Vademecum for Innovation through Knowledge Transfer: Continuous Training in Universities, Enterprises and Industries

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Abstract. In the current work we present a first state of the art in technology transfer from the university –public-private environment to the enterprises and industries in Spain and Italy and vice versa. In it are described the main causes that boost and damage that two-way relationship. Additionally, a first vademecum is established to avoid those environments where technology transfer is either nonexistent or difficult to carry out because of the human factors this process entails. This short guide allows one to detect easily through the Internet whether we are in a real or false technology transfer process.

Keywords: Innovation, Knowledge, Software, Hardware, Telecommunications, Education, Virtual Campus, Enterprises, Industries

1 Introduction

One of the main problems between the productive and the educational sector is the technology transfer in both directions to ensure that the last advances are quickly spread to the rest of the national and international society, with the purpose of increasing the quality of life of human beings [1-4]. However, we can see how these interrelations are not only nonexistent, but they can also slow down the technological growth of a local community, for instance. The main reason for these distortions are economic factors, where the private educational sector and the businesses have an active role. Chronologically these distortions originate in the era of the Internet's explosion, which in Mediterranean Europe can be dated to around 1995. In other realities, this phenomenon does not cause so many distortions like the cases that will be described in the current work, since it is a natural phenomenon between the educational sector and the entrepreunerial and/or industrial sectors [1] [5].

One of the main advantages of private university teaching in Southern Europe is the elasticity of their curricula and easiness to introduce changes, as compared to the public universities, where the modification process is slower. That is, the private

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universities theoretically adapt more quickly to the contents of the university courses in the B.As, engineering, masters, specialization courses, etc. However, this false reality in some educational environment ends up being a mirage in the desert of the educational trade. At the same time, we can find modern public university institutions, which, in given contexts of a state territory, work as a private university body. It is the case of those teaching centres located in territories where the religious or nationalistic factor regulates the changes have to be introduced or not, deriving from the new technologies, in their communities. Evidently, we are in the face of situations that do not keep the indispensable principles of university teaching, that is, free, universal, egalitarian and secular. To the extent to which the technological breakthroughs are faster in the labs, the mistakes made in the transfer towards the educational and productive sector are bigger, especially due to the human factors [6] [7].

To introduce or generate educational programs it is necessary to count on a professional team who do not only know the technological breakthroughs from the technical point of view, but also from a practical point of view. To this end, some businesses try to present their latest novelties in the educational sector to grasp the attention of the future professionals and eventual consumers of those products or services. The open spaces inside the private educational centres in the late 90s were the continuous training courses and/or the masters. In close analysis, it was easy to detect in those courses how the directors running the masters did not have any knowledge of the subjects that would be taught, but rather it was to aggregate a series of education professionals, of the business world and government institutions, especially those who represent the local and/or regional authorities. This happened in the then fashionable multimedia sector.

The direction of masters in new technologies, in our case multimedia, was assigned to those people who possessed a PhD. title, obtained in a private institution in the USA. If one analyzes the college curricula of these PhDs we can see how in the nineties already a kind of hybrid species of the current Bologna plan had set in, especially of the obtainment of doctorates. For instance, a technical engineer in digital signal processing (it takes three years to get that title), with two more years in private centres of the USA, obtained the title of PhD. However, these meteoric PhDs were those virtually responsible for the transfer of technology in the main cities of the European Mediterranean. The term “virtually” refers to the fact that in reality those neo-professionals lacked the necessary training in the formal and factual sciences to autonomously exercise those functions, especially in the multimedia sector. In spite of these real shortcomings, in certain university environments , the whole machinery of technology transfer from the educational environment towards the productive sector and vice versa turned around the meteoric PhDs through continuous training [8].

The continuous training of some private college centres features great investments of money in the publicity campaigns in the main traditional media such as the printed press, internet, television, billboards, buses, etc. The goal is to sell the main technological breakthroughs under the format of seminars, specialization courses, masters, etc. In the case of the masters, you can even attend those modules of the programme that are interesting to the potential students or clients. The mercantilist factor of education degenerates into many situations in which the students of that continuous training are regarded as simple clients to be pleased in their demands, instead of students who wish to receive a specialized training in a short time.

The problem that arises in the face of educative mercantilism is the heterogeneous composition of the courses, either because of the age of the attendees, the training and/or previous experience in the subjects that are being taught, the real reasons why they have registered in the continuous training courses (widening of knowledge or to be promoted inside a public or private institution, for instance), etc. This heterogeneity may impair the correct transfer of the latest technological breakthroughs, since many theoretical concepts are taken for granted at the moment of structuring the program and their respective modules.

2 The Importance of Empathy in the Educational Structuring for Technology Transfer

We can define the empathy in the interactive design as the interactive systems designer's mental ability to put himself in the shoes of the potential user. It is the result of the triad confirmed by the cultural knowledge, mental ability to occupy the place of the other in the communicative process and the competence in advancing the user's behaviour in front of certain situations [9], [10]. For instance, in multimedia design traditionally we talk about cognitive models, that is to say, the solution would be to frame it in the psychological context. Obviously, it is a valid alternative for the first hypertext and multimedia systems in the late eighties and the decade of the nineties. With the advent of the use of information networks, whether it is Internet or extranet from international entities, since the late nineties it has been a matter of communicability. A communicability that stems from the design process in the interactive systems and is translated to its usability. If we analyze some multimedia products aimed at the education of the nineties, we can find how in the design of their structure one resorts continuously to two quality attributes such as are prediction and self-evidence [10]. A priori, prediction and self-evidence can seem similar, but it is not so. In self-evidence, the navigation of pages with dynamic elements (i.e. audio, video, animation, etc.) and the structure of the system can be anticipated by the user from the first moment, even if the user has scarce experience in the use of hypermedia. On the contrary, in prediction the user must have previous ability in order to navigate efficiently and overpass complex situations, after having previously navigated the hypermedia system. These two attributes are related to the concept of isotopies inside the context of communication. That is to say, those elements that must be maintained continuously in each one of the design categories to favour the interaction of the users with the content of the multimedia system. For instance, the location itself of the navigation keys in the different screens. The same modes of activating and de-activating the dynamic means, the synchronization between the audio and the images in movement, regardless of whether they refer to a video or an animation, etc. The presence of the isotopies in the interactive design indicates a high degree of empathy towards the potential users.

In the face of such varied situations in the confirmation of the participants in the technology transfer courses, it is important to resort to empathy to organize the contents. These are contents that can be explained in the classical training classrooms, in presence lessons or in virtual classrooms or virtual campuses. In the latter cases, it

is an interesting work that is made by the virtual agents, especially for the explanation of the functioning of technological components or theoretical knowledge. Now empathy can be applied in the elaboration of contents of the interactive systems aimed at the education, thus dividing the potential users or students into several groups and intentions in the acquisition of knowledge. In the off-line and on-line multimedia systems of the late 90s and early 2000s it was feasible to have a defined profile of the potential users such as are the eventual ones (less than an hour of navigation, for instance, consulting a topic of tourist information, intentional users (between one and two hours, generally, are users interested in the content of a subject and want to go deeper into it) experts (unlimited time, such as a scientific researcher), inexpert and intentional (unlimited time, for instance, students who have no experience in the use of computers but who are keen on learning).

However, in the continuous training courses aimed at the transfer of technology is where some Lombardian public universities usually mix the university students with those who hail from professional training, it is very complicated to reach these goals in the short term. Consequently, the presence of empathy in the process of structuring the contents in the presence classes can do little or nothing to solve the problems that arise at the moment of approaching the issues of technology transfer due to the knowledge differences and/or experiences of the students who attend those courses. The only natural solution is the division of the courses between university students and those who attend professional training.

The instruments deriving from e-education may help to balance those disparities, but they do not solve the problem of the lack of knowledge and/or experiences, nor the diversity of ages among the participants in the courses. Through the chats, ads boards, videoconferences, interactive whiteboards, etc., it is possible to help to cohere the group, but with merely informative purposes instead of didactic.

The empathy in the communicability of those and other interactive systems is very positive when in the design process of the interactive system a communicability analyst or a team of professionals intervenes. In this sense we are not approaching the organization issues of the collaborations independently among themselves, that is, whether it is multidisciplinarity, interdisciplinarity or transdisciplinarity. To the readers interested in the differentiation of these terms you can look up the following bibliography [5]. Obviously the designers must take into account that these contents will have to be adapted to very different users and the strategies used in the videogames are advisable in these cases. In them empathy plays a very important role since the contents may be presented in a progressive way, in relation to the breakthroughs the user makes at the moment of interacting with the system. Now we can also detect new problems when we have false professionals in the sector of the interactive systems, or dynamic persuaders [8] [11], where the human factors seriously damage everything related to the new technologies and their transfer to the educational and/or productive world [11] [12]. In these cases, it is interesting to work with beta versions of the interactive systems and carry out tests with real users of the products made by these false professionals or dynamic persuaders, for instance. In the case of the educational presence courses one-day modules can be allocated to them and evaluation questionnaires to the participants at the end of the lesson to detect the quality of the educational process. These prevention measures are due to the fact that in Southern Europe there are professionals who are alien to the areas of knowledge

and/or experiences about which it is necessary to carry out the technology transfer. Besides, although we have banked on the empathy, the communicability analyst in the interactive systems to support the educational process, etc. sometimes they turn out to be difficult to detect before being inserted in the professors body [8] [9]. For instance, in the Balearic Islands we may have a PhD in computing and mathematics who never made an equation or a computer program because in fact he/she works in the fine arts. In contrast, in Catalonia there are industrial doctors who define themselves as artists in computer synthetic images (animated and/or static) without ever having made a drawing, painting or sculpture, whereas we can meet telecommunications PhDs without knowing what a wire is or which are the main components of a parabolic aerial. At the same time, in Lombardy we may come across with a graduate in computing who defines himself as PhD and researcher in multimedia, pedagogy, philosophy, etc., but who in reality has worked in the trade unions and landslides in the mountainsides. These are mere examples of the reality that those who attend as professors can find in the technology transfer courses in the Southern European areas. That is, we may have variegated classes, not only considering the students but also the professors, such as those previously enumerated. In both situations, the empathy to speed up the learning process and the communicability to improve the interrelation of the students with the real or virtual professors, little or nothing can they do in the face of the presented human factors.

3 Technology Transfer : Premises and Theoretical Models

Next a classical model followed for those universities who inside the triad administration (state, regional, local government bodies, etc.) university and enterprise, intend to achieve continuous training in the transfer of innovative technology with private bodies in Southern Europe:

• Denomination: avoid the confusion with other university titles
• Fulfillment of the minimal numbers of established hours
• Course programme: number of the subjects and credits
• Listing of institutions collaborating: practices, sponsors, etc.
• Professor body of the course: specifying titles and institutions to which they belong
• Director/s or coordinators of the course. At least one of the coordinators or directors will be professor of one of the professorship categories stated in the university by-laws.
• Explanation about the individualized evaluation of the students. In no case titles or diplomas will be delivered only because of attendance.
• Definition of the entry profile of every student.
• Justification of the adequacy of the course to the centre areas
• Adjustment to the demand of the market. Justification for the programme of courses that has not been successful in previous editions.
• The programming of the continuous training activities will be free for the centres and the certification will be responsibility of the organizing centre.
• The centre will inform about the activities to the university general secretariat in regard to the number of registered students in every course and on its development.

In this innovation, where groups of interconnected enterprises and related institutions belong to a sector or market sector and they are linked through common

and complementary elements [13], they join to create joint projects and thus increase their competitiveness [14], but in keeping with the vademecum presented to the intrinsic goals that they usually manifest in the Internet, such as:

- The creation of a cooperation axis, arriving together where one would not arrive on its own.
- Increase of productivity of the participating enterprises.
- Increase of the innovation ability at a low cost : collaborative innovation, creation of synergies, development of consortia and collaborative projects.

The main agents that intervene are the business associations, service provider enterprises, enterprises demanding services, university, public administrations, professional training institutions, etc. As their main goals we can mention: Development of thematic platforms according to sector, selection of the participating agents, definition of goals and operative organization of the technological innovation core and the relationships among their members. So far we can see the theoretical aspect of these activities. Now in the creation and development of the core of technological innovation appear the first economical aspects that may seriously distort the main challenges to be met in the technology transfer with a high quality level. In other activities it is possible to mention:

- Integral management of the innovation process
- Specialized reports (continuous follow-up of the technology trends and the national and international market).
- Specialized advice in management, strategy and organization in the setting in motion of activities.
- Creation of a common innovation space, that is, through forums and seminars of innovation. In these forums and seminars the participants are supposed to have a science, technology and market expert profile. However, here it is where the dynamic persuaders can destroy the whole innovation and technological transfer project, especially with the points that follow.
- Search of aids and subsidies, public and private
- Access to the community of enterprises and entrepreneurs.
- Collaboration with external agents, that is, interchange activities and promotion of the technological innovation process in national and international events.

Finally, we have a stage that is called consolidation and fostering of the innovation core, through such tasks as:

- Development of new concepts, technologies, collaborative and chartered projects: Promotion of larger projects; R+D national and international projects; New enterprise models; and Management of the generated knowledge (here the agents aim at the return of the investment that was made).
- Valuation programme of the innovation: Tech valuation; and Innovation market, through the access to external platforms of open innovation.
- Reaching a high local, regional, national and international media impact

Evidently these are the theoretical aspects of some models and classical principles in the analogical or paper support, but sometimes we can come across a mirage of this reality in the Internet., especially in the transfer sector of the latest technological breakthroughs [13] [14]. Here is the main reason why it is important to have a vademecum that will allow us to save money in the face of some oasis mirages in the search of excellence of technological innovation

4 Vademecum Towards Excellence in the Multidirectional Technological Transfer

The current vademecum represents the synthesis of a ten-year research process carried out in several European universities, with private, public and hybrid by-laws on a "sui generic" basis (we use this notion when they are realities that go against the rest of the rules). The universities and enterprises are located in the following autonomous regions of Europe: Aragon, Catalonia, Balearic Islands and Lombardy. The negative factors are marked with an "N", the positive with a "P" and indifferent with a "I". It is important to consider the order of the contents of the vademecum and the logical connectors of the sentences (and, or, and/or equal, not equal, etc).

• The courses promoted on line generally have the following structure: presentation, goals, contents, direction, duration, schedule of activities, titles, access to a virtual campus, job vacancies, cost of the registration and funding (I).
• The publicity campaign encompasses the main local, national and international media (N).
• The courses are taught in cities where several languages are simultaneously spoken (N).
• The classes are taught in several languages and dialects (N).
• The contents of the programmes are presented in dialects and eventually in languages (N).
• The classes are "presence" ones in a physical classroom (P).
• The classes are virtual (N).
• The university campuses are real (P).
• The university campuses are virtual (N).
• The universities are between 1 and 10 years old (N).
• The universities are between 10 and 30 years after their foundation (N).
• The universities are between 40 and 50 years after their inauguration (I).
• The universities are between 50-100 years old after they were opened (P).
• The universities have been working for centuries (P).
• The classes are combined into presence classes and virtual ones (P).
• The professors are from the university/enterprise/industry from which the courses are taught (I).
• The professors come from other universities and/or enterprises/industries (I).
• The professors have their resumes posted on-line (P).
• The professors have a varied and/or meteoric titling from the universities. For instance, degrees in psychology and history, master in journalism and PhD in telecommunications (N).
• The professors have a titling of technician and engineer obtained in software and hardware enterprises, such as HP, IBM, Xerox, etc. (N).
• Most of the professors have a PhD (P).
• The courses of the professors are in keeping with their training (P).
• The experience of the professors in the subject they present has extended for years (P).
• The professors use outsourcing resources in their lessons (N).
• The number of collaborators in the courses is lower than the number of professors (N).
• The practice labs have a unique technology brand that is presented to the student (N).

• The access to all the similar technologies is guaranteed at the moment of teaching the theoretical and/or practical classes (P).
• The accessibility to the technology that is being studied in the curricula is only for those firms for which there are mutual collaboration agreements (N).
• The courses imply a stay in the enterprises of the professors who teach the lessons (N).
• The students' selection depends on the University (P), the enterprise/industry (N) or both (I).
• The students must submit a real project before ending the technology transfer course (P).
• The access to the possibility of carrying out a final exam requires to overcome several previous tests or exams and the approval of a practical project (P).
• The students must pass several tests to obtain a certification or diploma (P).
• The obtainment of a diploma requires a minimum of hours of attendance in the presence courses (P).
• The evaluation of the knowledge is in the hands of the professors (P) or those responsible for the enterprises/industries (N).
• The exam of the acquired knowledge will be in a real space, with supervisors (P).
• The final exam to have access to the title is made through virtual campuses (N) or classrooms (P).
• The evaluation of the knowledge is done in a progressive way through the internet (P).
• The course is made through the academic rules of the university (P).
• The course is made in relation to the demand in the work market (I).
• The potential students must possess an academic (P) or entrepreneurial profile (N).
• The total amount of the registration fee must be paid before the beginning of the course (N).
• The student is oriented towards scholarships, loans and aid towards the financing possibilities under advantageous conditions (I).
• The reached results have a high media impact in the community where the core of the technological innovation has been generated (I).

Next we sum up graphically the main contents of the vademecum resorting to two *smiles* for the information on-line on these issues:

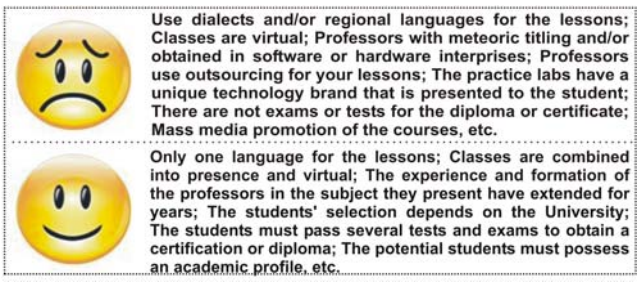

Fig. 1: Set of elements that boost and damage the transfer of technological innovation

This is the first state of the art in Southern Europe where it has been avoided to insert the names of the institutions, people responsible, training programmes, etc., with the purpose of keeping the anonymity and the respect to the privacy of information. Lastly, we insert the following graphic that demonstrates the result of applying the guidelines or vademecum to 50 Spanish and Italian portals chosen at random among university portals, industrial unions, associations and bank foundations, and local, provincial, regional, statewide bodies, etc. which are devoted to the transfer of innovating technology. The results are divided into two big groups: private and public institutions and the elements that boost the transfer of technological innovation.

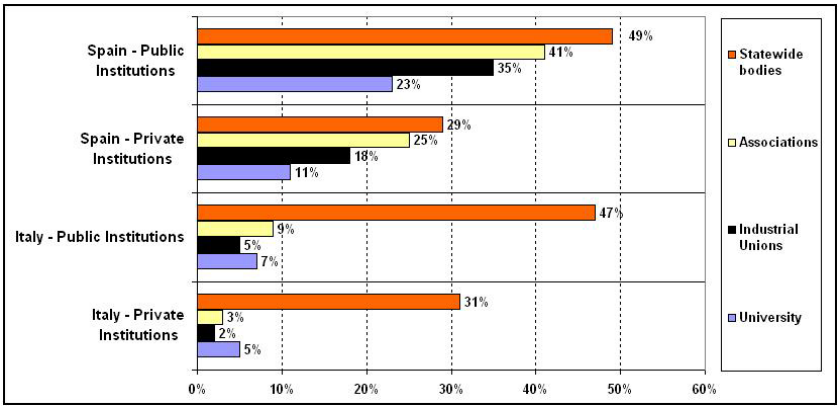

Fig. 2: A little State-of.-the-art in Internet about Innovation through Knowledge Transfer

5 Lessons Learned

With the development of the information society and its overall diffusion in the world, on-line training for the transfer of technological innovation will be in an arithmetic increase in quantity but in a geometric decrease of quality due to economic and financial costs. Factors that vary between the north, centre and south of Europe, such as the expected benefit margins and the time to achieve them. For instance, in the long term in the north and with figures that do not go above a dozen numbers in the north and centre of Europe, compared with those who aim at three digits in the short term in the south of Europe, regardless of the core of technological innovation that has been generated. Although these new virtual learning environments, profiting from the functionalities of the ITC (Information and Communication Technologies) offer environments for teaching and learning free from the restrictions set in time and space by presence teaching and capable of ensuring a mutual communication between students and professors, it is necessary to keep on the positive aspects of the transfer of technological innovation. On the other hand, these environments (with a wide implantation in university, work and occupational training) also allow to complement presence teaching with virtual activities and on-line credits that can be developed at home, in the teaching centres or in any place that has a connection to the internet. The latter can be reached if the main premises of the vademecum presented by the organizing agents of the technological innovation core centre are guaranteed in writing.

6 Conclusions

It is in the transfer of the technological innovations that is currently focused a mercantilist factor of the sciences that contradicts one of the main principles of

scientific knowledge: communicability, understood as a knowledge that is not private but public. The communication of the obtained results in the R+D labs in the private industries does not only improve and perfects overall education but it multiplies the chances of confirmation or rebuttal. These last two terms sometimes generate uncertainty in some scientific environments in Southern Europe in the continuity in receiving national and international financial subsidies. This is the reason why there is a kind of resistance in the scientific community to organize these courses. On the other extreme we have those who see in the results of the R+D labs a source of financial revenue. Between both situations those agents of the academic sector who need guidelines like those presented in the current work to make decision in a short lapse of time. These guidelines will be widened with the future works including other realities from the centre and north of Europe, like those hailing from Asia and America. Addtionally, with this first version of the guidelines it is possible to know the reliability and seriousness of the agents who take part in the educational process, since in many cases the students must self-finance courses that theoretically and from the standpoint of the main principles of science should be free of charge. Luckily, there are still public and private institutions that ensure that this principle is kept in our days.

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