Handbook on good practices for valorisation of R&D results

Transpyrenees Action on Advanced Infrastructures for Nanosciences and Nanotechnologies

TRAIN²

GT5 – Transfer mechanisms of nanotechnology R&D results in industrial environment

UE/EU - FEDER/ERDF

Contents

AUTHORS:

Miryam Asunción
CIC nanoGUNE

Joan Bausells
CNM-CSIC

Jordi Reverter
ICN

José Antonio Romero
UNIZAR-INA

Pascale Thévenod
LAAS-CNRS

1

Introduction

The Trans-Pyrenees Action on Advanced Infrastructures for Nanosciences and Nanotechnology (TRAIN^2) project aims to establish SUDOE region as a leading environment for research, innovation, and training in the fields of nanoscience and nanotechnology through several activities:

- Sharing capabilities (network of research infrastructures)
- Boosting knowledge (collaborative research projects)
- Investing in people (training strategy)
- Exchanging good practices (technology transfer & Entrepreneurship)

This handbook compiles the outcomes issued from the workpackage 5 (GT5) dedicated to transfer mechanisms of nanotechnology R+D results in industrial environment. The aim of the GT5 activities is to share the expertise of all the partners about technology transfer (TT) in order to reinforce the connections and fill the gap between Research Agents and Industry of each region. Six institutions from different SUDOE regions shared their expertise in TT. The diversity of these partners has enabled fruitful exchanges about the respective practices.

In this introduction, we briefly describe each of the institutions whose practices are at the origin of the results presented in the following chapters, that is: UNIZAR-INA (Spain, Aragon), CIC nanoGUNE (Spain, Basque Country), ICN (Spain, Catalonia), CSIC-CNM (Spain, Catalonia) and CNRS (France, Midi-Pyrenees). Finally the aims and scope of the handbook are summarized.

UNIZAR-INA – Spain, Aragon

The Institute of Nanoscience of Aragon (INA) is an interdisciplinary research institute of the University of Zaragoza (UNIZAR), created in 2003. Its activity is focused on R+D in nanoscience and nanotechnology, based in a multidisciplinary research that covers different fields such as Physics, Chemistry, Materials Science, Biology, Biochemistry and Biotechnology. INA collaborates with companies and technological institutes from different areas. INA's missions include:

- To establish and identify the INA as a reference in nanotechnology research in a national and international level.
- To develop new research lines.
- To train new scientists and technologists in the different research fields.
- To offer its experience and services to Research Centres and companies.
- To support and encourage innovation and technological transfer through contracts with companies and creation of new Spin-offs.
- To disseminate the research results and promote the nanoscience among the general public.

To this end, INA's resources encompass:

- High technology facilities.
- A multidisciplinary research team with excellent training in different fields.
- Collaboration with Research Centres both national and international.
- Collaboration with companies.
- Administration department.
- Technological Promotion Department to be in contact with companies and so fulfil the demands of the market.

CIC nanoGUNE – Spain, Basque Country

CIC nanoGUNE was created in September 2006 with the mission of performing world-class nanoscience research for the competitive growth of the Basque Country, thereby combining basic research with the objective of boosting nanotechnology-based market opportunities and contributing to the creation of an enabling framework to remove existing barriers between the academic and business worlds. Being a Cooperative Research Center, new infrastructures and researchers have been put together, with the aim of opening new areas of strategic research, and, at the same time, NanoGUNE also faces the challenge of fostering cooperation among various research and technological groups in the Basque Country and exploring new models to fill the gap between basic research and innovation.

NanoGUNE's research activity focuses not only on carrying out excellent research, but also on the transfer of knowledge and technology to our industrial environment. Graphenea, the first startup of nanoGUNE, was launched in 2010 and is located at the nanoGUNE building, thereby taking advantage, in a start-up phase, of nanoGUNE's experience, knowledge, and state-of-the-art equipment.

ICN – Spain, Catalonia

The Catalan Institute of Nanotechnology (ICN) is a non-profit international research institute located in Barcelona. It was created in July 2003 by the Ministry of Universities, Research and Information Society of the Catalan Government (DIUE) and the Autonomous University of Barcelona (UAB). ICN's mission is to achieve the highest level of scientific and technological excellence in Nanoscience and Nanotechnology. To this end, research at ICN encompasses:

- Basic science - primarily via European and national collaborative projects, including frontier areas.
- Technology - in areas of in-house expertise and in conjunction with industry.

Therefore, ICN interacts closely with universities, research centres, technology centres, private sector R&D, the scientific community and society in general.

ICN's charter mandates that the Institute engage in:

- the research of new properties of matter that arise from its state of aggregation at the nanometric scale,
- the development of nanoproduction methods, synthesis, analysis, and manipulation of aggregates and structures of nanometric dimension,
- the development of techniques for characterizing and manipulating nanostructures,
- the promotion of collaboration among scientists from diverse areas of specialisation (physics, chemistry, biology, engineering) with the purpose of integrating their knowledge into this new area of research,
- the training of researchers in the field of nanotechnology,
- any other objectives related to research in the area of nanoscience and nanotechnology.

CSIC-CNM – Spain, Catalonia

The Barcelona Microelectronics Institute (IMB) of the National Microelectronics Centre (CNM) is a research institute of the Spanish National Research Council (CSIC). It was created in 1985 and has a staff of about 220 people. Its main activity is research and development in the fields of silicon-based micro and nanotechnologies, devices and systems. Additional activities include industrial R+D+I contracts and postgraduate and industrial training. Typically around 50% of IMB-CNM funding arises from competitive research projects from the European or National programmes or from industrial contracts. Research results typically address the fields of energy and transportation, environment, health and agro-food.

IMB-CNM has an integrated micro and nanofabrication clean room, with a total surface of 1500 m2. It has the capability of fabricating CMOS integrated circuits and includes microsystems-specific and nanofabrication processes. The clean room and its complementary laboratories are recognized as one of the “Singular Scientific and Technological Infrastructures” (ICTS) by the Spanish Government. As such, an external academic user access programme has been running since 2006 and it has supported to date more than 280 projects.

CNRS – France, Midi-Pyrenees

The National Centre for Scientific Research (CNRS) is a government-funded research organization, under the administrative authority of France’s Ministry of Research. Founded in 1939 by governmental decree, CNRS has the following missions:

- To evaluate and carry out all research capable of advancing knowledge and bringing social, cultural, and economic benefits for society.
- To contribute to the application and promotion of research results.
- To develop scientific information.
- To support research training.
- To participate in the analysis of the national and international scientific climate and its potential for evolution in order to develop a national policy.

CNRS carries out research in all fields of knowledge: biological sciences, chemistry, ecology and environment, humanities and social sciences, information sciences and technologies, engineering and systems sciences, physics, nuclear and particle physics, mathematics, earth sciences and astronomy. CNRS encourages collaboration between specialists from different disciplines in particular with the university thus opening up new fields of enquiry to meet social and economic needs. CNRS has developed interdisciplinary programs that bring together various CNRS departments as well as other research institutions and industry. Interdisciplinary research is undertaken in several domains, including nanosciences and nanotechnologies. More than one thousand CNRS labs are located throughout France, about 90% of which are Joint labs partnered with universities, other research organizations, or industry. The administrative management of the CNRS labs is shifted to 19 Regional Offices.

Two CNRS labs are involved in the GT5 activities: LAAS (Laboratory of Analysis and Architecture of Systems, about 650 agents) and CEMES (Centre for Materials Elaboration and Structural Studies, about 180 agents). Both are CNRS intramural labs fully funded and managed by CNRS. Located in Toulouse, they are administrated by the Midi-Pyrenees Regional Office.

Aims and scope of the Handbook

To achieve the final goal of the GT5 working group, that is to establish SUDOE region as a leading environment for Nanoscience and Nanotechnology through extensive technology transfer & entrepreneurship, the partners proceeded as follows.

The first step was to exchange about good practices in each of the regions participating in the project: get to know each other. The interactions were focused on descriptions of the state-of-the art for practices already in place in each of the institutes to connect Industry and Research Centres. The challenge was to exchange about good practices and draw a joint SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of the current practices. The joint SWOT analysis was derived from three regional SWOT analyses (France, Spain, and Portugal) built in collaboration with regional industrial companies. Chapter 2 addresses this issue.

Starting from this background, the next step was to address a description of those differences identified among partners related to the practices already put in place individually and that can be taken as good example of added value for the other partners. The final goal is to propose a common strategy for valorisation and commercialisation that incorporates the most interesting aspects that have been specifically addressed in each region. Chapter 3 highlights those specific actions of each regional strategy that can be taken as a good example and presents the proposed common strategy.

Chapter 4 gives the main conclusions arising from the GT5 activities of the TRAIN^2 project.

2

Comparison of different Technology Transfer Mechanisms

The aim of this chapter is to share the expertise of all the participants in order to identify how to reinforce the connections between Research Centres and Industrial companies of each region.

The starting point (2.1 Definitions) is to clarify and agreed about a common vocabulary related to technology transfer (TT) and related concepts to use the same understanding for the reading of this handbook, independently of the readers expertise.

The following issue (2.2 Start of the art of on-going practices) in this chapter is a description of the state-of-the-art for good practices already in place in each of the different regions aimed to connect Industry and Research Centres. The description offered by each of the partners has kept the format with which each of them has addressed this issue: in this way what each of them have considered of importance is highlighted naturally by their written, in contrast with the outcome of chapter 3, where experienced differences of added value are described.

And finally this chapter addresses (2.3) the SWOT analysis on these good practices.

2.1. Definitions

Technology Transfer (TT) is an interactive process of moving information from development to manufacturing. Without a common vocabulary and a shared of tools, technology transfer can be particularly frustrating. The need to translate the language and associate knowledge between groups creates an inefficient process that inherently introduces the opportunity for error.

This chapter establishes a common vocabulary that gives diverse users a common understanding of business concepts, improving communication and efficiency. There could be many concepts to be outlined in this chapter, but here and under the scope of the aim of this handbook only two will be mentioned: Technology transfer, valorisation and commercialization.

According to the general definition of the US Dept. of Commerce (2003):

1. *Technology transfer (TT) from public laboratories is to get the ideas, inventions, and technologies developed with taxpayer money into the hands of the private sector as quickly as possible, and in forms useful to that community.*

   TT includes a number of activities summarised as follows:

   - Identify (internal marketing, ownership evaluation)
   - Protect (Patenting Strategy protection)
   - Translate (Proof of Concept, development design)
   - Market (Marketing ID customers Promotion)
   - Licensing (Valuation, Negotiation)
   - Spin out (Business Plan, Fundraising, Team management)

2. *Valorisation is the use, for socio-economic purposes, of the results of research financed by public authorities. It represents society's direct and indirect return on the public sector's investment in research and development.*

   This TRAIN² project has agreed to use the following techniques to valorise R+D:

   - → Identification of results.
   - → Technological potential assessment.
   - → Technological surveillance.
   - → Novelty analyse.
   - → Intellectual property and protection.
   - → Market opportunities research.
   - → Business plan.
   - → Commercialization.

3. *Commercialization is the process of transforming new technologies into commercially successful products.*

   It has been agreed that the commercialization process includes:

   - → market assessment, marketing strategy development, product design,
   - → manufacturing, engineering, worker training,
   - → management of intellectual property rights
   - → raising capital

2.2. State-of-the-art of on-going practices to fill the gap between Industry and Research Agents

2.2.1. Spain – UNIZAR-INA (Aragon)

The Technology Transfer scheme used by the University of Zaragoza to valorise the research results of the belonged Research Institutes and in particular by INA can be summarized as follows:

1. **Institutional Relations**

   - → Development of institutional relations at the University to promote their integration into the economic and social environment.
   - → To conduct external relationships with companies and institutions in the field of their own competence.
   - → To manage and to coordinate institutional Chairs and enterprise agreements. This is a strategic and lasting relationship, where both sides benefit from the research results, development and innovation, as well as the dissemination and common academic activities.

2. **Technology Transfer and Innovation**

    - Social commitment of the University of Zaragoza promoting innovation, transfer of results and technological progress.
    - To coordinate the activities of the technology transfer office (TTO). Its main mission is to enhance the capabilities and performance of Research Institutes and Research Groups of the University of Zaragoza, as well as to promote, enhance and disseminate in an effective way this transfer to society, promoting collaborative public-private R & D + i.
    - To develop a Strategic Plan to achieve an effective and proactive transfer.
    - To focus the promotion of technology to the requirements of regional companies.
    - To promote, enhance and disseminate the results of research from the University of Zaragoza in the business and social environment.
    - To analyze strategic technological demands of innovative companies. Coordinate relations with companies, public or private institutions, professional associations, clusters, technology platforms, business associations and entities of any kind, providing tools to facilitate research activities and technological development through the transfer of results from the University of Zaragoza, generating an efficient service for business innovation.
    - To inform and advise strategically on funding to companies and researchers in the presentation of the best technological alternatives.
    - To organize forums where companies and researchers can promote the scientific-technological transfer as well as analyze positions of common interest.

3. **Protection of Results**

    - To promote and advise on procedures to protect research results for possible commercialization.
    - To promote and strengthen patents and prototypes for both researchers and companies.

4. **Spin Off Office**

    - To coordinate a new service from Business Development Office SpinOff to create technology-based companies.
    - To establish procedures to promote entrepreneurship through the creation of new businesses to encourage and support the creation of University Spin-Off companies.

2.2.2. Spain – CIC nanoGUNE (Basque Country)

Most of the public research organisations of the Basque Science and Technology system have established in-house valorisation management through a reduced number of experts in the identification of key research results and impact in market. This expertise is a key contact within the Institutions for researchers aiming to valorise the results of their research. In Europe this knowledge is under more complex structures called **"Tech Transfer Offices".**

The process of valorisation helps to **accelerate scientific progress:** the transfer of a new technology between two or more public- or private-sector partners who already master technologies in the relevant field can enable them, for example, to develop new products and services. It also helps to **support the economic development** of the Basque Country **and preserve its competitiveness:** the valorisation of innovative results contributes to growth in the Basque Country by adding to the range of products offered by an existing business or by stimulating the creation of new businesses, thus helping to boost the country's competitiveness.

Moreover, the valorisation of research results helps to drive the emergence of a **new way of funding research:** the transfer of a technology into the socio-economic domain is based on a contract, which sets out terms and conditions for the financial returns deriving from commercial uses of the invention. This income can be shared by the owners of the technology, inventor(s) and the R+D agent(s). Valorisation can also **generate additional income.**

The support of these key people for the implementation of their valorisation strategy is developed under the following activities :

- **Contract support:** with regard to valorisation, the establishment of collaborative research projects can involve contract negotiations - this sensitive stage may require specialised external support.
- **Information and awareness-raising** activities focusing on valorisation issues and on the protection of intellectual property rights.
- **Identification of research results,** outcome of a very close interaction with researchers.
- **Initial evaluation** of the market potential and of the intellectual property precedence of individual research results, which might require external support.
- **Assistance throughout the process aiming to protect intellectual property,** which might require specialised external support.
- **Support for the socio-economic exploitation** of research results: identification of and negotiation with potential partners, comprehensive support for the creation of spin-offs and the development of a business plan, identification of potential sources of public or private funding
- **Establishment of networks** of national and international technology transfer and valorisation experts
- **Provision of documents and procedures** relating to technology transfer and valorisation

Besides these actions, we, as CIC nanoGUNE, are pushing specifically the **Direct collaboration with companies,** which is probably the most efficient form of valorisation. The research and development competences are complementary, and the interaction between the two approaches is, in itself, a catalyst for innovation. Two forms of collaboration co-exist: contract research and collaborative (competitive) research.

Contract research. It involves one company sub-contracting a clearly defined research or development project to a public research organisation selected for its research competences and/or equipment. The company usually claims ownership of the results, and the public research organisation does not retain any intellectual property beyond the possible enhancement of its know-how.

Collaborative (competitive) research is a more recent action tying in with the open innovation concept. Public research organisations and companies jointly select a research area and agree on a division of tasks that reflects their respective competences. Individual partners retain ownership of the results they have generated, and all partners jointly decide how to manage any exploitation rights. The advantages of this approach lie in the fact that it opens access to complementary competences and that it enables third parties to benefit from the potential applications that the partners may not have chosen to exploit. However, this type of cooperation is far more complex, particularly with regard to intellectual property.

2.2.3. **Spain – ICN (Catalonia)**

The Institut Catala de Nanotecnologia (ICN) focuses its activities concerning Technology Transfer (TT) as summarised in the following chart flow:

1. **Core activities:**

Identify	Protect	Translate	Market	License	Spinout
Internal	Patenting	Proof of Concept	Marketing	Valuation	Business plan
Marketing	Strategy	Development	ID customers	Negotiation	Fundraising
Ownership	Protection	Design	Promotion	Legalise	The team
Evaluation					

2. **Other activities:**
   - → Managing research grants
   - → Managing services and contract research
   - → Managing consultancy undertaken by researchers
   - → Training students and entrepreneurs
   - → Managing business incubation programmes, including premises
   - → Managing science parks

TT is an essential part of the Research Centres purpose, alongside the core activities of research and training. Taking the dissemination of new knowledge as the purpose of a Research Centre, Technology Transfer uses commercial routes to achieve the same objective.

When successful, TT achieves a number of positive objectives simultaneously:

- → Transfer of new knowledge outside the University;
- → Source of new innovative ideas for industry;
- → Opportunities for income generation by industry and university;
- → Generates a positive social and economic impact.

TT is a good thing at the personal level for researchers for a number of reasons:

- The chance to use income generated as discretionary research funding;
- The chance to see their science used for benefit of society;
- Exposure of the intellectual challenge for turning laboratory research into products;
- Increased awareness of interesting applied problems;
- The opportunity for personal wealth.

Several routes can be established for knowledge and technology transfer:

- Founding of spin-offs or start-up companies.
- Based in protected Intellectual Property (IP)
- With or without a commercial partner and with or without the participation of the Research Centre as a shareholder.
- Licensing. A contract licensing or assignment with a commercial partner, based on protected IP or Know-how.
- R&D collaboration. Collaborative research projects to improve products, processes and services.
- Training and provision of services:
- Integration of scientists into a company's workforce
- Training of technicians
- Provision of services (characterisation, quality control, consulting, metrology, etc.)

2.2.4. Spain - CSIC-CNM (Catalonia)

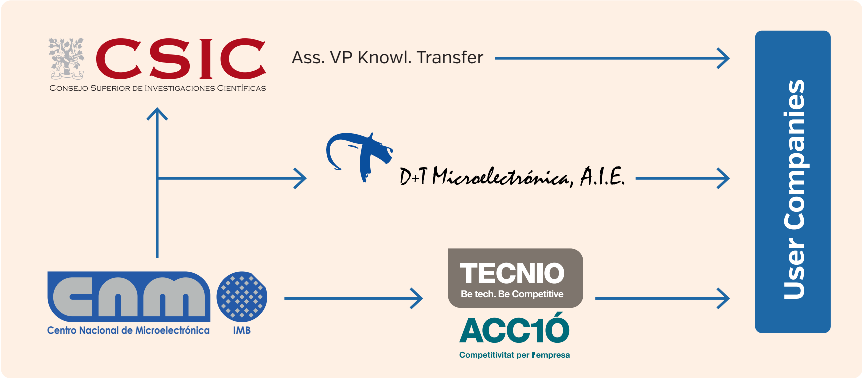
IMB-CNM is a research institute of the Spanish research Council (CSIC). Valorisation of the research results and cooperative research with the industrial sector are on the basis of IMB-CNM activities.

The applied research activities of IMB-CNM, which have the involvement of companies, are typically performed under two approaches:

Collaborative research with public competitive funding. Most of the research activities of CNM follow this approach. A consortium of various partners, including private companies and research centres develops a research project with funding support from a public competitive source.

Contract research. This involves a company subcontracting research, development and/or innovation activities to the research center. IMB-CNM offers to external companies technical and consulting services, technological and pre-industrial research, technology transfer, design and fabrication of prototypes and small series. Direct contract research may specifically include valorisation activities close to the industrialisation phase.

IMB-CNM has a three-fold framework for performing these valorisation activities illustrated in the following figure:



1] **CSIC Knowledge Transfer Office:**

valorisation is supported through the Assistant Vice-Presidency for Knowledge Transfer (AVKT), which offers the following services:

a) For external companies:

- Technological services (analysis, tests, validation).
- Research to solve a technology problem or develop a new product or service.
- Acquisition of a CSIC technology to solve a technology problem or develop a new product or service.
- Catalogue of CSIC's range of technologies.

b) For CSIC researchers:

- Protection of the research results (patent, utility model, etc) and intellectual issues handling.
- Support for working with companies (joint proposals to public calls, contract research, technological services, consultancy services).

c) Support to create a technology-based company using the CSIC's research results, skills and know-how (for CSIC researchers or external investors).

2] **D+T Microelectrónica, A.I.E.**

D+T Microelectrónica, is an Association of Economic Interest which has majority participation by CSIC and is also participated by three Spanish industries. The mission of D+T Microelectrónica is to facilitate the technology transfer of microelectronic technologies into industry. The services portfolio of D+T includes:

- Development and manufacture of prototypes or small volume series.
- Collaboration with industry in joint R&D projects of a national or European nature.
- Studies of technical and economic viability.
- Custom industrial and educational training.
- Valorisation activities during the validation and pre-industrialisation phases of research results.

3) **TECNIO groups at IMB-CNM**

TECNIO is a network promoted by ACC1Ó, which is the Catalan business competitiveness support agency, which brings together leading stakeholders and experts working in applied research and technology transfer in Catalonia.

TECNIO is a quality label that certifies that a research group or institute fulfills a number of standards concerning services, technologies and innovation (including marketing and valorisation activities).

2.2.5. France – CNRS (Midi-Pyrenees)

The LAAS and CEMES are two CNRS intramural labs fully funded and managed by CNRS (National Centre for Scientific Research). All research contracts and technology transfer activities (patents, licensing agreements, etc) are negotiated and signed by CNRS. Yet, new regional Technology Transfer Companies have recently been created on the initiative of the French government. Part of the CNRS valorisation activities is now shifted to these companies.

At the national level, CNRS is organized into two main departments: department of research and department of resources. In the department of research, a specific division for "Innovation and Relations with Business" oversees technology transfer for CNRS research. The administrative management of the CNRS labs is shifted to 19 Regional Offices. In each Regional Office, a specific team is dedicated to academic and industrial relationship (contract research and collaborative competitive research). It also provides a local support to technology transfer in close connection with the division for "Innovation and Relations with Business".

Collaboration with companies through research agreements is a current and efficient practice of valorisation. It may take different forms such as:

- → Consultancy performed by researchers or engineers.
- → Contract research involving one company and one (or several) research team(s); the results originating from the project are the co-ownership of the partners.
- → Collaborative research which involves a consortium of several partners from academic labs and companies; regarding intellectual property, each partner retains ownership of the results he has generated; results jointly generated by several partners are the co-ownership of those partners.

The CNRS Regional Offices are also the first entry point for identification of innovation in the labs before industrial protection and licensing. Finally, they provide a local support in case of spin-off creation in connection with the CNRS centralized division for "Innovation and Relations with Business" and regional incubators.

Protection & technology transfer for the overall CNRS research are overseen by the CNRS division for "Innovation and Relations with Business" (Paris); for the valorisation activities, the CNRS division gives a mandate to FIST SA (France Innovation Scientifique & Transfert SA), one a case-by-case basis. The services provided cover:

- Expert evaluation of technologies based on technical merit, patentability, and potential market.
- Defined strategies for protection of technologies and their promotion.
- A large network of potential industrial partners.
- Professional assistance in negotiating and drafting technology transfer agreements.

When results need to be protected, the decision power is owned by the "Innovation and Relations with Business" division. If protection is agreed then FIST SA is mandated for protection, licensing and/or identification of market opportunities.

Actually this procedure described so far is under revision: **Creation of new Transfer Technology Companies** is the new strategy. Since beginning of 2012 the French government has created 9 regional companies aimed to technology transfer: SATT (Societé d'Accélération du Transfert de Technologies). The SATT shareholders are CDC ("Caisse des Dépôts et Consignation") on behalf of the French Government, local universities and national research centres such as CNRS. For companies and in particular SMEs and spin-offs, they are the single entry point for all the public labs located in a region. SATT may also provide labs with support for the maturation phase of a specific technology/product before industrial transfer.

Concerning the French SUDOE regions, three SATT have been created: Toulouse Tech Transfer (January 2012, Toulouse, Midi-Pyrenees region), Aquitaine Science Transfert (July 2012, Bordeaux, Aquitaine region) and AxLR (August 2012, Montpellier, Languedoc-Roussillon region).

Quality of the technology transfer procedure: **The Carnot Institutes Network.** The "Carnot Institute" is a national label that certifies that the institute develops research activities and services in close connection with industry. Carnot Institutes endeavour to:

- Organise collaborative work with professionalism aiming at a lasting partnership (joint research laboratories, short or long-term bilateral research programmes, joint responses to calls for tender, etc.).
- Disseminate and provide access to research results.
- Transfer these results making the best use of all forms of knowledge & technology transfers: licences, assignment of results, spin-offs, business creation, participation in standardisation bodies, etc.

Carnot institutes benefit from special public funding to support the quality of their relationship with industry and part of their internal research projects.

2.3. Joint SWOT analysis[1]

Strenghts

- Strong technical and administrative capability to carry out collaborative research with companies: R&D institutes with excellence, youth groups with great motivation, very good scientific expertise, technical infrastructures and professional researchers.
- Good sharing of infrastructure and existing research teams, providing extensive capabilities and services and able to undertake both large and small projects with companies from all business sectors; the establishment of a common area of research in the SUDOE region with highly specialized centres in nanoscience and nanotechnology makes it a benchmark for future projects with companies. Growth of financial support allocated by the European Union; existence of solid companies with capital able to invest in research.
- Some success stories of spin-off companies and licensing of technologies already achieved during recent years.
- Technology Transfer Offices are continually improving, becoming more professional and employing increasingly well-trained personnel; licensing-out processes should be simplified and time-to-agreement shortened.

Weaknesses

- Lack of training dedicated to intellectual/industrial property, entrepreneurship, commerce and transfer of technology in the traditional scientific education system (universities, engineer schools). Lack of a real strategy for technology transference to industry: compromised agreements among them.
- The technology to be developed from the nanoscience is mainly an applied technology. The identification of the market requirements is not considered when an applied project based on nanotechnology is designed.
- For a public research laboratory, difficulty to find financial supports during 10 years which is the time most often required between first research investigation and actual technology transfer; as a result, several successive collaborative projects with different partners are required and difficulties may arise when the industrial property of the final results has to be defined to put them on the market.
- Public research budget cuts undoubtedly affect the creation of new research projects.
- Lack of transmission from the Research Centres of the possibilities that companies can take to develop new R & D projects related to nanoscience and nanotechnology. Companies are not familiar with the research in nanoscience and nanotechnology, nor the opportunities arising from local research centres, and therefore we have to make a major effort to publicise the possibilities (infrastructures, research results).
- Companies may see nanoscience and nanotechnology as something quite distant in time, rather than as a part of the immediate future.

[1] SWOT analysis details for each region are included in Annex 1

- General perception that nanotechnology is very complex, only for high-tech companies with expensive sophisticated labs.
- Lack of compromise in the industry in bridging the gap between lab results and products of interest for the market.

Opportunities

- Economic importance of new technologies: market for nanotechnology is an internationalized market without frontiers.
- Market surveys and industrial road maps should be taken into account to guide public research activities.
- Cultural barriers between industry and academia have to be broken down: good human relationship with mutual trust between academic and industrial partners is the key of success stories.
- "Joint Lab" experienced in France is a very achieved way of cooperation between public research centres and companies: multi-year research program with joint teams; PhD students and post-docs dedicated to the Lab; part-time senior researchers from public research laboratories; engineers from companies; research activities are well defined for several years (e.g. 8-12 years) and they encompass the industrial road map.
- Incentives for business creation: funding, incubators, Technology Transfer Offices, etc.
- Networking events and communication of scientific results are increasingly common. Promotion of science and technology news appears in newspapers and general magazines.
- TRAIN^2 can serve as a springboard for companies to finally be launched to the execution of research projects in the field of nanoscience and nanotechnology.
- Collaboration projects, especially with SMEs involvement, are a key focus of new Horizon 2020 program.

Threats

- Societal impact of risks induced by nanotechnology is an obstacle to transfer technology: risks to health/environment or ethical problems.
- Necessity to transmit to the society and companies the benefits of nanoscience and nanotechnology with specific applications in products, otherwise there is a risk of loss of credibility.
- Industrial road maps are often treated in confidence and are not known by academic laboratories. Lack of funding for TRLs (Technology Readiness Levels) 3 to 6; difficulty of scale-up of products developed in academic settings.
- Cutbacks of public funding in research and low value placed on newly trained technicians and scientists in the industrial workforce, could make the best and brightest researchers and technicians migrate to other countries where they have more opportunities for professional development.

3

Valorisation of R&D results

The aim of the GT5 activities of the TRAIN² project is to share the expertise of all the participant partners about technology transfer (TT) in order to reinforce the connections/fill the gap between Research Agents and Industry of each region. The agreed wish is to create a common space among the 3 regions sharing efficient vocabulary/understanding about TT, good practices, knowledge and business opportunities to improve competitiveness and strength innovation: if this SUDOE community wins in what tech transfer (as a whole) concerns, each region wins.

Concerning the GT5 activities, the project outlined the following techniques for the whole valorisation process of the R+D results, understanding valorisation as the first step to reach the market:

1. Identification of results.
2. Technological potential assessment.
3. Technological surveillance.
4. Novelty analyse.
5. Intellectual property and protection.
6. Market opportunities research.
7. Business plan.
8. Commercialization.

Each of the partners has already shown (chapter 2) how these activities are understood and accomplished; what tools have been put in place; and what are the most interesting aspects that have been specifically addressed in each region.

The chapter 3 addresses a description of those differences identified among partners about the practices already put in place individually and that can be taken as good example of added value for the other partners.

3.1. Challenges

From the book "Establishing a Technology Transfer Office", TA Young (based on a lifelong experience in establishing and running TTOs, with a chapter that provides many examples of TTO launches from around the globe (Australia, India, China, Japan, England, South Africa, Russia, and the United States):

Among the viable strategies for technology transfer (TT) is very much of wide usage to set up and operate a Technology Transfer Office (TTO). The TTO must be firmly grounded in realistic economic expectations. TT will not really make your university or research institution rich because building a robust technology transfer program will take sustained financial investment. It takes time (eight to ten years) to build an IP portfolio, establish contacts, and develop skills in TT. And it may take up to two decades or more before a university technology transfer program (including entrepreneurial spinouts) substantially affects the local economy. The ultimate impact, however, may be very large–both economically and culturally–for the university, its graduates, and the wider community.

Moving into the particulars of how to establish a TT stresses the importance of a strong mission statement, attention to staffing needs, and to the unique operating contexts of each institution. Young concludes that efficient and effective TTOs possess the following key characteristics, which are also, the challenges:

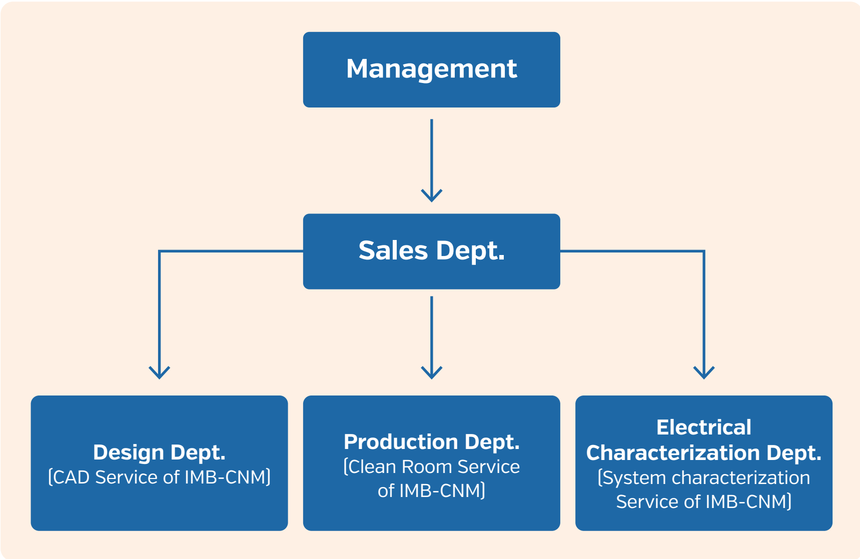
- An articulated mission
- Transparent policies and procedures
- Entrepreneurial staffing and an entrepreneurial environment
- Customer-friendly relations with both internal and external constituents
- A highly supportive university administration and community
- Strong links to potential industry partners
- Access to risk, or venture, capital

Even so, there is no "right" way to set up an office, but success does require considering some specific issues. One of these issues is establishing business processes at the outset. Adequate attention should be paid to information management and realistically setting budgets. Offices tend to be either a department within the institution or a subsidiary company. Either way, accountability lines will need to be transparent. The core element for successful technology transfer is people. The TTO should be led by an individual who understands the details of running a business. It is also useful to have staff with experience working in the relevant business sectors. To be able to recognize new opportunities, the technology transfer manager needs to win the confidence of academics, which is why it is helpful for the TTO to be embedded within the institution. Likewise, staff should be exposed to both academics and business people.

Having in mind these aspects as the common basis for TT, some of the non-common but specific actions taken by the TRAIN² partners are listed below these lines, in order to offer other possibilities beyond those aspects widely analysed.

SPAIN: Catalonia- The National Microelectronics Centre (CNM)

D+T Microelectronica AIE, legal entity whose shareholders are the same R+D institution (CSIC) plus Spanish industry. This AIE managing the functioning of CNM-IMB's Clean Room, placing within reach of industry microelectronic solutions that follow the cycle Design - Development - Production. The mission of **D+T Microelectrónica, A.I.E.** is to facilitate the incorporation of microelectronic technologies in industrial products, designing, developing and manufacturing chips tailored to specific needs



HIGHTLIGHTS → Business model: Service based in specific CNM infrastructure

SPAIN: Catalonia- The Catalan Institute of nanotechnology (ICN)

Very early in the establishment of TT activities at ICN it was evident that there was a need to form a strategic alliance with a Technology Center, an entity closer to industry than a research centre like ICN. With this aim, ICN joined forces with LEITAT Technology Centre (one of the biggest applied technology centres in Catalonia) and the Center for NanoBioSecurity and Sustainability (CNBSS) was created.

The Center for NanoBioSecurity and Sustainability

The CNBSS was established in 2009 as a joint initiative of the Catalan Institute of Nanotechnology (ICN) and the LEITAT Technological Centre, in response to the emerging needs to rationalise and assess the risks of new nanotechnologies. To do so, the CNBSS was granted 1.5M€ of initial funding by the local and national governments (Generalitat de Catalunya, and Spanish Ministry of Science and Innovation - MICINN).

Background

Rapidly increasing focus by government agencies and the public on the safety of nanotechnology and a growing real need in industry for high quality product samples and references for the future development of nanotechnology. ICN has a strong background in the development of reference nanoparticles while LEITAT has extensive industry contacts.

Mission - Vision

The Vision is to respond to emerging needs to rationalise and assess the risks of new nanotechnologies. The main mission is to develop high quality product samples, and new tools and methods to determine the safe and rational use of nanomaterials in products.

Values

Develop new, safe and sustainable applications of nanoscience and nanotechnology in a broad spectrum of fields including environmental remediation, drug delivery, energy, novel semiconductors, construction, and food. This goal also includes development of metrology, as a fundamental tool needed to facilitate efficient standardisation and regulation, and the production of standards.

Market-Customers

Emerging market with numerous clients from international academic research groups studying the safety of nanomaterials to local industry that need expert assistance to develop their nanotechnology R&D.

More information at www.cnbss.eu

HIGHTLIGHTS → A collaborative initiative to help the transfer of nanotechnology to industry within key focus areas: nanotoxicity, nanosustainability, nanometrology, regulatory watchdog.

SPAIN: Basque Country

nanoBasque — The nanoBasque Agency

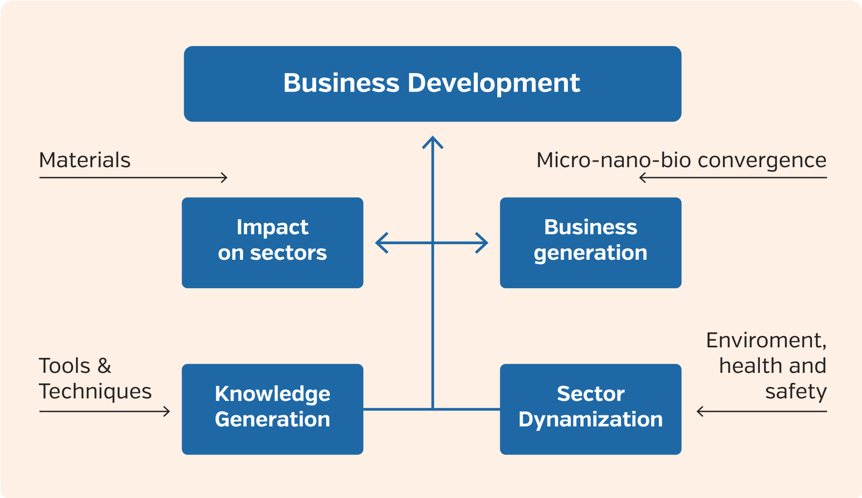
The Basque Country has put in place an specific tool to favour the incorporation of nanotechnology in its industrial fabric: the nanoBasque Agency.

Nanoscience, micro and nanotechnology are the catalyst of major qualitative and quantitative changes in industry that will bring us new products and processes that we can't even imagine today. The Basque Department of Industry, Innovation, Trade and Tourism is fully aware that now is the time to invest in the future. Therefore, through the nanobasque Strategy, the Department is working to accelerate the adoption of micro- and nanotechnology in basque companies to increase competitiveness in the leading areas of economic activity and promote the diversification of our industrial fabric.

The strategy is an open and integrative proposal that covers three main action areas:

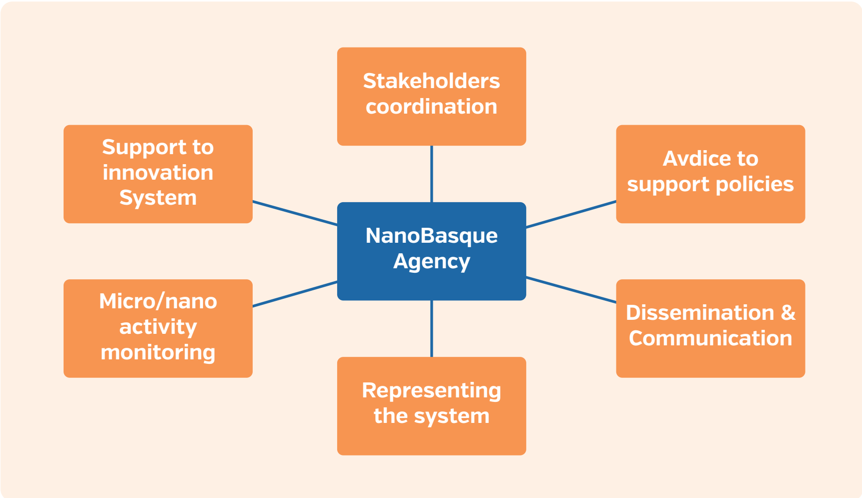
- business development
- knowledge generation
- sector dynamization

These activities are undertaken in the following four strategic areas, which are considered to be key concepts for roll-out of the strategy:



NanoBasque, a new relationships model

The Basque Department of Industry, Innovation, Trade and Tourism promotes the deployment of the nanoBasque Strategy through SPRI by creating a specific agency, the nanoBasque Agency. The enhancement of nanoscience, microtechnology and nanotechnology calls for a new model of relations that engages companies, scientific, technological, political social stakeholders. The nanoBasque Agency is the point of contact and dialogue for this new model which seeks to consolidate the transfer of knowledge and the creation of new business opportunities. Located in the San Sebastian Technology Park, the Agency assumes the functions of mobilising Basque businesses, organising a knowledge community and raising the profile in society of the value of nanoscience and micro and nanotechnology.



HIGHTLIGHTS → Specific tool to favour the incorporation of nanotechnology in its industrial fabric. Integrated actions devoted to TT, innovation and communication.

FRANCE:

1. **Toulouse Technology Transfer Company**

- Toulouse Tech Transfer (TTT) is a "Technology Transfer Acceleration Company", that is a one-stop shop for transfer and commercialization of innovative technologies.
- TTT manages intellectual property on behalf of its shareholders, namely CNRS and Toulouse University. They bring together most public institutions of higher education and research in Toulouse and the Midi-Pyrénées area.
- TTT supports the development and proof of concept of technologies, from detection up to selling licenses or creating start-up businesses. As a company, TTT invests in maturation projects, in partnership with public laboratories and towards businesses, by providing them with technical and human resources, and program management.
- Thus TTT:
  - Accelerates technology development,
  - Develops attractive technical solutions for businesses (proof of concept, prototypes, etc.),
  - Bears most of the initial risks,
  - Reduces enterprises need for equity to innovate.
- Highly skilled in the fields of intellectual property and technology development, TTT covers all science and technology areas.

HIGHTLIGHTS → Regional TT Offices to foster local competitiveness.

TTT invests in maturation projects

More information at www.toulouse-tech-transfer.com

2. **JOINT Labs:**

LAAS invented the concept of joint laboratories with Industry in France in 1991. A joint lab is a large research agreement involving important human and financial resources. The scientific program is well defined and corresponds to the technological barriers that industrial partners wish to raise. Several PhD students and post-docs are provided in addition to academic senior researchers and engineers from industry. The contract duration is four years, renewable. Most often, a joint laboratory is renewed once (8 years). The results are jointly owned by partners who have achieved them. The industrial partner has the exclusively right to market in its field of application and pay royalties to the joint owners.

Joint labs are the most achieved way of cooperation between a public research laboratory and an enterprise:

- Multi-year research program with joint teams
- PhD students & Post-docs dedicated to the lab
- Part-time senior researchers from LAAS
- Engineers from industry

- → Different concepts developed since (no unique model)
  - Single or multi Industry and Public Research Partners
  - Inside the walls
  - Outside the walls
  - No walls
- → Finances through public implication
  - Need Stability and long term (avoid call for project)
  - Subsidy from: Government, Regional Council, EFRD (FEDER)...

HIGHTLIGHTS → The scientific program is well defined and is addressed to overcome industrialisation

3.2. Proposed strategy for valorisation & commercialisation

Knowledge transfer aims to assist the development of competitive business in line with market opportunities, by the development of capacities and skills of industry. Take up of new technologies is essential if industry is to survive and progress in a highly competitive world. Valorisation and commercialisation activities are carried out by TTOs in order to advance and accelerate the transfer of knowledge generated in the academic sector. Our SUDOE regions have established a number of research infrastructures, have built networks and have influenced government policies to support R&D and knowledge transfer. Thus, hurdles in knowledge transfer are similar to other EU regions and countries, which may have similar political systems, infrastructures and R&D environments.

TT includes a number of actions between technology offer and technology demand. TT involves the transfer of knowledge and technical know-how, as well as facilitating the use of sophisticated devices and equipment, often otherwise unavailable to most industries, especially SMEs. Therefore, TT involves moving a technological innovation from an R&D organisation to a receptor organisation, most commonly a private company.

As highlighted in this document, the TT process is a challenge and most hurdles are common with other European regions. While there are numerous models for TT, including licensing agreements, co-operative R&D projects between research centres and private companies, the creation of spin-offs companies, personnel training and other mechanisms, the human factors and organisational or environmental factors play a significant role in determining the success or failure of TT and commercialisation of knowledge. Market forces and economic environment are known to affect new technology uptake by the Industry. In addition, human and organisational hurdles can significantly influence innovation and the whole TT process.

Some strategies on how to overcome these human and organisational barriers are summarised in this section.

1. Involvement of the researchers in the commercialisation process. Knowledge level, skills and incentives to carry on the research, management and commercial development needed to achieve a successful transfer.

TT indicators could be included into researchers' evaluation criteria. Researcher training in innovation during early career studies would help to overcome some cultural barriers.

2. Include TT activities into the research centre mission. TT varies across centres due to the diversity and scope of their missions. Some centres are more inclined towards technology transfer that leads to commercialisation because it is in the interest of achieving the mission of the centre.

3. Increase the visibility and interaction between research centres and industry. Industry has little knowledge of the opportunities that exist within research centres and research centres do not know the industry demand. Actions of matchmaking are required. Government agency support is absolutely necessary in this regard. Initiatives like the Nanobasque Agency are good examples of specific tools to overcome this barrier. TT activities should focus on the mutual benefit of both the research centre and industry.

4. Support from centre directors. Support from centre directors and senior management can have a marked effect on TT and commercialisation activities. For example, centre directors who support TT may provide resources, flexibility, and creative license to their TT offices (TTO). Those TTOs who are not supported by their centre leadership can be severely constrained.

5. TTO structure and efficiency are key factors: commercial, scientific and technological staff experience; internal processes and procedures; available support from legal authorities, and how TT staff makes use of this; full-time dedicated and highly qualified personnel specifically trained for the tasks they should perform. Establishment of a framework to plan future research projects with final knowledge transfer objectives is very important. Knowledge transfer objectives should form part of the project plan and should not be an "add-on".

6. TT activities must be well organised and coordinated. The centralisation/decentralisation of TT functions affects the speed of implementation of their actions, the consistency of policies, and the ability to share best practices amongst centres and agencies. The location of TT offices within a centre can affect the visibility of technology transfer. The set up of a private company to perform the TT activities from a research centre like D+T Microelectronica AEI as example from the CNM in Catalonia or the creation of a centralised TT company for a whole region like Toulouse Tech Transfer in France are good initiatives to organise and progress the transfer of knowledge.

7. Governmental support is absolutely required. Despite government support for TT, government activities and surveillance may create an anti-risk culture in research centres. Changes in priorities and short-term policies may impede TT activities which are usually long term. A special support from the government agencies should be dedicated to spin-offs: funding, getting access to international markets, brand reputation growing, contacts facilitation, etc.

8. Resources devoted to TT and commercialisation vary across research centres and agencies. Further, the extent to which the centres leverage European, national and local programs that support technology-based economic development may also affect TT and commercialisation. Valorisation funding programs like Valtec or Valor, which were set up in Catalonia two years ago, are very valuable and help to short the gap between basic research results and market demand.

9. Involvement of Industry at the early stages of the innovation process to maximize the chances that the innovative product or process developed by the research centre will satisfy industry needs. The inclusion of the industry in the development process will also help to ensure the success of commercialisation efforts. TTOs should actively sell their expertise to local companies, not wait for the companies to find them.

10. TTOs should increase flexibility in regards to methods of collaboration, types of agreements, funding, etc. to facilitate working with different types of partners both at national and international level.

11. Established local companies should be encouraged to participate in more collaborative R&D, especially FP7 projects that involve many international partners. This is not only to advance their technology but to develop links with potential clients and partners.

12. Processes for licensing out technologies must be simplified and the time-to-agreement shortened significantly.

13. The public system should implement a new metric for technology transfer – number of scientifically trained graduates who go on to work in a technical role in industry. Career options and pay for scientists, both in public and private industry, must be improved, and public recognition of their value to society promoted.

14. Transfer/secondment of people is a very effective mode of knowledge transfer/uptake. Transfer of people not only facilitates the effective uptake / implementation of the technology by industry, it also results in the transfer of tacit knowledge (informal knowledge which is not documented/ codified…"the way people do things"). Tacit knowledge from an R & D organisation to industry and vice-versa is a very valuable resource for both parties. Such people secondments, will also encourage the development of personal working relationships that have been shown to be important in the building of mutual credibility and trust between an R & D organisation and industry.

4

Conclusion

Nanotechnology exploits phenomena at the level of atoms and molecules. It opens up the possibility of understanding new phenomena and producing new and sometimes unexpected properties that differ significantly from those at a larger scale. New materials and devices may be developed with novel functions and performances. The applications have potential for nearly every sector: health, information and communication, energy and transport, environment. The impact for society is considerable.

As a result, nanotechnology is expected to boost the competitiveness of industry in the near future. It offers opportunities for industry to bring to market a large number of innovations. Achieving strong synergies among research, infrastructure, teaching and technology transfer to industry will be a key factor for getting safe nanotechnology-based products into the market.

This handbook compiles the outcomes issued from the TRAIN² workpackage dedicated to transfer mechanisms of nanotechnology R&D results in industrial environment. By working together, TRAIN² partners have shared their expertise about Technology Transfer (TT) in order to reinforce the connections and fill the gap between Research Agents and Industry of each SUDOE region. Main outcomes presented in the handbook are:

- State-of-the-art for good practices already in place in five partner institutes aimed to connect Industry and Research Centres.
- A joint SWOT analysis on these good practices derived from three regional SWOT analyses (France, Spain, Portugal).
- A highlight of the differences identified between partners about individual practices already in place and that can be taken as good examples of added value for the other partners.
- Some strategies on how to overcome the human and organisational hurdles that can significantly influence innovation and the whole TT process.

The proposed strategies are based on the SWOT analysis of existing mechanisms: it is intended to take advantage of the opportunities identified to fight against the threats identified. They encompass existing regional practices with a strong added value for the other partners, as well as new strategies to overcome common weaknesses. We hope they will be implemented in the very near future to establish SUDOE as a leading environment for technology transfer in nanosciences and nanotechnology and boost the competitiveness of our industry and especially SMEs.

Emphasis has to be put on the crucial role of technology transfer offices. TT activities must be well organised and coordinated. The centralisation/decentralisation of TT functions affects the speed of implementation of their actions, the consistency of policies, and the ability to share best practices amongst centres and agencies. The location of TT offices within a centre can affect the visibility of technology transfer. The set up of a private company to perform the TT activities from a research centre like D+T Microelectronica AEI as example from the CNM in Catalonia or the creation of a centralised TT company for a whole region like Toulouse Tech Transfer in France are good initiatives to organise and progress the transfer of knowledge. Hence, as a proposed future action that would be a major consequence of TRAIN^2, let us suggest setting up of a SUDOE network of TT0s to share the pool of supply and demand for innovation in nanosciences and nanotechnology and boost technology transfer.

Regarding the near future, the next EU Framework Programme for Research and Innovation (Horizon 2020) is a great opportunity to increase collaborative projects, especially with SMEs. Horizon 2020 will tackle societal challenges by helping to bridge the gap between research and the market by, for example, helping innovative enterprise to develop their technological breakthroughs into viable products with real commercial potential. This market-driven approach will include creating partnerships with the private sector and Member States to bring together the resources needed. Nanotechnology is one of the 6 Key Enabling Technologies (KET) identified by the European Commission. The TRAIN^2 project can serve as a springboard for SUDOE companies to finally be launched to the execution of research projects in the Horizon 2020 framework. To support such research projects, a network of TTOs would be a powerful tool to drastically boost technology transfer in SUDOE region.

5

Acknowledgements

The TRAIN² project has been funded by the Territorial Cooperation Programme INTERREG IV B SUDOE.

The authors acknowledge the contribution of the following persons to the work of GT5 and to its results described in this handbook:

Boaz Kogon, Cristina López and Ana de la Osa from ICN for contributing to the GT5 workshop organisation and general support.

Francesc Pérez-Murano and Lorea Oria from CNM for contributing to the GT5 workshop organisation and general support.

Ruth Aguarod from INA for contributing to the GT5 workshop organisation and general support.

Amaia Martinez Muro from the nanobasque Agency for support throughout the GT5 work.

João Pedro Esteves de Araújo and Célia Tavares de Sousa from University of Porto for the Portuguese SWOT Analysis and Workshop.

Brigitte Ducrocq from LAAS for the organisation of three GT5 workshops.

ANNEX
1

Swot Analysis for France, Spain and Portugal about Technology Transfer

FRANCE (Midi-Pyrénées)

PROJECT
Transpyrenees Action on Advanced Infrastructures for Nanosciences and Nanotechnologies. TRAIN²

Investigator in charge of this line

Name: Pascale
Family Name: Thévenod
e-mail address: pascale.thevenod@laas.fr
Institution: CNRS Midi-Pyrénées - LAAS

Mark the line you are considering

- [ ] Nanomagnetism and Spintronics
- [ ] Molecular and other low-dimensional nano-systems
- [x] Nanomagnetism and Spintronics
- [ ] Nanobiosciences
- [ ] Nanocatalysis
- [ ] Other: ....

Mention the strengths of this line in the SUDOE area both in the european and world context

✔ Collaborative research work is necessary when a new technology has to be developed; a solid partner is required to share the risks.
✔ The process to discuss and sign collaborative agreements does not take too much time because royalties related to commercialization of future joined results are not discussed. The co-owners will negotiate them when the company will actually commercialize a result.
✔ "Joint Labs" are a very achieved way of cooperation between public research laboratories and companies: multi-year research program with joint teams; PhD students and post-docs dedicated to the Lab; part-time senior researchers from public research laboratories; engineers from companies; research activities are well defined for several years (e.g. 12 years for Freescale/LAAS Joint Lab) and they encompass the industrial road map.
✔ Good human relationship with mutual trust between academic and industrial partners is the key of success stories.

Mention the weaknesses of this line in the SUDOE area both in the european and world context

✔ For a public research laboratory, it is difficult to find financial supports during 10 years which is the time most often required between first research investigation and actual technology transfer.
✔ As a result, several successive collaborative projects with different partners are required for the financial support; thus difficulties may arise when the industrial property of the final results has to be defined.
✔ The process to discuss and sign co-ownership agreements may take too much time.
✔ As regards researchers assessment by their employer (National Research Centres, Universities), technology transfer activities are not well weighed; published articles are much more important for career development.
✔ Lack of training dedicated to intellectual/industrial property in the French universities and engineer schools (technical degree course); thus, researchers may not be aware of the importance of property and confidentiality issues for companies.

Mention the opportunities of this line in the SUDOE area both in the european and world context

✔ For a small company, having access to technical facilities for micro and nanotechnologies such as those available at LAAS (RENATECH network) is of upmost importance.
✔ Market surveys and industrial road maps could be taken into account to guide more public research activities. Agency such as Toulouse Tech Transfer founded in last January should give help for this.
✔ When new technology challenges are set by industrial road maps, only results from previous academic fundamental research work can provide solutions.

Mention the threats of this line in the SUDOE area both in the european and world context

✔ Micro/nano technologies set up drastic safety and health issues inducing additional costs.
✔ Societal impact of risks induced by nanotechnologies is an obstacle to transfer technology.
✔ Lack of funding for TRLs (Technology Readiness Levels) 3 to 6.
✔ Actual industrial road maps are often treated in confidence and are not known by academic laboratories.
✔ Companies are not enough aware of research results available in academic laboratories.

SPAIN (Aragon, Catalonia, Basque Country)

PROJECT
Transpyrenees Action on Advanced Infrastructures for Nanosciences and Nanotechnologies. TRAIN²

Train²

Investigator in charge of this line

Name: Jordi
Family Name: Reverter
e-mail address: jordi.reverter@icn.cat
Institution: ICN

Mark the line you are considering

- [ ] Nanomagnetism and Spintronics
- [ ] Nanobiosciences
- [ ] Molecular and other low-dimensional nano-systems
- [ ] Nanocatalysis
- [ ] Micro-and nano-devices
- [x] Other: Technology Transfer

Mention the strengths of this line in the SUDOE area both in the european and world context

- ✔ The establishment of a common area of research in the SUDOE region with highly specialized centers in Nanoscience and Nanotechnology makes it a benchmark for future projects with companies.
- ✔ Strong technical and administrative capability to carry out collaborative research with companies.
- ✔ Ability to carry out new projects on Nanoscience and Nanotechnology with companies from all business sectors.
- ✔ Have achieved some success stories of spin-offs companies and licensing of technologies during recent years
- ✔ Good sharing of infrastructure and existing research teams, providing extensive capabilities and services and able to undertake both large and small projects with companies.
- ✔ Cultural barriers between industry and academia are starting to break down.
- ✔ TTOs are continually improving, becoming more professional and employing increasingly well-trained personnel.

Mention the weaknesses of this line in the SUDOE area both in the european and world context

- ✔ Lack of transmission from the Research Centers of the possibilities that companies can take to develop new R & D projects related to Nanoscience and Nanotechnology.
- ✔ Budget cuts in government of Spain, which undoubtedly also affect to the creation of new research projects.
- ✔ Companies may see Nanoscience and Nanotechnology as something quite distant in time, rather than as a part of the immediate future.
- ✔ General perception that nanotechnology is very complex, only for high-tech companies with sophisticated labs.
- ✔ No clear consensus on the preferred TT route: spin-off founding, licensing, R&D collaborative projects, training and provision of services.
- ✔ New IP generated from basic research is difficult to commercialise.
- ✔ Lack of agility,flexibility and legal instruments to create/participate in a spin-off created from the acedemia research. Too much bureaucracy. .
- ✔ Traditional scientific education system does not include subjects about entrepreneurship, commerce and transfer of technology.
- ✔ Scientists and technicians are not as valued in Spanish society as in other countries (relatively low pay and status).

Mention the opportunities of this line in the SUDOE area both in the european and world context

- ✔ Networking events and communication of scientific results are increasingly common. Promotion of science and technology news appears in newspapers and general magazines.
- ✔ Collaboration projects, specially with SMEs involvement, are a key focus of new Horizon 2020 program.
- ✔ New research centres like ICN or Nanogune can be more flexible and can be closer to industry than traditional universities.
- ✔ TTOs may become more professional with full-time dedication and highly qualified personnel.
- ✔ Public agencies are giving more support to valorisation projects and spin-off creation.
- ✔ Licensing-out processes can be simplified and time-to-agreement shortened.
- ✔ TRAIN² can serve as a springboard for companies to finally be launched to the execution of research projects in the field of Nanoscience and Nanotechnology.
- ✔ The collective prestige that the SUDOE region can attain via a strong TRAIN² consortium can be very relevant in order to be able to attract new projects with companies.

Mention the threats of this line in the SUDOE area both in the european and world context

- ✔ We have to transmit to the society and companies the benefits of Nanoscience and Nanotechnology with specific applications in products, otherwise there is a risk of loss of credibility.
- ✔ Companies are not familiar with the research in Nanoscience and Nanotechnology, nor the opportunities arising from local research centres, and therefore we have to make a major efforts to publicise the possibilities.
- ✔ The lack of local success stories, cutbacks of public funding in research, and low value placed on newly trained technicians and scientists in the industrial workforce, could make the best and brightest researchers and technicians migrate to other countries where they have more opportunities for professional development.

PORTUGAL

PROJECT
Transpyrenees Action on Advanced Infrastructures for Nanosciences and Nanotechnologies. TRAIN²

Investigator in charge of this line

Name: João Pedro
Family Name: Araújo
e-mail address: jearaujo@fc.up.pt
Institution: Associated Partner - UP

Mark the line you are considering

- [ ] Nanomagnetism and Spintronics
- [ ] Molecular and other low-dimensional nano-systems
- [x] Micro-and nano-devices
- [ ] Nanobiosciences
- [ ] Nanocatalysis
- [ ] Other: ....

Mention the strengths of this line in the SUDOE area both in the european and world context

R&D Institutes with excellence, youth groups with great motivation, in some, there is already a considerable amount of work maturity. Evident increase in recent years, the collaborations between groups in the sector and increasing internationalization (access to complementary equipment, internships, collaborative projects). University courses directed to new materials and nanotechnologies, especially in the Departments of Basic Science. Recent birth of some companies for new technologies. Growth of financial support allocated by the UE. The sharing of experiences of people with different realities but with mutual concerns. Complementarity of multidisciplinary knowledge structures. Advanced knowledge level of the state of the art in many of the topics. Well-trained human resources. Interest of researchers in the industry for opportunities combined with the ability to transfer knowledge. Existence of solid companies with capital able to invest in research. Increasing investment in R&D in the field of nanotechnology, especially in bodies of scientific and technological system. Existence of organizations dedicated to technology transfer in the scientific and technological system.

Mention the weaknesses of this line in the SUDOE area both in the european and world context

The priorities of R&D centers and businesses are very different, such as the manner in which they define deadlines and how important are scientific topics without immediate commercial value. Dissemination of scientific activity is weak and does not reach the industry. Little demand for research centers to companies and their problems. Lack of long-term planning. Mentality of protection of scientific work is still very oriented towards scientific publications and not to patents. Science is generally financed by entities (eg FCT) that values science and not technology. Resistance by the companies. Lack of preparation either of the universities or companies, to establish connections. Most times, collaborations university / industry are only "SOS". Universities do not know marketing. Lack of risk capital. Very diffuse perception on the potential of nanotechnology. Lack of strategic lines of national development, both in research and industry, targeting the country's economic development. Universities: platforms can improve the interface with the outside world, and assiduously interacting more directly with representatives of the Institutes, Companies. Integrating also experienced consultants. Portuguese industry is dedicated to transforming. Geographical location (sometimes limits the interest by the company). Low monetary investment with the purpose for patents. Research based on students (they leave after graduation). Offices of technology transfer appear only when there are results (and there are scientists who take the results to the offices). The human and material resources in technology transfer remain limited. Identified in Portugal a few companies that implement or use nanotechnology. Offices for technology transfer do not know results of research in nanotechnology.

Mention the opportunities of this line in the SUDOE area both in the european and world context

The junction of the "engine" in the existing R&D institutes with the commercial power of industry can be a very powerful tool for innovation, as well as a source of revenue for both parties. Events like this one where the two agents know each other. Sharing of PhD or post-doc students. The use of overheads that result from research projects to finance marketing activities and technology transfer. Internationalization of companies. Portuguese companies buy technology in international trade fairs from third parties, here the university has the opportunity to develop that technology. Connection with technology transfer centers. Economic importance of new technologies (avidity of the markets). Incentives for business creation (funding, incubators, etc.). Awareness of the need to approach academy / companies already with some results. Business incubators, technology centers linked to the industry. Market for nanotechnology is an internationalized market without frontiers, reducing barriers to technology transfer to foreign companies. Networks of contacts created by researchers who will come out of universities and to industry. The Portuguese R&D in nanotechnology is recognized internationally. The need for modernization of companies and the increase of their competitiveness implies an engagement in innovation and technological development.

Mention the threats of this line in the SUDOE area both in the european and world context

The loss in time devoted to basic science or regarding possible ideas to market can be risky. The difficulty of scale-up of products developed in academic settings. Difficulty in traditional formation and performance of partnerships. Loss of identity of research institutions. Lack of funding that can lead to the disappearance of some research centers. A large dependence on funding from industry (which has profit as its goal) can have negative effects: projects (scientific but also, eg social) of little commercial interest are ignored. Risks to health/environment or ethical problems that arise with new technologies. When the driving force of evolution is the profit there is a historical tendency to ignore these problems. Failure to be competitive / lack of competitiveness. "Escape" to another countries of researchers with higher education. Output of graduates / Masters, teachers and researchers abroad due to the recent financial situation of the country. Marketing is done by consultants who do not know so well the investigation. Maintaining patents is expensive, if industry does not buy it, then do not patent the ideas. Local industry is not very interested in innovation but in survival in the global market. Focus on applied research / technology transfer centers may mischaracterize R&D. Being nanotechnology a relatively new area, it is unknown / harder to see the effects of medium and long term. This uncertainty makes it difficult to transfer technology. Nanotechnology companies are new and focused. It will be difficult to transfer them to new technologies. R&D in nanotechnology is expensive. Sustainable in the medium and long term? Will it remain money for technology transfer? Risk of strangulation in the financing or in research companies. Lack of motivation of researchers. Excessive abandonment of basic research.

ANNEX
2

Companies and Institutions that have participated in the regional GT5 Workshops and Industry Forum

FRANCE

31 Degrees	Laurent Rabbia
CEMES-CNRS	Marc Verelst
Dendris SAS	Jean-Marie François
Essilor R&D	Jean-Paul Cano
Freescale Semiconductor	Eric Moreau
Nanomade Concept	Faouzy Soilihi
Pylote	Loïc Marchin
Sanofi Montpellier	Pascale Roux
Toulouse Tech Transfer	Christophe Haunold, Elodie Larive

PORTUGAL

CENTI	António Mota Vieira, María José Machado
FiberSensing	Cristina Barbosa, Francisco Araújo
Innovnano	Ana Casaca
NANOGAP	Daniel Fernandez
Portucel	Alexandre Gaspar
UPIN	André Fernandes
Ynvisible SA	Ana Marques

SPAIN

ACC1Ó	Oriol Alcoba
Aragón Government	Miguel Ángel García Muro
Basque Government	Juan Goicolea
Bax & Willems	Laszlo Bax
Cidete Ingenieros	Germán Noriega
Corporación Patricio Echeverría/ Herramientas Bellota	Yolanda Muñoz
FEIQUE	Blanca Serrano
Fluebetech	Carles Colominas
Grupo SAMCA	Miguel Ángel Caballero
Likuid Nanotek	Jaione Ollo
Nanoimmunotech	Rubén Santos
NanoInnova Technologies	Rafael Ferrito
Nanoscale Biomagnetics	Nicolás Casinelli
TECNAN	Germán Medina
TV3	Marc Boada

ANNEX
3

TRAIN² Trans-Pyrenees Industry Forum on Nanoscience and Nanotechnology

Technology Transfer: Industry's Key to the Future

November 21st, 2012

Barcelona - World Trade Center

Summary of issues raised at the TRAIN² Industry Forum roundtable

The TRAIN² Industry Forum on Nanoscience and Nanotechnology took place at World Trade Center of Barcelona on November 21st 2012. This event was part of the workpackage 5 (GT5), dedicated to the transfer of Nanoscience and Nanotechnology R&D results to industry.

This appendix is a summary of the issues discussed during the round table with the participation of several companies and institutions from the three countries participating in the project TRAIN², Spain, France and Portugal.

1 TRAIN² Industry Forum agenda

9:30-10:00	Opening and Presentation
10:00-10:30	Overview of State of Nanotechnology in Europe as covered by the ObservatoryNano Project
10:30-10:35	TRAIN² Video
10:35-11:00	Presentation of results of SUDOE Nanotechnology Transfer SWOT Analysis
11:00 -11:30	Coffee Break
11:30-13:30	Round Table: → Barriers on Technology Transfer. → Future actions on Technology Transfer.
13:30-13:45	Closing
14:00-15:30	Lunch

2 Roundtable participants

The participants in the Round Table were the following:

- Moderator 1: Marc Boada. Scientific Journalist at TV3 Catalonia (Spain).
- Moderator 2: Boaz Kogon. Communication and Strategy Project Manager at ICN (Spain).

- Christophe Haunold, Director at Toulouse Tech Transfer (France).
- Jean-Paul Cano, Manager of Active Optics Department at Essilor R&D (France).
- Miguel Ángel Caballero, R&D Business Director at Grupo Samca (Spain).
- Blanca Serrano, Product Manager at FEIQUE (Spain).
- Ana Casaca, Head of Innovation at Innovnano (Portugal).
- María José Machado, Business Development Manager at Centi (Portugal).
- Laszlo Bax, General Manager at Bax & Willems (Spain).

3 Roundtable contents

The roundtable was intended as an open discussion forum where each participant could contribute from his/her point of view and previous experience on different aspects of Nanotechnology and Technology Transfer, giving a complete overview about the barriers and possible future actions on Technology Transfer.

The following text summarizes the most relevant ideas and statements provided by the participants regarding the issues raised by the moderators:

Q1: Can you tell us how has your company incorporated Nanoscience and Nanotechnology to its processes and products? What meant for your company to introduce these technologies?

- Most companies represented in this round table have included Nanotechnology in their process and products during the last decade, although in other companies the introduction of Nanotechnology began before, twenty years ago.
- Technology Centres are giving support to companies to develop new products. New ways of business are arising with the application of Nanotechnology in new products and materials.
- In many cases, Nanotechnology is yet in an embryonic state with a large capacity of industrial development.
- In general for companies, the introduction of Nanotechnology in their processes and products supposed a big effort in R&D resources and in all cases a significant commitment of future.
- All companies attending the round table have products in the market which incorporate nanomaterials and Nanotechnology. Some of these products and applications are the following:
  - Metal oxides for industrial applications and other base nanomaterials.
  - Thermal lenses and organic lenses which incorporate nanomaterials to increase the mechanical performance.
  - Textile materials which include cosmetics principles (this resulted in a big jump in this field).
  - Ceramic products, introducing new metallic nanoparticles to create new colors and surfaces on the ceramic pieces.

- Polymers, creating new nanocomposites for automotive, packaging and electrical industry.

→ The companies highlighted the collaboration with universities and Technology Centres to carry out successfully the R&D projects on Nanotechnology. As a consequence of these collaborations, in some cases a permanent relationship has arisen. An example of this collaboration is the "Cátedra Samca" created between Grupo Samca and University of Zaragoza.

Q2: What message would you launch to companies that have not yet incorporated these technologies into their processes and products but are interested in them?

→ It is very important to identify the position of every company in the market, to know the kind of product the company wants to offer in the market and clearly to fix the objectives to achieve with the incorporation of Nanotechnology in the processes and products. On the other hand, it is very important to decide the correct moment to introduce Nanotechnology and to define the right road to success.

→ It is necessary to consider that this type of projects require a lot of money, effort and hard work. So, all these aspects should be considered before starting the project.

→ Some companies cannot support big costs in R&D. So, sometimes it is much more effective and realistic to buy licenses and technology previously developed by other companies or technological centres. Every company should know their limitations; otherwise, it might be a serious mistake to get into a field unknown for them. Sometimes it is better to have the best supplier of products with the best solutions in Nanotechnology than trying to develop a new product by themselves.

→ Nanotechnology has represented for companies a qualitative jump and a differentiation in the market, allowing to characterize the properties of the materials to be introduced in the market.

Q3: Do we know the market needs and how to drive the research towards those requirements and products? Should we do more accurate market research to know the real needs of the market?

→ The market research is absolutely necessary but it is expensive. So, it will depend on the type of company involved and what the company will want to obtain with the market study.

→ Technology transfer centres are a very good solution for companies to know the market requirements.

→ It is essential for Research Centres to interact with industry to know the real needs of the market; otherwise the research can be useless and lead to nowhere.

Q4: Which aspects do you consider essential to be able to conduct a Technology Transfer process?

- A basic aspect for the success of a Technology Transfer process is to know which company is really interested in the Technology Transfer. So, the election of the company to carry out a Technology Transfer project will be determinant.
- The results will be good and the process will be useful when the company can commercialize the new product or process.
- The final result must be industrialized by the company. The main objective of companies is focused in earning money, so this will be an essential condition to consider that the Technology Transfer process has been good.
- Other important aspect to consider in the industrialization of new products which incorporate Nanotechnology is the possibility to obtain the new raw materials. Sometimes these materials are very expensive and it is not possible to introduce them in the final products.
- Industrial Property represents a critical point in Technology Transfer processes.
- The difficulty to define delivery times and the possibility that the Research Centres do not deliver a result at the agreed time is another important aspect for the success in the Technology Transfer projects.
- The knowledge of the market by part of the main professor, who drives the Technology Transfer process, is a key factor for the success of the project.
- It should be very important for the Technology Transfer process the exchange of professors between industry and University and vice versa. These exchanges are very common in Germany, obtaining very good results in Technology Transfer. Big multinational companies in Germany use this method to transfer technology from universities and Technology Centres to companies.
- One important aspect to consider is the lack of flexibility in R&D careers; at this regard some countries are implementing PhD programs which are coordinated and funded in a 50% between companies and universities.
- There is a perception of a lack of recognition of the qualified technicians in the industry and of limited possibilities of promotion for them. As a result, very limited research work is done in many companies and only the biggest companies invest money in research.
- In general, researchers do not obtain extra money and an advantage from Technology Transfer projects. This aspect may determine the effort to be made by research centres, because the benefit obtained is not proportional for both parts, the company and the Research Centre.
- Often the basic phases of development in Technology Transfer projects, from TRL1 to TRL5 (TRL: Technology Readiness Level), do not have enough funding from the companies, because they still see the product

far from the market. A solution can be to put more public money to accelerate the phases of basic research in the Technology Transfer projects.

- The lack of a standard contract for Technology Transfer processes results in increased delays, especially regarding to the Intellectual Property Rights.
- Safety risks associated to the use of new nanomaterials can be an important obstacle to introduce new products in the market. Currently the lack of legislation about new nanomaterials can be a barrier for market success.

Q5: Are patents inhibiting the Technology Transfer?

- Often companies do not know which is the most appropriate way to manage the business model. There is no "book" to search the best way to manage the Intellectual Property Rights of every partner in a given project. This aspect of the contracts can slow down the signing of them and the starting of projects.
- Often the process to obtain a patent is very long. As a result, Marketing Departments of companies do not know for a long time if their patent is finally accepted or rejected.
- The European Union is working to make the process to obtain patents easier and cheaper for companies. This will be a great news if finally is achieved.
- Patents are one part of the companies' value, but often they have no use or industrial application and they are only used to attract business angels. Of course, there are companies where the patents are very important to start new businesses and this provides a lot of money to them, especially patents on new raw materials.
- Really the importance of the patents for the partners in a Technology Transfer project is in the profitability of the patent. If patents do not have a real value in the market, they are only a paper without value.
- Often some patents infringe other patents which have been previously registered by the company or the technological centre before beginning the process of Technology Transfer. This produces an added complexity and requires a great effort from the legal departments to establish agreements for the projects.

Q6: Which are the most effective incentives for stimulating public-private collaborative R&D?

- It would be very important to have incentives for Industrial Property registration. Many companies develop R&D projects but sometimes patents are not registered by them. So, these companies do not have profit from patents. Having more incentives would help to finish Technology Transfer processes with an adequate I.P. protection.
- In Portugal there exists the "Technology Transfer Voucher". This formula allows the subcontracting of research institutes by companies. Each

company can use up to 15.000€ per year for research on new processes or products. Companies can only subcontract Portuguese research institutes.

- Often Technology Transfer Offices do not know about the companies of their own geographic area, but they offer their services to other companies even located in other countries. So, TTO´s should focus efforts to help small and medium size companies located in their own region of influence to develop R&D projects to assure the future of these companies.
- Public TTO´s do not have enough resources to give a good service to all companies they would like.

Q7: Which are the most effective ways to make companies know the types of services and R&D collaborations offered by local Research Centres? Are we able to find them in our environment?

- To have regular meetings to publicize the possibilities regarding possible collaborations in Technology Transfer in different fields of science is a good way to know all stakeholders involved in Technology Transfer processes: Universities, Companies, TTC´s, Government, etc.
- The mobility of professionals in different fields (Technology Transfer, IP, Project Management, etc.) and between companies and Technology Centres or universities, facilitates the mutual collaboration and allows new links which generate new opportunities to establish collaborations.
- Often, the daily overwork does not permit to look outside to evaluate all possibilities of collaboration. Lack of resources to explore new opportunities is a common issue for Research Centres, TTO´s and universities.
- Media are really important to reach companies, especially for the small and medium size companies which do not have stable channels to drive their technological needs. These companies need technology in a TRL 6 or higher level of development.

Q8: Do you consider that Technology Transfer can be a key element in the future of some companies?

- Technology Transfer is crucial, mandatory. Traditional sectors as ceramics, wood, leather or textiles have to improve their processes and final products; otherwise these sectors will have a very uncertain future. Technology Transfer is certainly a key factor to reach markets in an advantageous position and above all it allows ensuring the survival of many companies.
- For big companies in sectors such as health, energy, telecommunications, etc., the Technology Transfer is part of their business. The market leadership of these companies is based on a strong technological capability and constant adaptation to new technologies, new materials and new processes. This requires of Technology Transfer as a basic tool to cover all these needs.

- Other important aspect to consider is the creation of spin-off companies. Research allows finding out new business lines and new market niches in most science fields. These can be addressed by spin-offs, which are an important way for Technology Transfer.
- Companies in general need Technology Transfer because they do not have all competences at home.

Q9: What aspects would you change for the future of the Technology Transfer if it would be possible?

- Reduction of complexity for collaborations between Research Centres and companies.
- Big projects with many implied people and centres are very difficult to manage, because everyone has different interests in the final results. So, the collaborations should be concentrated in small groups, thus the Technology Transfer would be much more effective.
- It will be necessary to change the mentality of many companies. Innovation should be incorporated in the processes of companies as a normal part of the business. Innovation cannot be intended as something sporadic with immediate results.
- Bureaucracy has to be reduced in Technology Transfer processes. Often researchers spend much of their time to process papers and issues not related exclusively with research.
- Technology Transfer has to concentrate its efforts in the commercial results of companies.

Q10: What is the point of view of the media regarding Technology Transfer and Nanoscience in particular?

- Nanoscience and Nanotechnology have a good marketing. Society identifies with the message and values that Nanotechnology transmits. So, Research Centres and companies should use it to intensify the Technology Transfer in this science area.
- The rhythms for companies and public sector are different. This is often a big obstacle for the success in Technology Transfer processes.
- Knowledge should be directed to specific objectives of the society.
- To define timing and cost is fundamental for a Technology Transfer project.
- Confidence in the team work is a fundamental aspect for success.
- To innovate with many people involved in the work is very difficult. So, it is better to work in small research groups.
- The technological success is equivalent to market success.
- Bureaucracy should be reduced in the Technology Transfer projects to allow researchers to be isolated from issues not related with the scientific objectives of the projects.