it is expected that, over time, the KTO becomes self sustainable.

7 Diagnosing the Innovation Ecosystem: Governments, Universities and Companies

From the end of the 20th century, universities and public research institutions have notably increase their knowledge transfer activities, in line with the so-called "third mission", which is added to teaching (first mission) and research (second mission). In the economic model of the knowledge-based society, the products and services of this economy come, to a great degree, from innovation activities, whether technological or of another kind. As has been said, innovation is a complex reality and does not have a linear, autonomous process. The generation of knowledge, its dissemination and it's learning constitute a basic pillar of innovation processes.

The concept of "innovation systems" is important to understand the modelling of innovation. They are fields in which diverse players develop and interact (researchers, businessmen, financiers, the administrations, among others). Normally, these systems require proximity to develop, which is why they are formed in local ecosystems. In a knowledge-based society, as we have seen, university, industry and government have complementary functions, forming a triple helix in stimulating innovation. The interactions generate an important flow of knowledge exchange and transfer which has developed and changed to the requirements of use, adapting to the legal and economic conditions to be able to be used, respecting the rights of all parties. The interactions also generate relational capital based on the creativity that arises from the exchange of ideas and their specification on new economic activities.

Industry takes on a prominent role in training, research and development, often at the same level as universities. If knowledge-based industries are needed, university-government interactions can help with their creation and, if they are present, can help to expand their growth. The benefits of knowledge transfer, understood to be the exploitation of research carried out by university research groups, goes beyond simple economic benefit and must be evaluated long term. Even in the United States, where knowledge transfer is more developed, only a small part of this activity generates benefits.

Opinion

F. Xavier Gil

Deputy Vice Chancellor of Scientific Policy
Universitat Politècnica de Catalunya

“The social appraisal of the task of knowledge transfer as personal merit and that of the research group has meant a very significant impulse for the third university mission.

Knowledge transfer can be stimulated from university policies promoting meetings between companies and researchers and facilitating the application of the research, as the driving force behind innovation, to the business fabric to create wealth and social well-being.”

The real gain comes from other less tangible benefits for the university, for industry and for society as a whole. Below, we quote some benefits as an example:

- › The development of mutual confidence between universities and industries is beneficial for setting up long-term strategic alliances.
- › The analysis and development challenges proposed by society through research and the updating of teaching programmes.
- › The improvement of research and training activities based on skills and techniques developed in industry and better knowledge about the market needs and the problems of industry.
- › The increase of the university's prestige.
- › The identification of potential clients or new partners for future research.
- › Attracting, retaining and motivating talented scientists interested in business aspects or in new professional opportunities.
- › The increased socioeconomic value of public funding of research.

The analysis of the peculiarities of the university and its environment, validating the triple helix model, is the preliminary step in the strategic definition process to introduce an efficient transfer system in universities. We should not forget that knowledge spillover, which we have already mentioned, is closely linked to the territorial area as there is a tacit component of knowledge that requires frequent, repetitive interaction. The document *Knowledge for African Development* (KAD) also states this:

Innovation needs to be understood as fundamentally involving high levels of interaction between a range of people; innovation is not done in isolation. Innovation cannot be determined mechanistically; it needs to be nurtured so that it may emerge organically from a fertile environment. Innovation is related to its context: what is new in a particular context and has an impact is innovative, even if it has been done elsewhere. For instance, it must be nurtured at various levels, and in a way that is not only sensitive to its context, but that turns its context into an advantage. So, making careful use of indigenous knowledge and harnessing the possibilities of local conditions is key.

Opinion

Josep Clotet

Managing Director of the Lleida Agri-Food Science and Technology Park
Universitat de Lleida

“The huge size of the installations and an inexact definition of our public objective delayed the optimisation of the activity.

The kind of users that the park have are, basically, highly innovative micro and small enterprises.”

Therefore, in order to be efficient and achieve suitable introduction, it is important to carry out a key diagnosis of the territorial ecosystem and to adapt the knowledge transfer model to its specificities. To facilitate this analysis, below a set of features is listed, all of which are dealt with in this document, about which information needs to be compiled, grouped into three levels (favourable environment, capacities and financing) in each of the spheres that make up the triple helix (governments, companies and universities).

7.1 Governments

Knowledge transfer at a national or regional level potentially has a heavy impact on local development, through the creation of new jobs, new market products and better education. Universities, with their research units and companies, which use the knowledge generated by the research units and launch the various innovations onto the market as products, services or processes, are mainly responsible for this. Nevertheless, we should not forget the relevant role that various public administration levels play in promoting the quality and intensity of the transfer processes. Above all, by establishing the framework conditions suitable for promoting innovation. This is why national innovation system development policies should go beyond financing and supporting innovation activities; they must state the significant role of the public administrations in the success of the innovation ecosystem. The innovation system is made up by a complex network of subsystems (local, municipal, provincial, and regional), each with a specific function. Therefore, to manage the innovation system, we need to identify the main players that take part in it and to define the organisation of the innovation subsystems.

The role of governments in the knowledge transfer framework is, therefore, that of generating public policies that promote a favourable environment for carrying out activities related to it. In this way, the government should define the strategic pillars of its public policies to promote research and innovation, the priority areas for executing them and the instruments available to do so. The existence of a state strategy in science, technology and innovation, with a vision for the long-term innovation system, favours the alignment of the entire value chain of the innovation and allows for medium- and long-term planning in keeping with the territorial needs. The government should also take responsibility for this strategy and for the lines of action that will lead to its introduction. As well as its evaluation and follow-up, it is also important that the government should detail the support to public-private research and innovation activities, as well as the efficient management of the research results and their exploitation, explaining, at the same time, support to innovation in companies, particularly in SMEs, both with regard to innovation in products and technological processes as well as organisational or commercial innovation. Finally, it is also important to provide a regulatory legal framework that allows innovation to be stimulated and to make it compatible with international standards, setting the regulations that facilitate the transfer processes, with a state regulation on intellectual and industrial protection that is well defined and implemented, fiscal incentives for innovation and for risk capital.

Opinion

Josep Jofre

Deputy Manager of the Research and Economics Area
Universitat Pompeu Fabra

“To be able to make a qualitative leap ahead in the area of commercialising research, shared structures need to be created between universities, made up of experts in the various areas of knowledge or highly familiar with the international market.

The main factors to be taken into account for constructing a good knowledge transfer system include having incentives in the system that value the transfer activity and having a financing system for the appraisal phase of the project.”

Pere Condom

Director of the Science and Technology Park
Universitat de Girona

“Universities must provide the suitable context so that their researchers can take on the knowledge transfer function with freedom and decision. This involves three things: stimuli, support services and clear, precise regulations.

One of the main factors to be taken into consideration for constructing a good knowledge transfer system is that the research should be organised in such a way that market opportunities can be identified quickly.”

In addition, public policies should develop skills in research and innovation, whether technological or not, in universities, research centres and in companies, especially in SMEs. To achieve this objective, the government should support universities' dedication to research and knowledge transfer. It can do so by incentivising clear but realistic strategies in the university, favouring greater comprehension by researchers concerning the needs

of industry and the appraisal of the results of the research and involvement in commercialisation actions. It should also improve the financial resources for KTOs and their ability to manage the intellectual property rights produced by the researchers. This can be done, for example, through financial rewards to the university for the use of university inventions by industry. Another of the aspects to be prioritised is promoting agents which, due to proximity, facilitate the innovation and dissemination of knowledge, such as science parks and technology centres. This can be done through managing quality infrastructures, specific advanced services in knowledge transfer or specialist physical spaces that facilitate the interaction between research centres and companies and provide value and competitive advantages to their users (universities, research centres and companies).

Continuing with the actions that the administration could develop at all levels to support knowledge transfer, we should highlight promoting the creation of associations that arouse business interests and efforts, such as clusters and networks. It should also support empowerment and lifelong training of workers and businessmen, in keeping with their needs, as well as develop the ability to innovate and the entrepreneur spirit of individuals, communities and all the sectors of society. People and communities are innovative by nature, but a great deal of this innovative spirit is lost if the environment is not favourable. Therefore, we need to develop the cultural and behavioural aspects

and the motivation necessary to stimulate innovation, through identifying and promoting services and incentives that stimulate the introduction of the entrepreneur spirit and of the innovative culture in all areas of society. Finally, the public administrations need to align their financial ability with the objectives described previously in order to facilitate R&D activities, both by the public as well as the private sector, that enable innovative activities in the initial stages to be developed (prototypes, proof of concept or creation of companies) and to align private financing agents from the environment (seed capital and risk capital) with this strategy.

Opinion

Màrius Rubiralta

Former General Secretary of Universities of the Ministry of Education

“The combination of nearby transfer structures and central structures of commercialisation and appraisal of the results of the knowledge should be promoted that take into account the opportunity to foster public and private cooperation.

New organisational models that favour coordination policies and the concentration of efforts should be analysed.”

Guillermo Ricarte

Director
Crea Futur Foundation

“The key for a good system of knowledge transfer is, on the one hand, guaranteeing the protection of the intellectual property of the research and, on the other hand, developing a project that can be commercialised with a market vocation.”

1	Governments
1.1	Favourable Environment
1.1.1	There is an explicit policy in the national development plan and in the yearly governmental budgets.
1.1.2	There are multi-annual research and innovation plans.
1.1.3	There are specific government positions for research and innovation.
1.1.4	There are governmental organisations or ones that depend on the public administration assigned the responsibilities for promoting and fostering innovation and knowledge transfer activities.
1.1.5	There is support to guided research.
1.1.6	There are policies to promote the dissemination of capacities in research and innovation and research results, that can be freely accessed, generated by the public sector for their use by agents of the innovation system, as well as for their protection.
1.1.7	There are policies to support the management of innovation and the appraisal of knowledge for the implementation of evaluation and protection processes of the research results and to establish appraisal units in public research organisations.
1.1.8	There is a support system to the commercialisation of the research and innovation.
1.1.9	There is explicit support to technological and non-technological innovation.
1.1.10	There are metrics to get to know the innovation climate and to do a follow-up on the impact of the innovation policies.
1.1.11	There is state legislation on intellectual and industrial protection that is well defined and implemented, compatible with international detection strategies and a simple patent process.
1.1.12	There is state legislation referring to intellectual and industrial property rights that favours and motivates inventive activity and knowledge transfer by university staff (as employees) and by universities (as employees).
1.1.13	There is state legislation that favours and motivates the participation of university staff in activities with the private sector.
1.1.14	There are policies that promote the incorporation of the innovative culture and entrepreneurship as a transversal skill at all education levels.
1.1.15	The creation of mixed structures for public-private collaboration will be promoted, such as Associations of Economic Interest.
1.1.16	There are policies that promote "innovative public purchase" in the different areas of the administration.
1.1.17	There are policies to promote entrepreneurship.
1.1.18	There are policies to promote industrial growth and competitiveness.
1.1.19	There are positive discrimination policies for SMEs.
1.1.20	There are programmes to detect innovative entrepreneurs.
1.1.21	The government offers facilities for starting up new businesses.
1.1.22	There are active policies to eliminate difficulties for SMEs and entrepreneurs.
1.1.23	There is a single window for information and recommendations.
1.1.24	There are initiatives to reduce administrative charges.

1.1.25	There are reduced taxes or fiscal incentives for entrepreneurship.
1.1.26	There are fiscal incentives to promote the investment of venture capital in new companies.
1.1.27	Mentoring programmes are promoted for new business adventures.
1.1.28	There are policies to promote business incubators.
1.1.29	There are policies to motivate university staff to create spin-off companies.
1.1.30	There is state legislation that favours and motivates university entrepreneurship (academic spin-off).
1.1.31	There are quantitative and qualitative objectives to increase spin-off companies and new innovative start-ups.
1.1.32	Forums and networking activities are promoted.
1.1.33	There are special initiatives for target groups (young people, women, jobless people, etc.).
1.2	Capacities
1.2.1	There are programmes to promote excellence groups/centres in research and innovation in universities and public research organisations.
1.2.2	There are programmes that encourage the incorporation of university staff into research and innovation activities.
1.2.3	There are programmes that facilitate and recognise talent hunting and retaining in universities.
1.2.4	There is an evaluation of universities' effort, linked to incentives for institutions, which incorporates the results in knowledge transfer and links with industry into the evaluation criteria.
1.2.5	There are research exchange programmes between universities and industry.
1.2.6	There are programmes for training doctors in industry (internships).
1.2.7	There are programmes for training research staff aimed at improving the understanding of IPR and the benefit involved in their involvement in activities to appraise and commercialise research results, for the university and for society.
1.2.8	There are economic or academic (linked to their professional career) incentive policies for university staff in R&D, depending on the activity done and the results obtained.
1.2.9	There are programmes to support knowledge transfer management in universities.
1.2.10	There are programmes for developing organisations that facilitate transfer actions (science parks, technology parks, technology centres, business incubators).
1.2.11	There are programmes for developing industrial competitiveness linked to formalising clusters and networks in keeping with business needs and their business model.
1.2.12	There are policies for training SMEs personnel.
1.2.13	There are programmes to develop entrepreneur capacities, in all the social segments.

ABOUT THE GUIDE

THE UNIVERSITY IN AFRICA

THE ENTREPRENEUR UNIVERSITY

INTRODUCTION OF A KNOWLEDGE TRANSFER SYSTEM

APPRAISAL PROCESS: PRACTICAL RECOMMENDATIONS

KNOWLEDGE TRANSFER OFFICES

DIAGNOSING THE INNOVATION ECOSYSTEM: GOVERNMENTS, UNIVERSITIES AND COMPANIES

1.3	Financing
1.3.1	There is a specific budget for research and innovation policies.
1.3.2	There are tax incentives to promote research and innovation activities in companies.
1.3.3	There are policies to help SMEs access credits and subsidies linked to innovation actions and improving competitiveness.
1.3.4	There are lines of public financing to support innovation activities, particularly for states of development furthest from the market.
1.3.5	The government has policies to increase the financing of the initial phases of innovation projects and entrepreneurialism.
1.3.6	There is a budget for programmes for training in innovation.
1.3.7	There is a budget for programmes for training business people.
1.3.8	There are efficient micro-financing programmes.
1.3.9	There is support for networks of business angels/investors.
1.3.10	There is a public risk capital fund.
1.3.11	There is a secondary stock market.

7.2 Universities

As we have seen, universities are one of the key agents in the system for offering solutions to the future competitiveness of production and to an improved quality of life. In keeping with the International Association of University Technology Managers (IAUTM), there are four main reasons why public research organisations, including universities, should promote academic technology transfer: to facilitate the commercialisation of the results of the research for the public good; to reward, retain and recruit top-quality researchers; to create closer links with industry and to generate income and promote economic growth. For this, universities must construct a favourable environment for knowledge transfer activities, develop their capacities in research and innovation and guarantee the availability of economic resources that make a strategy to motivate knowledge transfer feasible. To do this, it will be necessary to analyse and diagnose the favourable environment in the university, as well as the capacities and financing available.

In this respect, the way in which knowledge transfer policies are inserted into the general context of the university is fundamental, as the leadership of the policies and operations of the knowledge transfer programmes and of the interaction with companies must be directed from the maximum governing body. So that the policies are effective, there will need to be resources (economic, material and human) which will need to be placed

Opinion

Júlia Prats

Assistant Professor at the Department of Entrepreneur Initiative
IESE Business School

“Public policies are needed that promote the excellence and dissemination of knowledge, providing not just economic support but also, for example, identifying top-quality centres and making them visible.”

at the service of the activities to be developed. Due to the fact that these resources are limited, and often scarce, even more importantly, lines of action suitable to the objectives to be achieved must be designed, which prioritise their use and follow up on the results obtained. From this point of view, universities must have an institutional strategy that clearly defines the objectives set in R&D and knowledge transfer matters, the actions envisaged and the priority strategic R&D areas for the institution. Therefore, the institutional strategy should align priorities with capacities in R&D and knowledge transfer, both internal and external, and incorporate a system for analysing the results, with the aim of evaluating the efficacy of the actions carried out.

This strategy will be a reflection of the university governing bodies' commitment to R&D and knowledge transfer and must therefore be public and notified to the entire university community. On the other hand, the definition of a management policy for the intellectual and industrial property as a result of the institutional research must be at the centre of the institution's policy, dealing with aspects that are crucial to the success of the knowledge transfer programmes. In this respect, it must be guaranteed that the interventions can be easily identified and, if necessary, protected (communication of inventions policy). The capacity and the university's stock of knowledge must be disseminated in order to promote its exploitation. At the same time, it must manage, protect and promote the exploitation of intellectual property rights, based on the research results obtained with public funds or in collaboration with companies. It is important to bear in mind that these policies must also have regulations applicable to the personnel that do not directly form part of the institution, such as students or visiting lecturers.

Opinion

Jordi Vinaixa

Academic Director of the ESADE
Entrepreneurship Institute
ESADE Business School

“Public policies are needed that favour access to the academic activity of professionals in industry/business and that facilitate university academic staff being able to have periods of professional activity in the world of industry.”

Other key aspects to be dealt with, concerning the management and exploitation of knowledge are, for example, the use of research results financed with public funds, including the creation of spin-off companies and the definition of the participation policy in these companies. Possible conflicts of interest related to the staff involved in the knowledge activities must also be defined, foreseen and helped to identify in order to guarantee that the scientific objectivity of the university and the academic independence are not affected and that the research of the institution does not involve activities that come into conflict with its missions and basic values. It must also define a distribution of the net benefits derived from income through royalties, assign the responsibility for the management of the corresponding unit], and introduce the evaluation and effort process of the units responsible for knowledge management.

One aspect to be taken into account, in view of the fact that knowledge transfer is, in short, an activity carried out by individuals, is incentives. These will be a key feature to be considered in promoting a knowledge transfer system. The university must develop and communicate mechanisms of incentives that are clear and transparent so that the academic and non-academic staff actively participate in knowledge transfer. These incentives should not only be economic, they may also be of another kind. Some examples of this modality could consist of promoting the development of their academic career or the availability of financing to develop their R&D and knowledge transfer activities. In other words, to offer facilities for greater dedication to these activities as opposed to other responsibilities, such as teaching. The incentive policy must be defined in such a way that it reflects the performance generated (including non-economic returns for the university), but which, at the same time, does not have an undesired influence on guiding the university research towards research applied to short-term scenarios. In short, there must be mechanisms to stimulate the participation of researchers in this kind of activity, subject to a preliminary process of evaluation.

Institutional policies should, in addition, actively favour the participation of researchers in collaboration activities with the private sector, making this collaboration an agile, transparent process, as well as stimulating an environment favourable for the development of the entrepreneur spirit and an innovative culture. As we have seen, research and knowledge transfer are activities that are closely related. Knowledge transfer is possible, among other factors, thanks to the results of research and the experience acquired by researchers in their R&D activities. A solid knowledge transfer system cannot exist if the university does not have solid lines of research. The solidity of the research depends on existing capacities, in terms of quantity and quality. Therefore, the university must develop its capacities through favouring internal structures with dedication to R&D and knowledge transfer, and be able to attract and retain it.

Opinion

Cristina Horcajada

Head of the Technology Transfer Office
of the Institute of Biomedical Research

“To facilitate the commercialisation of the knowledge that is produced in universities, we need a flexible legislation, the support of specialist staff and a professional, agile management system.

To start and develop an entrepreneurial project in the University, it must be able to organise a multidisciplinary team of people that complement each other thanks to their technical and business capacities.”

Opinion

Xavier Ferràs

Director of the Business Innovation Centre
ACC10

“By introducing a strategic plan for knowledge transfer from the administration, one of the main factors of success is to guarantee the financing of the research groups, offering support to activities that the university does not implement, such as commercial promotion, for example, with a long-term view of stability.

The private sector will absorb the technology generated in the university if, and only if, two conditions are met: a) that this technology generates competitive advantages and b) that the company has "absorption capacity". ”

Jordi Marquet

Director of the Research Park
Universitat Autònoma de Barcelona

“One of the main difficulties that university researchers come up against when commercialising their knowledge is, in many cases, the lack of suitable instruments for transferring and disseminating knowledge to the market, and the intermediation and support in negotiations with businesses or institutions.

Preparing "entrepreneur researchers" to face the world of business and markets is one of the key factors to help them initiate and develop an entrepreneurial project. ”

In addition, knowledge transfer is based on the communication process and therefore requires a transmitter, a receptor, a message and a codification system. Management capacities in R&D and knowledge transfer will also be a key feature as they represent the codification system. In other words, professionals with skills in diverse areas involved in knowledge transfer and able to translate from science to the market and vice versa, as well as knowledge about the necessary relation channels between academia and industry. Apart from this, a parallel awareness-creation task, training and integration of the business community in joint motivation bodies with the academic community is fundamental to stimulate entrepreneurship. To favour all these capacities, universities may provide economic programmes of their own to support the research, innovation and entrepreneurship activities of their research groups. These programmes are introduced following the priorities established in the university strategy and in keeping with criteria of excellence and results obtained.

2	Universities
2.1	Favourable Environment
2.1.1	There is an institutional strategy, in the form of a formal document, that explicitly incorporates research and knowledge transfer into the productive environment as one of the university's missions.
2.1.2	There is an institutional strategy that determines the priority strategic areas of R&D&I of the institution. By priority area we understand scientific foci of main interest of the university that help to prevent the dispersion of activities.
2.1.3	The priority strategic areas of the university's R&D&I are backed by specific scientific capacities. By scientific capacities, we understand the availability of human R&D resources, of sufficient scientific infrastructures and the generation of knowledge from a qualitative and quantitative point of view.
2.1.4	There is a mechanism for assessing and following up on the effort of the university in the knowledge transfer activity.
2.1.5	The institutional strategy is adopted by the university's maximum governing body, is made public and is notified to the entire university community.
2.1.6	There are mechanisms to facilitate the identification, protection of research results and their licensing to companies.
2.1.7	They are own lines of actions for disseminating the capacities and the results of R&D&I and for their use by the agents of the innovation system, as well as for their protection.
2.1.8	There are internal regulations referring to the management of IPR that favour and promote inventive activity and knowledge transfer of university staff, prevent situations of conflict of interest and describe the division of the net benefits derived from its exploitation.
2.1.9	The responsibility for managing the transfer function is clearly assigned.
2.1.10	There is an assessment and follow up mechanism on the effort of the units responsible for the transfer function.
2.1.11	There are incentives to the university staff's R&D activity, for example through economic recognition or that of another kind, based on evaluations by means of defined procedures.
2.1.12	There are incentives to the university staff's knowledge transfer activity, for example through economic recognition or that of another kind, based on evaluations by means of defined procedures.
2.1.13	There are defined evaluation procedures on the research activity of the university staff. By defined evaluation procedures we understand those that allow for the analysis of the quantity and quality of the research carried out by the researchers (for example, the number of publications indexed, number of quotes, H-index, co-authorship, international collaborations, etc.).
2.1.14	There are defined evaluation procedures on the transfer activity of the university staff. By defined evaluation procedures we understand those that allow for the analysis of the quantity and quality of the activities developed by the researchers (for example, the number of interventions communicated, patents applied for, income from patents being exploited, creation of companies, etc.).

2.1.15	There are active policies that facilitate the collaboration of university staff with the economic sector. By collaboration we understand the execution of consultancy contracts, technical assessment and contracted and/or collaborative research.
2.1.16	There is an internal regulation that governs the participation of research staff and of visiting lecturers in R&D&I activities, particularly with regard to confidentiality and rights of the research results.
2.1.17	There is an internal regulation concerning the prevention of conflicts of interest of the university staff in their relations with the private sector.
2.1.18	There are programmes that promote and facilitate the incorporation of researchers into companies.
2.1.19	There are mechanisms of public-private collaboration, such as the creation of mixed structures, for example Associations of Economic Interest.
2.1.20	There are mechanisms of stable relations between the university and the government that permit knowledge transfer policies to be dealt with and debated.
2.1.21	There are mechanisms of stable relations between the university and the business community (by stable mechanisms, we understand forums, symposiums, etc.).
2.1.22	There are relations with private investment entities (seed capital, business angels and venture capital) and financing (banks).
2.1.23	There are active policies that promote the creation of technology-and knowledge-based companies by university staff. These policies facilitate and promote the creation and the participation of researchers in newly created companies based on results of research and promote their collaboration to facilitate their growth.
2.1.24	There is an internal regulation that governs the creation of technology-and knowledge-based companies by university staff.

2.2	Capacities
2.2.1	There are staff that have been specifically contracted to carry out R&D activities.
2.2.2	There are human resources, with training and experience, dedicated to managing the research.
2.2.3	There are stable research structures (research groups, research centres, etc.).
2.2.4	The research task requires a superstructure that goes beyond the individual researcher and that promotes the multidisciplinary and transversal nature of knowledge, to facilitate networking.
2.2.5	There are programmes to promote the internationalisation of teaching and research. The internationalisation effort involves a process of continuous improvement of the teaching and research quality, in as much as it generates a two-way transfer that keeps the internal evolution connected with the typical dynamics of an industry of globalised knowledge.
2.2.6	There are programmes for hunting and retaining talent, based on criteria of excellence and in line with the priority strategic areas of R&D.
2.2.7	There are human resources, with training and experience, dedicated to managing knowledge transfer.
2.2.8	There are management procedures and tools for notifying about inventions and their dissemination.
2.2.9	There are management procedures and tools for appraising the results (analysis of patentability, market studies, competitive advantages, etc.).
2.2.10	There are management procedures and tools for commercialising the technological and knowledge offer.
2.2.11	There is a stock of knowledge and patents.
2.2.12	There are tools for creating awareness in the university community about knowledge transfer and entrepreneurship activities.
2.2.13	There are programmes for training entrepreneurs.
2.2.14	There are courses for training SME staff.
2.2.15	The teaching staff have been specially trained in transmitting knowledge in entrepreneurship.
2.2.15	The business community collaborates in training entrepreneurs.
2.3	Financing
2.3.1	There are own financing programmes for R&D activities for university research groups.
2.3.2	There are own programmes for financing the appraisal and commercialisation processes of the research results.
2.3.3	There is an instrument for the participation of the university in the spin-off companies created.
2.3.4	There are programmes to offer economic support to the growth and internationalisation of their spin-off companies.

7.3 Companies

The company is the receiver of the knowledge transfer and must be capable to create value with the knowledge acquired. Knowing the quantity and quality of the companies that make up the business fabric of the territory permits us to focus our strategic plan. If this information should not exist, a detailed study of the economic structure must be carried out, with the aim of identifying the sectors and companies that will help in the projects to be promoted. The improvement of the relations between large companies and SMEs is a very slow but very useful task which, in the long term, generates a confidence that allows large companies to share strategies and lines of innovation with business realities of a smaller size. In addition, an evaluation of the logistical infrastructures (roads, ports, railways, and others) and communication infrastructures will allow us to anticipate future problems of saturation and collapse.

Business cooperation has also been revealed as one of the most important pillars of competitiveness of the territory. In this respect, business associations (boards, chambers of commerce) play an important role as a driving force behind the business union in defence of its interests and behind support to the most necessary policies. One example of this is the case of internationalisation, in which the companies require significant

infrastructures and support which often requires a lobbying action by the associations. In many cases, these associations may help to create mechanisms to facilitate the strategic analysis of the SMEs, a task which normally shows the strengths of the company and contributes to rebalancing it. All this environment helps SMEs to become part of the internationalisation, innovation and entrepreneurship tasks. Therefore, in the case of an ecosystem that is sensitive to business controversy, it is important that the government should intervene in creating support policies and to be very aware of the financial entities that specialise in new business adventures. One should not forget that the first requirement for obtaining a favourable environment for entrepreneurship is the existence of the necessary financial capital to allow the growth of the new company and its different phases.

The company requires a capacity to transform knowledge into value. And the company is made up of people who must have the capacity to absorb and specify the flow of knowledge. A company which incorporates staff trained at university in its organisation is a company that manages to establish a more fluent relation with the world of research. If, in addition, this staff has a doctorate level, this capacity crystallises in a possibility to generate its own knowledge within the organisation. The empowerment and talent of the internal team allow effective collaboration channels to be sought with the university in R&D&I tasks. Tasks that must become stable and growing. To empower staff in an increasingly more specialised world, it is a good idea to have specialist organisations in training in innovation management and in training for entrepreneurship.

Opinion

Antoni Cañete

Secretary-General

Micro, small and medium enterprises of Catalonia (PIMEC)

“Public policies need to be created that facilitate creating synergies between companies and that share knowledge and projects with the aim of minimising costs and creating opportunities for collaboration.”

Ricard Jiménez

Technical Director

Catalan Association of Moulds and Matrices (ASCAMM)

“Knowledge transfer should not be focused on projects, but the talent of researchers as the main instrument. The migration of researchers with talent from universities to companies will provide good projects.”

For lower levels, professional training is basic and the existence of good schools is vital for empowering new generations. These schools should not be far removed from the university orbit, as there must be a system logic led by them. In the same way, the exchange of experiences is an important tool for advancing in the field of information and entrepreneurship. The possibility of making forums in which university-company experience is debated allows for a benchmarking between elements of the territory and diverse players. The existence of infrastructures to support innovation, such as technology centres, laboratories or engineering companies, acts as an effective interface in processes in which innovation must be taken to the productive system. In this case, the alliance with professional experts in the day-to-day running of the company will facilitate the innovation process. As a starting point, it is important to know the innovation management in the companies of the territory and to count on suitable metrics to be able to follow the advances to be achieved over time. It is recommended to carry out this initial evaluation from the point of view of entrepreneur capacity, trying to measure up to what point there is a collective that has the ability to lead an entrepreneurial project. In addition, the financial analysis must value the feasibility of the theoretical approach. The existence of a financial market accessible to SMEs that enables them to carry out their innovation or entrepreneurship projects is a fundamental item. Normally, this is one of the weakest points in the chain and requires special effort to incorporate and involve the financial sector right from the beginning.

3	Company
3.1	Favourable Environment
3.1.1	<p>Favourable environment for innovation</p> <p>There is a significant, consolidated business fabric of micro, small and medium enterprises. The critical mass is important for generating open innovation policies.</p>
3.1.2	<p>There is a study of the economic structure of the territory in which knowledge transfer may take place. Good cartography allows the definition of innovation activities to be improved.</p>
3.1.3	<p>There are strategic industrial sectors for the development of the territory. The presence of these sectors may act as a driving force for the rest of the sectors.</p>
3.1.4	<p>There are high-growth emerging business sectors. This kind of company usually bases its competitive strategy on innovation.</p>
3.1.5	<p>There is a fluid relationship between large companies and SMEs. Large companies, with greater strategic capacity, act as a guiding element of micro-policies in innovation for the SMEs in the territory.</p>
3.1.6	<p>There are the necessary logistical and communication infrastructures for industrial development. An essential feature of territorial competitiveness.</p>
3.1.7	<p>There are associations that bring together companies, by sector or territory (chambers of commerce, guilds, boards, etc.).</p>

3.1.8	There are infrastructures that support the internationalisation of companies.
3.1.9	There are instruments that facilitate the strategic analysis of the companies that wish to innovate.
	Favourable environment for entrepreneurship
3.1.10	The company finds infrastructures that support the creation of companies and the acceleration of businesses.
3.1.11	The company finds governmental support for the entrepreneurship.
3.1.12	There are organised networks and structures for accessing risk capital (business angels and venture capital).
3.1.13	There is sufficient financial capital to tackle new businesses.
3.2	Capacities
	Capacity for innovation
3.2.1	There are companies that habitually include university trained personnel on their staff.
3.2.2	There are companies that incorporate doctors in their work profiles.
3.2.3	There are companies that regularly participate in R&D&I activities with the university.
3.2.4	There are organisations dedicated to training in innovation management, whether technological or non-technological, and entrepreneurship.
3.2.5	There are forums for participation in which companies state the training needs for their work profiles.
3.2.6	There are support infrastructures to business innovation such as technology centres or laboratories.
3.2.7	There are education organisations and professional and technical training programmes in line with business needs.
3.2.8	There is internal knowledge in companies about innovation management.
	Capacity for entrepreneurship
3.2.9	There are a suitable number of people with the ability to lead an entrepreneur project.
3.3	Company - Financing
3.3.1	Financial market accessible to SMEs to undertake R&D&I activities.
3.3.2	The entrepreneur finds facilities for obtaining financial resources.

8 Bibliography and resources

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Resources

- › Association of European Science and Technology Transfer Professionals (ASTP) <http://www.astp.net>
- › Association for University Research and Industry Links (AURIL) <http://www.auril.org.uk>
- › Association of University Technology Managers (AUTM) <http://www.autm.net>
- › Partnerships for Research and Innovation (UK) www.auril.org.uk/publications/pfrai
- › ProTON Europe <http://www.protoneurope.org>
- › RedOTRI Universidades <http://www.redotriuniversidades.net>
- › Technology Innovation International (TII) <http://www.tii.org/>

9 Acronyms

ACCD: Catalan Agency for Development Co-operation

ACUP: Catalan Association of Public Universities

AECID: Spanish Agency for International Development Co-operation

CeSTII: Center for Science, Technology and Innovation Indicators

CIGU: Interuniversity Consortium of University Management

CSIR: Council of Scientific and Industrial Research

DIGU: Institutional Development and Training in University Management Project

EPO: European Patent Office

FTE: Full Time Equivalent

HSRC: Human Sciences Research Council

IAUTM: International Association of University Technology Managers

IFCO: Innovation Fund Commercialization Office

IPR: Intellectual Property Right

KAD: Knowledge for African Development

KT: Knowledge Transfer

KTO: Knowledge Transfer Offices

MDG: Millennium Development Goals

NTEM: China's Northern Technology Exchange Market

OECD: Organisation for Economic Co-operation and Development

OEPM: Spanish Patent and Trademark Office

PCT: Patent Cooperation Treaty

R&D: Research and Development

R&D&I: Research, Development and Innovation

RedOTRI: Research Results Transfer Offices Network for Spanish universities

SARIMA: Southern African Research and Innovation Management Association

SMEs: Small and Medium Enterprises

TIA: Technology Innovation Agency

TRS: Teaching and Research Staff

TT: Technology Transfer

TTO: Technology Transfer Office

UAB: Universitat Autònoma de Barcelona

UB: Universitat de Barcelona

UdG: Universitat de Girona

UdL: Universitat de Lleida

UNESCO: United Nations Educational, Scientific and Cultural Organization

UOC: Universitat Oberta de Catalunya

UPC: Universitat Politècnica de Catalunya

UPF: Universitat Pompeu Fabra

URV: Universitat Rovira i Virgili

USPTO: United States Patent and Trademark Office

