European Commission

Innovation

How to convert Research into Commercial Success Story?

Part 3 :
Innovation Management for Practitioners

Research and Innovation

EUROPEAN COMMISSION

Directorate-General for Research and Innovation
Directorate G – Industrial Technologies
Unit G.1 – Horizontal aspects and coordination

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Innovation
How to convert research into commercial success story?

Part 3: Innovation Management for Practitioners

Directorate-General for Research and Innovation
2013 Nanosciences, Nanotechnologies, Materials and New Production Technologies (NMP)

This guide is based on 2 studies carried out for the European Commission by PricewaterhouseCoopers EU Services EESV, KMU Forschung Austria and Oxford Research.

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Luxembourg: Publications Office of the European Union, 2013

ISBN 978-92-79-29717-5
doi 10.2777/10737

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1. Why a good planning of innovation-related activities is crucial?

A key objective of publicly-funded research is that it should lead to the exploitation of results, which goes one step further than the mere production and dissemination of new scientific knowledge. Such an approach is essential to tackle the "European paradox": a strong science base but weak innovation performance (exploitation).

Therefore, increased emphasis is placed on innovation in EU-funded R&D projects. Innovation is understood as any activity aiming to promote not only the dissemination, but especially the subsequent exploitation of the results of the R&D projects.

Accordingly, consortia are encouraged to include innovation-related activities in their project, and such activities may be supported by EC funding under the same conditions as R&D activities.

This publication aims at providing to researchers a better understanding of the innovation process. It is mainly based on the findings of two reports:

- "How to convert research into commercial success stories? Analysis of EU-funded research projects in the field of industrial technologies".
- "How to convert research into commercial success story? Analysis of innovation successes in the field of industrial technologies".

These reports provide qualitative analysis based on a sample projects and present case studies. They can be downloaded via the Industrial technologies Innovation Platform (see p. 18 for more information).

The focus of this publication is on innovation management for key enabling technologies projects.

What are Key enabling technologies (KETs)?

- Six strategic technologies
- Driving competitiveness and growth opportunities, contribution to solving societal challenges and knowledge intensity
- Knowledge- and Capital intensive
- Cut across many sectors

- Nanotechnologies
- Advanced Materials
- Micro- and nano-electronics
- Photonics
- Biotechnology
- Advanced Manufacturing

2. Innovation pathways, what can we learn for EU-funded industrial technologies projects?

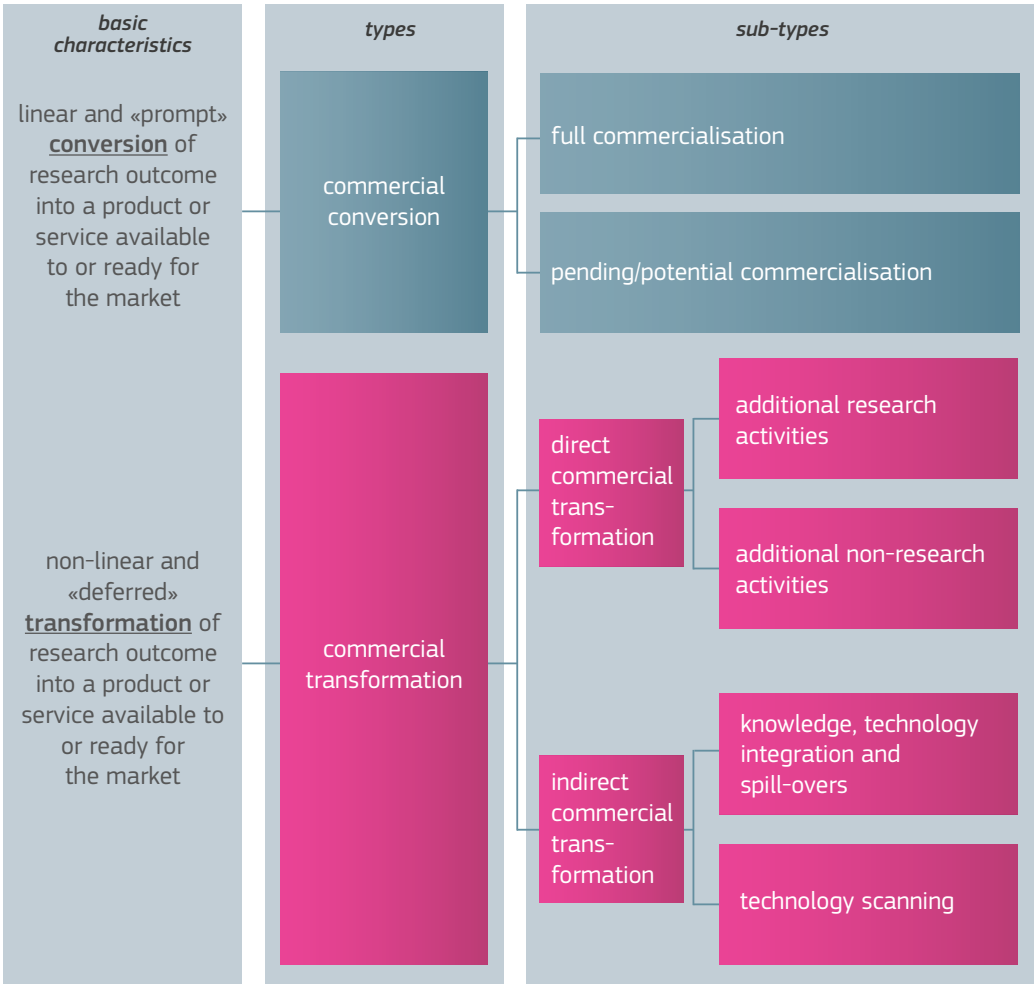
What successful commercialisation means?

The term 'successful commercialisation' cannot be understood as a well-defined concept of any kind. Whilst 'Commercialisation' is almost always conceived as directly converting research results into a product available to the market, there are only a few cases where such a direct and almost linear relation between research and market success was actually found. The concept "Market-oriented exploitation" provides a better view of market impact of R&D projects. It can be defined as any exploitation process of research outcome that has a commercial objective and contributes to gaining or increasing profits and/or economic (i.e. market-related) competitiveness.

Types of pathways of market-oriented exploitation, converting or transforming knowledge?

- *conversion of knowledge* (or commercialisation) corresponds to projects with direct and almost fully linear relation between the research outcome produced in an EU-funded R&D project and a technology, product or service available to the market.

- *transformation of knowledge* corresponds to non-linear, complex relation between the research outcome produced in an EU-funded R&D project and a technology, product or service available to the market.



Source: Austrian Institute of SME Research 2012

An analysis of a sample of FP4/5/6 projects showed that a comparably small group managed to convert their research in a very direct, linear way into a product or service available to the market without including major additional development steps. The second type "commercial transformation" largely dominates the overall picture. In this case, the results of a project are at the centre of such processes, i.e. research outcome produced in other projects or non-research activities are added to these results.

3. Key factors for successful innovation management

General factors

Combination of both technology push and market pull:
There needs to be a clear demand/market for the innovation, but at the same time, the technology should be at the level that is advanced enough to satisfy the existing demand and to create new markets. The latter is particularly relevant to high-tech NMP products. Which of the two, technology push or market pull, dominates the process depends on the nature and the application sector of innovation. The more technically complex the innovation is, the more important is technology push. This trend can also be related to the need to create markets for innovations which are mainly technology-driven.

Duration of the innovation cycle depending on sector rather than technical complexity:
Several innovations demonstrating high technical complexity managed to reach the market within a couple of years, whereas the market entry of innovations related to the medical sector can take 15-20 years due to the regulatory environment.

High complexity of innovations:
The multidisciplinary nature of enabling technologies means that their scope is broader than in other technologies, and it involves more players in the field than might appear at first glance. For example, a nanotechnology patent may have implications for semiconductor design, biotechnology, materials science, telecommunications, textiles.

Human factor: charismatic leaders and highly motivated teams:
This comprises the presence of charismatic leaders demonstrating clear vision, sensitivity to the environment, to needs of the team, personal risk taking, as well as enthusiastic, ambitious and highly skilled teams.

Financial support from diversified funds:
Several types of funds are used to support enabling technologies, such as personal savings of entrepreneurs; FFF (Friends, Family and Fools); business angels; venture capital investors; institutional funds (risk-bearing capital; bank loans; grants from private funds); and grants from public funds. Whilst public authorities were traditionaly predominantly supporting basic research and first prototyping activities (up to TRL 5: validation in a relevant environment), several public initiatives provide support beyond TRL 5, e.g., funding for the development of a marketable product and first commercialisation activities. Moreover, public support can take different forms such as grants, innovation vouchers, loans,guarantees, pre-commercial procurement, prizes, etc

Impact factors for EU-funded research projects

Through a qualitative analysis of a sample of FP4/5/6 project in the area of Industrial technologies, the report "How to convert research into commercial success stories? Analysis of EU-funded research projects in the field of industrial technologies" identified the main impact factors for market-oriented exploitation.

This chapter provides a mapping of these factors.

The analysis showed that:

- A number of impact factors are linked to the type of research conducted and thus, cannot be changed or altered.
- Although certain impact factors such as market pull can emerge in the later stages of the innovation process, the majority of impact factors emerge in the earliest stages and continue to affect the exploitation success.
- With every step further the pathway to successful market-oriented exploitation is less and less influenceable.
- Primarily during the research stage organisations can prepare themselves for the challenges of market-oriented exploitation and thus, the earlier and more intense this preparation is being conducted the more likely is success in this regard.

Mapping of impact factors

Research fields and level of innovation

- applied R&D projects are commercially exploited faster and more easily
- successful market-oriented exploitation of platform technologies is linked to the ability to fully exploit the whole range of potential applications
- for some research fields, successful market-oriented exploitation heavily depends on managing the public opinion
- a research breakthrough (or radical innovation) does either vastly extend commercial possibilities and opportunities (scope of the exploitation, new application areas etc.) or blocks the chance of market-oriented exploitation (almost) completely

Cooperation

- involvement of industry in R&D consortia increases the success rate of market-oriented exploitation
- end-users often safeguard the important application orientation of a R&D project but can limit the impact of market-oriented exploitation by limiting the application scope
- vertical integration (i.e. including the whole value chain) in R&D projects is a success factor for market-oriented exploitation
- large enterprises can make a difference in successful market-oriented exploitation as long as the research outcomes are in line with their 'expectations'

- larger R&D projects with larger consortia are less strongly affected from mal-performance or drop-out of partners because substitution from inside the consortium is simpler

Management

- ability of organisations and consortia to manage respective risks – and in the event of a risk becoming an actual challenge or threat: emergencies – is crucial for success

- risk or emergency management need to be developed and kept up-to-date

Market knowledge and awareness

- knowing who will buy a technology, product or service and under which performance or price conditions, is the success factor for successful market-oriented exploitation

- most successful organisations tend to investigate their potential markets quite early and often even before they develop a concept for a R&D project

- adding external perspectives on market opportunities is highly effective, especially when unexpected research outcome was produced

- the ability and willingness to act flexibly on well-defined strategies in some cases facilitates a multiplication of potential applications and thus, customers

Additional R&D activities

- investing time and financial resources into the advancement of a technology or innovative modifications of up-/down-stream technologies to an innovation is often the only way for a R&D project to be successfully exploited in the market

Organisational change

- the market-oriented exploitation of innovative technologies is sometimes hindered by an organisational bottleneck and thus, the ability to bypass such bottlenecks by means of organisational change (spin-offs, new departments) is often underestimated as a key element (prerequisite) of market success

Dissemination

- actively disseminating the research outcome through conferences, trade fairs, workshops, publications etc. sometimes provides the only possibility to get feedback on the economic potential and recommended market-oriented exploitation pathways

Demand

- even the best-prepared and executed market-oriented exploitation process fails if the demand is not there or not strong enough, which can have a number of reasons from the overall economic climate to a mismatch between innovation and investment cycles

- organisations that successfully commercialised their research outcome possess an almost intimate knowledge of the production processes and challenges of integrating an innovation in particular production chains and are able to actively convince their customers of their innovation's advantages and easy integration

International competition

- international competition does not only affect prices but is a constant source of potentially competitive (or even the same) technologies

- uncertain price developments make it vital to develop and act on a flexible strategy

that allows downgrading an innovation if prices are too low to market an innovative system price efficiently or use different marketing approaches for different (geographical) markets

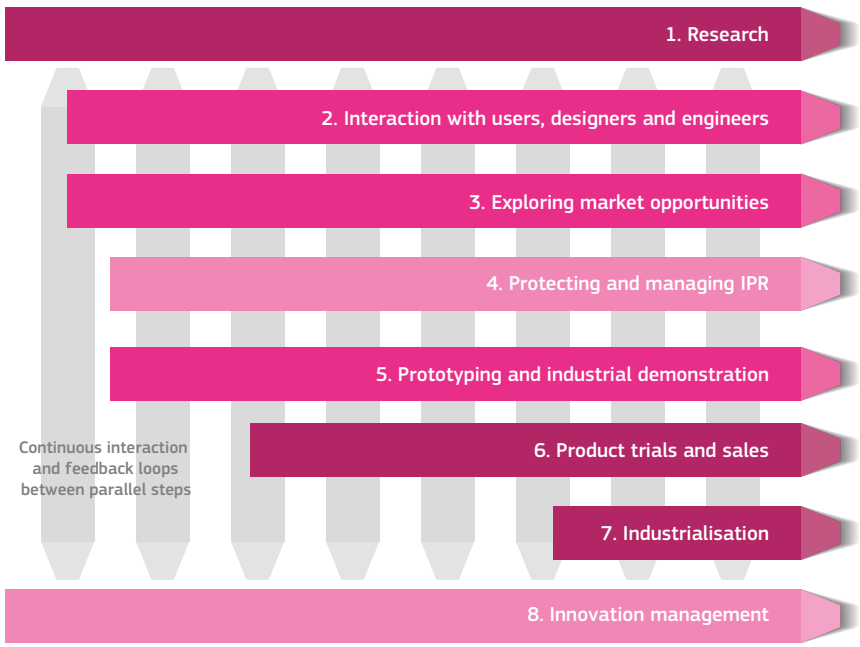
Standards and regulation

- Formal and informal standards can play a vital role. Some technologies developed opened up new markets or niche markets, which – by being the first and at least for some time the only supplier – creates a quasi-standard

4. Activities of the innovation trajectory

Innovation cycle as a continuous process with parallel activities

Rather than a chain of sub-sequent steps, KET innovation trajectory is a continuous process consisting of closely interrelated activities.

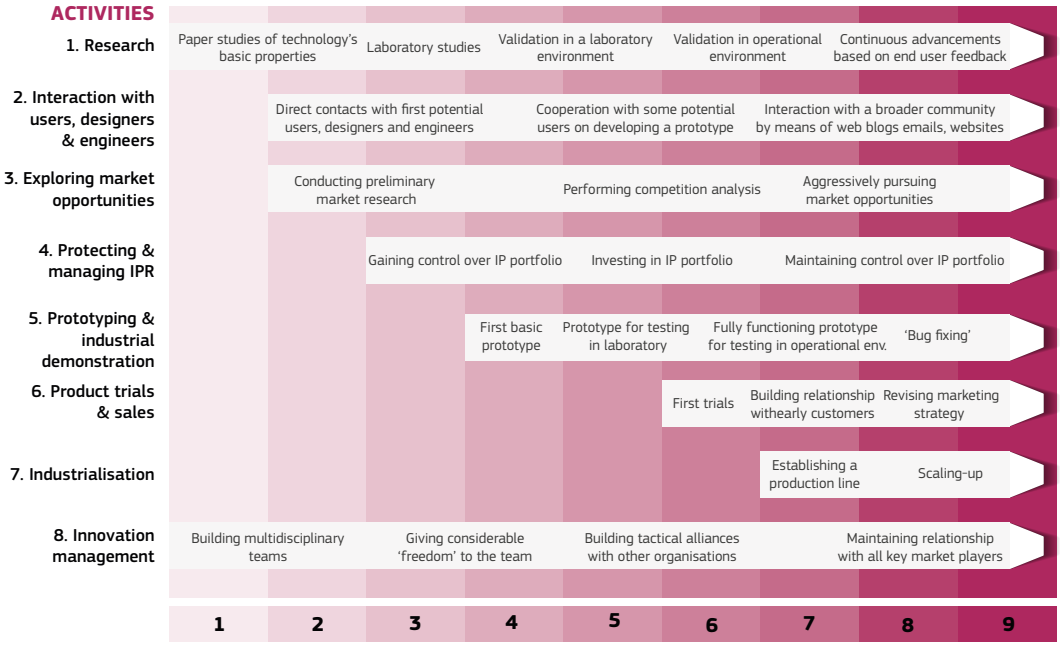


Moreover, the innovation cycle is a continuous iterative process, and it implies several loops. Such feedback loops mainly refer to incorporating feedback from designers, engineer community and users. Activities such as incorporating feedback and exploring market opportunities are reported to take place in parallel with other key steps of the innovation cycle (e.g., research, prototyping, industrial demonstration etc.). In case of successful innovations, incorporating feedback and exploring market opportunities start from the very beginning of the innovation cycle, not long after the beginning of research activities. Furthermore, research itself is typically of ongoing nature, closely linked to feedback incorporation and exploration of market opportunities.

Additionally, given a complex nature of innovations, protecting and managing Intellectual Property Rights becomes a continuous process too. Finally, KET innovations typically represent complex products that often imply trials on the client's side. Since user feedback plays a prominent role in the innovation cycle and allows for further advancement of the product, actual product trials and sales often start in the middle of the innovation cycle rather than closer to the end.

Evolution of activities and technology readiness:

the table below establishes a link between the evolution of activities and Technology Readiness Levels (TRLs):



What are Technology Readiness Levels (TRLs)?

It is a scale from 1 to 9 allowing the measurement of the maturity of a technology, lower TRLs corresponding to basic research and highest ones to a technology (nearly) ready to be introduced on the market:

1. Basic principles observed and reported.
2. Technology concept formulated.
3. Analytical and experimental critical function proof of concept.
4. Component and/or breadboard validation in a laboratory environment.
5. Component and/or breadboard validation in a relevant environment.
6. System/subsystem model or prototype demonstration in a relevant environment.
7. System prototype demonstration in an operational environment.
8. Actual system completed and operationally qualified through test and demonstration.
9. Actual system, proven through successful practical use.

ACTIVITY 1 Research: close involvement of industry and diverse funding sources

An innovation typically begins as a result of research, leading to a set of discoveries, research being investigation and experimentation, while discovery is the result of such research and entails the realisation of the previously unknown concept, idea, principle or phenomenon (e.g., new material, new process). Research thus represents an activity that is focused on the development of knowledge in the form of discoveries.

Common success factors:

- Highly motivated and highly skilled research team
- Leader's commitment and support to the project
- Close collaboration between companies and universities/research institutes

Common challenges and barriers:

- Good knowledge of the state-of-the-art developments in the field;
- The need to tackle technical problems nobody ever tackled before;
- The need to balance between quality and cost due to budget limitations.

ACTIVITY 2 Interaction with users, designers and engineers: active involvement of community from the very beginning

Successful NMP innovations demonstrate an active involvement of users, designers and engineers from the very beginning of their innovation trajectory. Interaction with users strengthened the organisation' ability to quickly adapt to new market demand or circumstances. The feedback provided by the users allows for rapid improvement of the product.

This involvement may take different forms such as:

- online collaboration platforms with a broader community;
- direct contacts with users, designers and engineers at company's premises, conferences, fairs and/or other events;
- interaction with a broader community by means of web blogs and emails;
- engagement in open source approach.

ACTIVITY 3 Exploring market opportunities: obtaining good knowledge of the market

This activity implies rigorous marker scans, negotiations with potential partners and consumers.

Conducting preliminary market research: in technology transfer, there are two key types of markets. The first market is the market of the innovation's developers, i.e., the market for licensing, joint venturing, raising capital, or otherwise commercialising the technology. The second market is the market of the innovation's buyers, that is the market in which the potential commercialisation partners sell something with the aid of the technology to their customers: the end users.

Performing competition analysis: there are two sets of competitors for any technology: (1) competitors relevant when selling goods embodying or made with the technology to end-users, and (2) competitors relevant when determining who is developing substitute technologies.

ACTIVITY 4 Protecting and managing Intellectual Property Rights

The complexity of IP rights for enabling technologies means that there are potentially more players in the field than might appear at first glance. For example, a nanotechnology patent may have implications for semiconductor design,

biotechnology, materials science, telecommunications, and textiles, even though the patent is held by a firm that works in only one of these industries. Unlike other new industries, in which the patentees are largely actual or at least potential participants in the market, a significant number of enabling technologies patentees owns rights not just in the industry in which they participate, but in other industries as well.

Different scenarios are possible regarding the creation of IP for KET products, and there is no one best way to deal with IP. It depends, among others, on whether IP already exists or needs to be created, the risk of substitution, as well as the size and financial capacity of a company.

Companies got their initial IP from universities or large companies

- Companies filed patents themselves based on own research
- Companies licensed patents from small companies
- Companies did not file any patents at all

The key reason for not filing any patents refers to the risk of disclosing the way the technology works and making it relatively easy for other companies (especially big players) to come up with a substitute and finding ways to circumvent the patent. In these specific cases, companies shall work with non-disclosure agreements and trade secrets measures.

ACTIVITY 5 Prototyping and industrial demonstration: processes for efficient manufacture and market delivery in the future

A prototype is a necessary prerequisite for a successful innovation: This stage often involves contacts with customers and collaboration partners. Moreover, possible failure modes in different environments are thoroughly tested to ensure that failure model predictions are verified.

During the industrial demonstrator stage, the focus shifts to adapting the prototype for commercial exploitation: creation of the processes required for efficient manufacture and market delivery of a commercial product based upon the prototype characterizes innovation in the commercial stage. Innovative emphasis shifts from product function to process development and refinement.

ACTIVITY 6 Product trials and sales: clear naming and framing

The competitive landscape during the commercial stage is characterized by product variation between competing firms, each focused on bringing to market their versions of the product. Since product differentiation in terms of function and cost may well determine the market winners, the commercial stage represents the peak of private value for the innovation timeline.

Key aspects have to be considered, such as the choice of an easy-to-understand name to make the product recognisable for the very first customers, and clear positioning on the market, specifying who it is for and what it is for. Positioning of successful innovations specifies their R&D aspects and potential applications, key product features and direct customer benefits.

KET innovations are innovations of potentially disruptive nature, often offering radically new ways of doing things and are initially too unknown and sophisticated for the majority of their potential customers. Moreover, KET innovations are associated with a wide range of social complexities that need to be taken into account when

developing marketing strategies for such innovations. These social complexities among others include the following:

- the need to 'prepare' the market mentally for the arrival of the innovation;
- the need to educate the users with regard to how to exploit the innovation;
- the need to exploit new communication channels with potential users;
- the need to develop new business models that best reflect the nature of the innovation (including new type of after-sales services).

Consequently, there is a need to embrace a broader concept of innovation, including its non-technological aspects, i.e. social innovation.

Building a relationship of trust between the company and its early customers can be a key success factor. Early customers are often unfamiliar with the product and may feel reluctant to bet their resources on it. In most of the cases, successful innovations offer their early adopters a clear comparative business advantage, e.g., lower product costs, faster time-to-market, more complete customer service.

ACTIVITY 7 Industrialisation: searching for cost-efficient solutions

This activity implies a shift toward real-life applications, as well as the increasing demand from industry (scaling-up), growing customer base and first licensing agreements. Upscaling KET products can be problematic, costly and requires significant investments.

Some industrialisation-related key success factors:

- Careful selection of an external manufacturing company which could provide detailed feedback on product design
- Working with small-size partners allows for making decisions quickly
- Working with used equipment through Internet auctions

ACTIVITY 8 Managing innovation: connected and free thinking

Innovation management refers to the central activity of the innovation cycle and is linked to all other elements. Without proper management processes, it is not possible for R&D&I to be efficient. Innovation management includes a set of tools that allow entrepreneurs, managers and researchers to cooperate with a common understanding of goals and processes. To succeed in it, an understanding of both the market and the technical problems is needed. Both dimensions can be covered by:

- Multidisciplinary teams: organizations that produce successful products typically practice the integrated team approach, mainly to develop processes and equipment for manufacturing, assembly, and measurement.
- No thinking in terms of silos.
- Openness for ideas from outside.
- Engagement of diverse stakeholder groups: actors of the market, actors of the value chain, partners in research projects, public actors.
- Maintaining relations with all market players: customers, press and analysts, hardware and software partners, distributors, dealers, value-added-resellers, system integrators, user groups, vertically oriented industry organisations, universities, standards bodies, and international partners.
- Building tactical alliances with other organisations: partnering with others can for example lead to cost reductions by enabling the partners to leverage economies of scale and scope or network economies, offering learning curve advantages, guaranteeing access to suppliers.

5. How to address innovation issues at proposal stage and during the project lifecycle

At proposal stage:

Whilst all details cannot be provided on how future results will be exploited at this stage, several elements on how innovation aspects will be further developed during the project life can and should be addressed:

- Identify key application(s) of the envisaged results and describe the main technical advantages of the new solution(s).
- Define the maturity of the technology addressed and link it to the timescale and scope of the innovation process.
- Identify measures needed to support the uptake (demonstration, prototyping, proof of concept, validation, testing, standardisation).
- Describe the industrial/commercial involvement of individual partners to ensure exploitation of the results, and how the involvement of SMEs has been addressed. It can show if the whole value chain is considered in the project planning, the involvement of potential technology end users, the expertise in exploitation, etc
- Integrate technology intelligence elements through analysis of scientific state-of-the-art, patent search, existing standards, etc
- Demonstrate and quantify knowledge about the existing and potential new markets, the competitors and the existing technologies.
- Quantify the direct expected impact (economic and commercial) for partner organisations: benefits, new markets penetration, new clients, creation of new companies, updating of portfolio, diversification, internationalization, employment, etc.
- Quantify the wider potential impact at European and global scale, economic as well as other societal benefits.
- Include a specific work-package focused on the market exploitation planned and the roles and synergies between the partners' experiences/ competencies/ capabilities, how partners will protect, share, manage, and ensure the IPR actual exploitation, the commercialization route envisaged for the exploitation of the results (market strategy, distribution channels, etc.).
- Include an exploitation plan within the proposal, as detailed as possible.
- Describe deliverables such as market studies, detailed exploitation plans, exploitation agreements, IPR status, etc
- Describe the planned resources for addressing exploitation and impact during the project.

At project stage:

Management of innovation activities is an integral part of an industrial technologies research project. Detailing of the exploitation plans and preparation for innovation and commercialisation activities must be continuously followed up throughout the research project.

This includes:

- Protecting before disseminating project results. It is advisable to set up clear and efficient procedures for rapidly protecting new results and agreeing on dissemination, hereby ensuring that no information is published which could be detrimental to the protection of some results.

- Ownership of results: agreements on access rights for research and commercial use must be put in place early.

- Implementing "innovation-related activities" such as validation or take-up activities, definition of strategies relating to the granting of licences to third parties or to the identification of potential hurdles for the implementation of the project's results (e.g. standards or third parties' patents), etc.

- Refining progressively the "plan for using and disseminating knowledge", as results are generated and as their exploitation potential becomes more accurate

- Identifying and collaborating with potential users

- Identifying potential partners and sources of finance for commercialisation for next steps.

6. Support and Information Sources

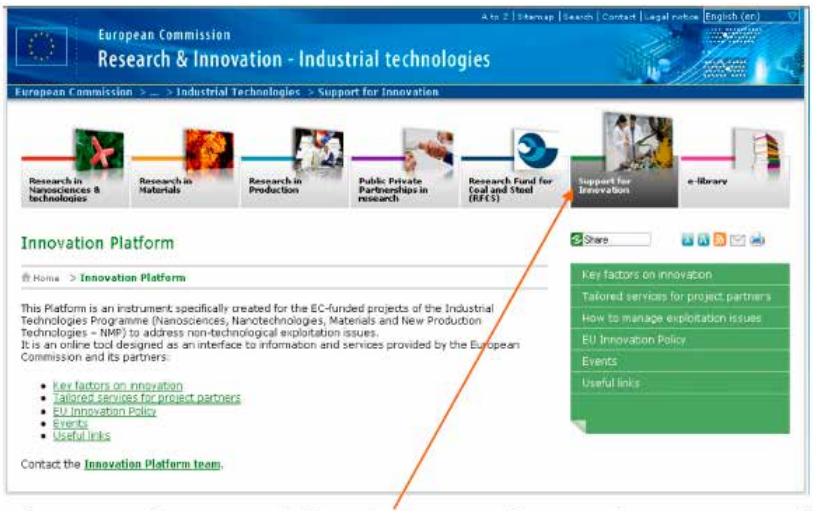
The Industrial Technology Innovation Platform

The Innovation Platform is an instrument created for the EC-funded projects of the Industrial Technologies Programme (Nanosciences, Nanotechnologies, Materials and New Production Technologies).

It offers

- Tailored services to assist project partners (ESIC services).
- Advice and information on how to address key exploitation factors.
- Innovation on events related to innovation topics.
- Useful links to partners offering supports.

It is an online tool available on the Industrial Technologies Website:
http://ec.europa.eu/research/industrial_technologies



Click on "Support for Innovation" to access the servives of the Innovation Platform

For more information, contact the Innovation Platform:
rtd-nmp-innovation@ec.europa.eu

Services provided by Exploitation Strategy and Innovation Consultants (ESIC)

The Innovation Platform helps NMP projects to bridge the gap between research outcomes and exploitation through a series of tailored services.

These services are provided by Exploitation Strategy and Innovation Consultants (ESIC) for free and under confidentiality agreement.

ESIC services:

- *Project Risk Analysis (PRA)* to identify the risks and potential obstacles to the future exploitation of project results.
- *Exploitation Strategy Seminars (ESS)* to brainstorm on how a consortium can address the risks and potential obstacles identified in the PRA.
- *Business plan development service* to assist partners with this crucial step towards exploitation.
- *Assistance for patenting* to support the partners with the writing, filing and legal follow-up of patents.
- *Assistance for standardisation* to help partners to exploit project results that can benefit from the development of standards

For more information, visit the Industrial technologies Innovation Platform or contact RTD-NMP-ESIC@ec.europa.eu

Other networks and supports

The NMP National Contact Points (NCPs) network is the main provider of FP advice and individual assistance in all Member States. The NMP TeAm 2 project aims at assisting the NMP NCP Network, which includes tools such as a partner search system and information about events and projects.

For more information, visit the website http://www.nmpteam.com/

Enterprise Europe Network helps small companies seize business to the opportunities in the EU Single Market and beyond. It can help to find appropriate SME partners for a consortium or support SMEs to be involved in a consortium.

For more information, visit the website http://een.ec.europa.eu

The European IPR Helpdesk assists potential and current contractors on intellectual property rights (IPR) issues including Community diffusion and protection rules.

For more information, visit the website https://www.iprhelpdesk.eu/

ESP@CENET is an instrument to conduct Patent information search. Patent information centres (PATLIB), supported by the European Patent Office, can offer practical assistance on different kinds of intellectual property rights (IPRs).

For more information, visit the website http://www.epo.org/searching.html

CEN-Cenelec has created a research helpdesk to whom applicants can benefit from and contribute to standardization, and published a Guide for FP7 project proposers.

For more information, contact research@cencenelec.eu

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European Commission

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Luxembourg: Publications Office of the European Union

2013 — 20 pp. — 17,6 x 25 cm

ISBN 978-92-79-29717-5
doi 10.2777/10737

KI-NC-25-952-EN-N

The three publications «How to convert research into commercial success story?» aim to analyse how to successfully bridge the gap between research outputs and innovations' access to the market in the area of industrial and enabling technologies.

The aim of this publication is to help researchers involved in EU-funded projects to understand innovation management and entrepreneurial aspects necessary to commercially exploit research results.

It is based on the results of the following reports:
The report «How to convert research into commercial success stories? Analysis of EU-funded research projects in the field of industrial technologies» retraces the pathways from research outcomes to commercialisation.

The report «How to convert research into commercial success story? Analysis of innovation successes in the field of industrial technologies» describes commercial successes not necessarily funded by the European Union in the field of industrial technologies.

Studies and reports

Publications Office

ISBN 978-92-79-29717-5

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doi:10.2777/10737