Innovation, valorisation and university: the Innova programme at the UPC

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A plausible rationale for this introduction could perfectly be the following: «We are living in knowledge society. In knowledge society, knowledge is important. In medium-high income countries, universities are the institutions producing most knowledge. Therefore, universities are important in knowledge society.» There is no need to say that this rationale, conveniently adorned, would be widely accepted without much ado. However, such a prompt argumentation would have accurate readers twist their nose.

The importance of university as a player in the science and technology system all over the world, especially in medium-high income countries

The first assertion: «in knowledge society, knowledge is important» seems a smart remark rather than a respectable sentence. Put in other words, for this rationale to have the force of a solid argument for this article and give some hints about setting up an industry and technology policy or simply understanding the exact functioning of mechanisms by which universities are an indispensable player within the science and technology system, we would need to analyse in-depth each of its assertions.

Going along this rationale, we need to define with quite some precision what we understand by information society, define knowledge, analyse its features and classify its different types, find out who produces knowledge, under which conditions, in what stages and – very importantly – how the step from knowledge to innovation is completed, that is, how knowledge becomes concrete to satisfy the needs of society. I do not believe that we need to engage in such a Sisyphean task, nor am I sure that we know enough to solve it satisfactorily. I rather consider that for our purpose we should keep to commenting, in a more or less precise way, some aspects of the university-innovation rationale so as to better understand the possible role of universities in the overall competitiveness of a country, especially ours. Perhaps we could work out a new rationale, more accurate and adapted to the purpose of this article, which could be the following: «Universities produce systematically certain previous knowledge or information in their research activity. Previous knowledge is manifested in publications. In knowledge society, the production system and organisations in general need previous knowledge to innovate and adapt to the market on an ongoing basis.» It could also be useful to talk of competencies acquired by teachers, researchers and PhD students as they produce high-quality publications. Perhaps it is not even necessary to be so meticulous and rather be straightforward and use the triple helix or entrepreneurial university model or any other fortunate theoretical remedy to prove the importance of university and by the way avoid turning this article into a doctoral thesis.

Knowledge is for a country all that makes its players in the production and auxiliary systems take decisions and go into the right direction.

However, we refuse to be that direct and will dwell on separating knowledge from information. Understanding by knowledge «anything capacitating a person, country or organisation for action», we distinguish it from previous information or know-how, that is, those publications increasing the information stock, which is what the university is best at.

Knowledge is what allows a professional to act at their working place. Knowledge is for a company the set of procedures allowing it to survive on the market. Knowledge is for a country all that makes its players in the production and auxiliary systems take decisions and go into the right direction. All in all, the complexity of economic organisation makes it difficult to take decisions and act without that «previous knowledge» nor the competencies of people working in that. The capacity to act is very limited without accompanying expertise and competencies and its added value will not be enough to make progress. If we add the statistic data showing that universities are the institutions that are best prepared and do most work to produce «previous knowledge» in Catalonia, their importance for competitiveness becomes apparent.

Confronted with these assertions, sceptics will argue that companies also produce previous knowledge, though of a different nature and surely more adapted, especially those having an R&D department of their own. They will also tell us that previous knowledge can be bought, either translated and shipped with the same equipment or by digitalised means. They will add, with a cynical smile, that if previous knowledge is to be necessary it really needs to be previous, i.e. something has to come out of it later instead of being left in a drawer or shelf in the lab. Sceptics are right with all this, but these assertions do not take any objective relevance from the task of creating previous knowledge, both to train research professionals and to produce opportunities that can become innovations, no matter how distant they may be from the market in their initial experimental or publication format.

Industry and technology policies are much easier guided and implemented at universities than in companies.

It is also known that in medium-high income countries there are few companies with an R&D department, and expenditure related to this activity is lower than in high-income countries. This is precisely the reason for which the income is lower than in more developed countries. There is another relevant factor. Industry and technology policies are much easier guided and implemented at universities than in companies. In fact, public universities raise a proportion of their funds from public administration and return to society seems to be more compelling than in other organisations. Also, research as a whole is not accumulation but system. Universities networking with the production system have a proven synergetic ability. Figures are also plain. The staff potentially devoted to research at Catalan universities is extraordinarily numerous. The Polytechnic University of Catalonia (UPC), for instance, has almost 13,000 people counting full-time professors and researchers, PhD students, research trainees and undergraduates doing their final project in labs. Similar figures also apply to the rest of universities. Such facts give hope. In other words, there is an enormous amount of previous knowledge potentially producible by universities and these institutions are the ones producing most in our country. To finish answering to those sceptical with the relevance of universities to the economic development of our society, they shall be told that they are not right as long as universities are able to transfer to society all they have in their drawers and shelves ready to be used.

Research as the origin of valorisation. And why not teaching?

We said between the lines that transforming knowledge – understood as the capacity to act – into innovation is the final result of the process reaching from previous knowledge to society. It is here where the system demonstrates its efficiency. The quality of the system shows when innovation resulting from the process ensures competitiveness and contributes with added value to the welfare of medium-income citizens. Innovation is not the only goal today, the final goal is to innovate better. We also said that universities are relevant players in the process, especially in medium-high income countries as ours. Universities assure the competencies of future professionals and capacitate them for action at a higher level than the one they would have if they did not study there. Universities produce previous knowledge that can be transformed into opportunities and are also an active part of the network circulating valuable information to other territorial players. Its objective relevance for human and material resources makes of universities a crucial player in the science and technology system. In medium-high income countries, universities replace and complete the production of previous knowledge by companies, whereas in high-income countries they

spearhead knowledge and new initiatives. However, transferring previous knowledge, publications and trials to society is not that obvious nor automatic. It is precisely in medium-high income countries where the transfer is most difficult, especially if the research and teaching system is not appropriate.

If a university conveys much information but few knowledge, i.e. it creates an alleged knowledge stock but does not explain how to use and recreate it to experiment on it, the transfer of knowledge to society by means of competencies will be poor.

Let us start with teaching. If a university conveys much information but few knowledge – in technology, science, arts and humanities, social sciences, medicine etc. – i.e. it creates an alleged knowledge stock but does not explain how to use and recreate it to experiment on it, the transfer of knowledge to society by means of competencies will be poor. There is no need to be a teaching expert to see that students learning through participation and trial, who are asked to be creative and to solve difficult problems with advanced tools they are to discover with the assistance of teachers, will learn more than those just taking notes and having an exam. The former group will be better prepared to make a contribution to society than the latter.

However, there is more to it. In the second group, students will not improve their entrepreneurial, innovating and engagement capacity either, so when they leave university they will not be able to think of any exciting project discovered during their career. The ultimate test in education are elective subjects. When a student chooses them for reasons other than their deliberate management of their own educational cycle, then they have not made up their mind about the latter. When a student is unable to build up an educational cycle, then the learning procedures during their career have not given them any hints to create a fair picture of what their profession is about and thus to know what educational gaps can be filled by the curriculum.

After teaching comes research. The issue is more complex here, though not more relevant. We have been talking in-depth of the important and proven capacity of Catalan universities to produce previous knowledge. But to what extent does this previous knowledge reach society in the short, medium or long term? How does it get there? How intense is its added value? And what is the final contribution of Catalan research to the competitiveness and growth of our production system? In how far does it improve organisations and the rest of society?

Previous knowledge – despite being complex and the use of many means to create it – does not necessarily become useful for organisations if there is not any kind of transfer or transformation of this knowledge into something applicable to processes, products, organisations, the production system or the functioning of society in a wider sense. We cannot talk about valorisation of research without mentioning the apparent conflict between applied and pure research.

Long-term quality research is not opposed nor shall pose any problem to transfer, patents and spin-offs, about which we will talk later on. Research cannot be developed in a society hostile to science and technological progress.

It is a useful discussion precisely to help avoid prejudices and over-simplification. It is about discussing basic and applied research, the importance of basic support sciences, the need that science reaches out to the production system and eventually society. This discussion is definitely interesting if accurate as it offers parameters for taking decisions in science and technology poli-

cy. However, it is often the result of the fear that requirements in research quality may be lowered, that funds may be linked to applicability deadlines and that the necessary continuity of teams and trials may break up. It is a perfectly understandable attitude.

Nevertheless, these arguments are sometimes used as a pretext to hide a lack of commitment with the public cause. Long-term quality research is not opposed nor shall pose any problem to transfer, patents and spin-offs, about which we will talk later on. The technical and scientific origin of technological innovation has no borders and research practice at universities and public laboratories can contribute to it out of any level of development, both directly and indirectly, thanks to subproducts of knowledge or the results of thoughts and trials.

Scientific novelties are called discoveries, while changes in technological applications are known as inventions. When previous knowledge from the science and technology stock is used to introduce change in products, processes or organisations in general and it is accepted by the market, it is called innovation. The science and technology stock is of different nature and its use by the production system can vary extremely, and so will the valorisation case studies.

Let us just think of the amount and diversity of science and technology behind the development of a particle accelerator, a mobile phone, a hard drive or the production of a molecule for medical use, as well as behind artificial intelligence, machine translation and also the organisation of an education system or a city council, and the social contribution of all those thinking of and disseminating the values and principles that are to guide our social life. Of course there is diversity in the creation of science and technology stock, but it is also in the methods and tools to disseminate and valorise it.

Research cannot be developed in a society hostile to science and technological progress. Researchers and engineers have always made big efforts to present their activities so as to interest non-specialised audiences, either to satisfy their curiosity or to prove the interest of the results. There are different ways of disseminating knowledge: publication of books and articles, lectures, congresses, participation in media or expert committees, informal meetings etc. The impact or the degree of success of such dissemination can be measured in very different ways: through expert committees, the degree of dissemination, its influence on programmes, legislation or changes in public opinion, not to mention teaching as a means of transfer, etc. We will now dwell on valorisation without challenging the relevance of dissemination and its contribution to change in our society.

Valorisation can be measured in transfer contracts, patents and spin-offs. These procedures are not the only transfer methods but certainly the most evident and measurable ones.

In fact, research at our universities is voluntary. Its structure is precarious, spontaneous, its size not adequate and resources hardly sustainable and too often erratic.

However, there is no dissemination nor valorisation of research without research. This sounds obvious but it often seems to be assumed that everyone at university does research, that it is done for a given purpose, that research groups are well organised, that they have the critical mass, that they are well managed and that their continuity is guaranteed by a management system according to research goals. The only thing that is sometimes challenged is that research groups have enough resources to spearhead science or that salaries are in accordance with their high social status.

These assumptions are far from reality. In fact, research at our universities is voluntary. Its struc-

ture is precarious or, if you prefer, spontaneous, its size not adequate and resources hardly sustainable and too often erratic.

Research output originating in personal initiative or microgroups often produces high-quality articles. However, it is obvious that the other shortcomings related to poor organisation of the group render management of recurrent trials and prototypes difficult. It is people or reduced groups of people who, given the possibilities of the legal framework and the university statutes, have chosen an environment allowing to write articles, even high-quality ones. In such cases, which are the majority, transfer is not far-flung, very person-related, and most patents, which are scarce anyway, need a later technical treatment, all of which requires a big effort, making its later use very difficult.

The organisation and governance gaps in labs or research groups render specialisation, long-term planning, sustainability of both human and material resources and the security of processes, consolidation of trials, regularity of transfer, prototypes, patents and spin-offs impossible.

In the case of voluntary research, the transfer effort is craft-like, as it is in other valorisation modes. All in all, the organisation and governance gaps in labs or research groups render specialisation, long-term planning, sustainability of both human and material resources and thus the security of processes, consolidation of trials, regularity of transfer, prototypes, patents and spin-offs impossible.

From time to time, there are entrepreneurial researchers able to drag a numerous group of colleagues thanks to their leading capacity, apart from their academic qualification. Leaders look for and find money here and there and create around them an effective research structure able to generate more resources, making research more comfortable. Such groups are much more prone to transfer, producing patents and opportunities to create spin-offs. This is an interesting phenomenon, worth a study in organisation sociology, but it is spontaneous, not planned and definitely not provided for in university rules nor protected from the rigidity of its statutes. These groups eventually seek independence under different institutional umbrellas, while keeping attached to the university.

The final picture of university research is that of a spontaneous and fragile structure, a result of the historical will, capacity and vicissitudes of its players. If progress in research and valorisation is to be achieved, it would be convenient to create a new legal framework for university research that, while respecting what has been done so far, makes its organisation possible, ensures its stability and resources, fosters entrepreneurial behaviour and stimulates new initiatives.

Valorisation, at last!

The valorisation function in research as such is not new, but it is in its current size and relevance for society, especially the production system. Valorisation means the set of actions needed for research results to contribute to economic and social development of a country in the shape of wealth and employment in the most efficient way possible. This is an important part of the social commitment of research, especially if publicly funded.

The distinction within the valorisation function between transfer, patents, spin-offs and other complementary services is especially useful to understand the mechanisms to foster and organise it through both universities and public policies. To put it simple, the transfer function becomes concrete in a contract between a professor

or a university research group and a person, company, organisation or administration for «transferring» a given knowledge or expertise required. The university appears here as a supplier of advanced services. The nature of transfer is very diverse, reaching from advice to making prototypes. Once the contract is fulfilled in its terms, the job of the university is over. What is left are tasks related to net profit management.

Valorisation programmes and units have two tasks. The first is geared to university, the second to the market.

In the case of patents and spin-offs as tasks to be done and promoted by universities, their characteristics are different. Here, the results of valorisation are passed from the university to society as independent units, patents and companies with their own life. The university appears thus as an entrepreneur, owner and driver of the production and social system.

In this respect, patents are definitely owned by the university, although professors participate in them. In the case of companies, their owners are the entrepreneurs, though universities often take part in them, especially if they are a result of a patent. Although the university does not participate in the created company, it is a matter of course that it manages the network of companies created for the benefit of the university and its goals, especially if the company finally settles in a technology park of the same university. The result of transfer terminates with every contract. The result of valorisation remains with licenses, involvement in companies and managing the created production base.

It is natural that universities use the network of created companies to improve mobility with professors, PhD students and undergraduates in order to generate agreements, provide PhD students with work, increase the critical mass of their service customers etc. Moreover, universities can draw a considerable economic benefit from licences and shares in companies, which yield a return of public funds used to that end. This way, universities can grow their funds and revenues and, perhaps more significantly, acquire competencies in financial market knowledge, increase their capacity to interact with business and manage the creation of clusters in parks and its results in a safer and more efficient way.

The importance of raising the awareness of universities for valorisation, detecting opportunities out of publications, the transformation of the latter into a prototype or an object, the analysis of its market value, the protection of results and their commercial processing by means of licences or the creation of technology-based companies thus becomes apparent. The valorisation task is not homogeneous but of differing nature, requiring various forms of organisation.

Valorisation requires awareness-raising and cultural change, detecting opportunities out of publications, projects and trials, transfer contracts, their transformation into a prototype or a valorisable object, the assessment of its value and the protection of results.

However, it is very clear that the drive to create companies for patents and licenses as well as their management is a highly professional task that requires specific attention. If labs were accordingly organised it would be much easier, but as long as research remains personal and research groups small in size, valorisation units will not only have to grasp technological opportunities and assess their qualification for a patent or spin-off, but also to help transform an idea into an object so as to enter the valorisation process.

Valorisation programmes and units therefore have two tasks. The first is geared to university. It

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is about searching, detecting opportunities and engaging researchers at their secluded working place. Then it is about collaborating with them to transform such not-yet-opportunities into valorisable objects. The second task is geared to the market.

Once in possession of something valuable and tangible, it is about initiating the process to place it on the market, laying out a logical path towards the patent (i.e. obtaining a patent and taking it to the market) or giving advice and seeking funding to create a technology-based company making use of the technological opportunity once it is polished and ready for valorisation.

This is of course quite a difficult task that requires considerable human and financial resources. It is the only way to yield results that, according to our experience, will have an economic and social return much higher than the investment of public funds and efforts.

The Innova programme as an example of a valorisation tool

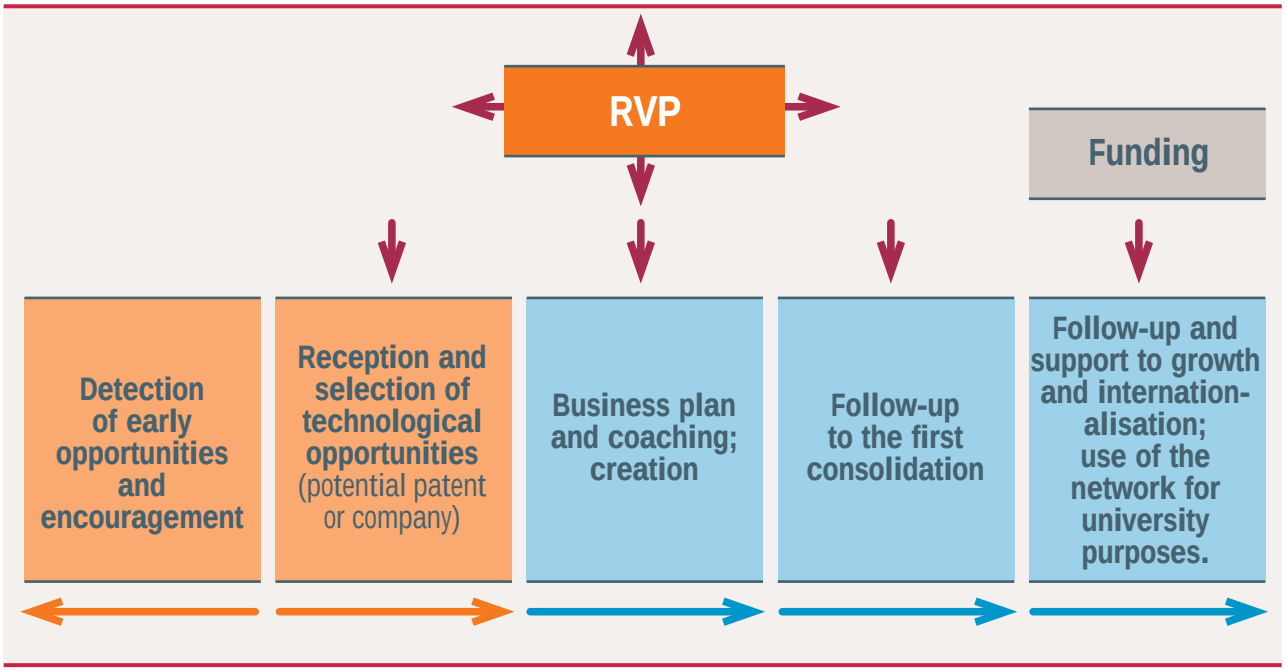
Beyond transfer, valorisation requires awareness-raising and cultural change, detecting opportunities out of publications, projects and trials, even of transfer contracts, their transformation into a prototype or a valorisable object, the assessment of its value and the protection of results, through either licences of industrial and intellectual property rights or creating technology-based companies. This is a highly professional task that requires a specific unit.

The transfer from early opportunity to opportunity, from opportunity to business opportunity and from business opportunity to company is not child's play.

The unit in charge of taking industrial property to the market and helping transform early opportunities into spin-offs at the UPC is the Innova programme. It was created in 1998 and has helped 520 entrepreneurs to create 212 companies and 2400 jobs ever since. In 2006, it assumed the task of taking patents to the market in order to complete the valorisation model by which property rights are created at the university, after which new independent organisations, i.e. participated or non-participated companies are created.

After two years of work, the amount of administered patents reached 40 national and six international ones in 2006 and 38 national and eight international ones in 2007. The licensing rights amount to 200,000 euros per year, with a reasonable forecast of reaching 400,000 euros in 2010. What conclusions can we draw from the work done in the last ten years? How does the Innova programme work?

Graph 1. **Sequence of processes in research valorisation programmes.**



▲ The Innova programme was created in 1998 and has helped 520 entrepreneurs to create 212 companies and 2400 jobs ever since.

▸ *Detecting early opportunities.* If labs were adequately organised and their goals included indicators and incentives regarding licensable patents and spin-offs, the task of valorisation programmes would be much easier. As long as the research structure follows a spontaneous model and the agreed incentives or objectives do not cover patents and spin-offs, valorisation units such as the Innova programme will need not only to grasp technological opportunities and assess their qualification for a patent or a spin-off but also to help transform an idea into an object that may enter a valorisation process.

Valorisation programmes and units therefore have two tasks. The first is geared to university. It is about searching, detecting opportunities and engaging researchers at their secluded working place. Then it is about collaborating with them to transform such not-yet-opportunities into valorisable objects. The task of transforming early opportunities into something valorisable can take up to two years.

Gathering and managing early or not-yet-opportunities is a task against the stream, which is the reason why the arrow in graph 1 points down. The tools used are diverse since they include awareness-raising and collaboration with the technology transfer centre, from where valorisable opportunities will also come out.

▸ *Reception and valorisation as such.* Once in possession of something valuable and tangible, the process to place it on the market needs to be initiated, laying out a logical path towards the patent. This requires obtaining a patent and taking it to the market or hosting the entrepreneur, giving them total support and filling the gaps in local markets related to both financing and commercial space as well as in knowledge and abilities of the future entrepreneur.

The technological opportunity is now tuned and ready to be valorised but the way to get there is long and strenuous. Opportunities coming about are very diverse. Their markets are often global and the clients very specific. There are considerable difficulties in finding out their utility for potential clients and in most cases a good deal of realism is necessary to add to what can already be called business opportunity. The transfer from early opportunity to opportunity, from opportunity to business opportunity and from business opportunity to company is not precisely child's play.

Fostering entrepreneurship is a cultural change and it needs to be done, but organising the step from the paper to an internationalised company is something completely different.

Such coaching is long and costly, so it requires considerable human and financial resources as the only way to yield results. Experience shows that results have a much higher financial and social return than the investment of public funds and efforts.

- *The path towards creating spin-offs.* The path taking the defined opportunity to the market can be followed through the business plan, which is not a more or less academic exercise nor a goal in itself but a tool serving advisors and entrepreneurs, the future businesspeople, to take care of obstacles, necessary resources and weaknesses and to finally transform their original project into a realistic one. If new resource needs come up in the course of a business plan, the programme will give advice to the entrepreneur on the best way to obtain them.

- *Creating a company.* The creation of a company is a formal step but also the starting point to go out to the market. It is when the financial statement clock starts ticking. Although business angels can be planned for in an earlier stage, it is now – in the light of financial or management difficulties or due to lack of market knowledge – when partners and space need to be found. Universities do supply space, especially to those companies having started in a technology park. Companies and entrepreneurs, now having become businesspeople, retrieve energy, knowledge and resources from their labs of origin – with the according return – as well as human resources (PhD students, research trainees etc.). This proximity helps the company survive first and consolidate later. Agglomeration economies and synergies become apparent and are a cushion for the company. Catalan universities, aware of the difficulty in raising specific funding, have created their own business angels network.

- *Consolidation and growth.* Consolidation of technology-based companies – which, as mentioned before, have global and often specific markets – therefore requires more aid than traditional ones or, to be more precise, a different kind of aid. Given the difficulties to consolidate and grow this type of companies, Catalan universities have developed their expertise and relation of trust with CIDEM, CDTI and financial institutions to make the task of raising capital easier for entrepreneurs. Besides, the Innova programme – together with the La Salle technology park, the 22@ district and the Chamber of Commerce, with the help of the Spanish Ministry of Industry and CIDEM – has created two programmes that have proven useful: Accel and Landing. The former contributes to the growth of companies through training and mentoring, while the latter facilitates internationalisation through mutual advice and service agreements with regional development agencies from different countries all over the world. Both programmes are costly but yield returns higher than their cost.

Finally, some readers might miss the promotion of entrepreneurial spirit and innovation culture. It is natural since there is the common belief that if both things are fostered, this will encourage the creation of companies and companies

will come about by themselves. The first assertion is true, but the second not so much. In the case of technology-based companies, the step from an early opportunity to a company is not a self-accomplishing task, that is, it is not enough to foster entrepreneurship at universities so publications go from the paper to the market.

Catalan universities are doing a remarkable task in fostering an entrepreneurial spirit linked to creation as such and in approaching entrepreneurial students to research.

Fostering entrepreneurship is therefore a cultural change and it needs to be done, but organising the step from the paper to an internationalised company is something completely different. With initiatives such as the Top programme, idea contests and recurrent training and tailor-made programmes such as Innova, Catalan universities are doing a remarkable task in fostering an entrepreneurial spirit linked to creation as such and in approaching entrepreneurial students to research.

Conclusions

All in all, the task of bringing knowledge to the market is both indispensable and possible, its benefits being apparent. What is still needed is an understanding that programmes require resources, of course with accurate accountability. Both things will be equally welcome.

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