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Knowledge Management Analysis of the Research & Development & Transference Process at HEROs: a Public University Case

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Abstract: In Higher Education and Research Organisations (HEROs), one of the most important activities in the R&D process is the effective management of knowledge transference. A correct analysis and diagnosis of that process through knowledge management methodology is essential for the correct orientation of organisation strategy. The aim of this paper is to describe the analysis carried out in order to diagnose the research & development & transference (R&D&T) activities at a public university in Spain. The diagnosis analyses the key phases in the knowledge transference process, because these different stages define important implications for the monitoring of the intellectual capital and the organisation's performance. Also with in the diagnostic analysis preformed here an methodological innovation is introduced related with the cause and effect relations of the knowledge collaboration and a process witch deals mainly with intangibles.

Key Words: Knowledge Management at Universities, Research and Development Management, Process Analysis
Categories: A.0, A.1, E.1, K.4

1 Introduction

In Higher Education and Research Organisations (HRROs), one of the most important activities in the R&D process is the effective management of knowledge transference. In most cases the research results are intangibles assets and they represent an important portion of organization's intellectual capital [Leitner, 2002]. A correct analysis and diagnosis of that process through knowledge management methodology is essential for the correct orientation of organisation strategy.

Recent literature states that some management policies and programmes can drive the performance of intangibles or intellectual capital, and even tries to quantify this relationship [Lev, 2001; Hurwitz *et al.*, 2002]. Although this line of research is very

interesting, our opinion is that management practices do not act directly as drivers of intellectual capital but stimulate and promote key knowledge types that are the genuine drivers of intellectual capital. Consequently, a basic task for knowledge management analysis is to thoroughly analyse the current state of the process and then discover those management practices that promote change and learning in the organisation.

The aim of this paper is therefore to describe the analysis carried out in order to diagnose the Research & Development & Transference (R&D&T) activities at a public university in Spain. This diagnosis analyses the key process phases in the knowledge transference process, such as establishing the first contact, developing the collaboration and exploiting common results. These different stages act as drivers for the process and define important implications for monitoring the intellectual capital of the organisation's performance.

The research work presented here is part of the project "Knowledge Management at a Public University: The process of Research, Development and Transference of Scientific and Technical Knowledge" funded in 2000 and 2001 by the Spanish Ministry of Science and Technology and the project "Design of a model of transfer of research results based on Knowledge Management" funded by the Basque Regional Government in 2002-2003. This project was set up at the University of the Basque Country (UPV/EHU) in Spain and brought together a multi-disciplinary group of researchers with the purpose of drawing up a new model for knowledge management that could cover the whole process, from pure research to the transference of scientific and technical knowledge from universities to businesses, institutions and other social agents [Rodriguez *et al,* 2001*;* Rodriguez *et al,*2004].

The knowledge management analysis was carried out bearing in mind three different complementary approaches, each requiring different methodologies:

1. Current level of the types of knowledge that are key to the process, identified in the knowledge map analysis.
2. Diagnosis of the current knowledge management of that process in the University.
3. Analysis of other aspects that can have an influence on how the process is carried out, as well as estimating the risks involved in its future implementation.

This paper presents the activities carried out in the second phase of the research, concerning the analysis and diagnosis of the current practices to generate and transfer scientific and technical knowledge from the University of the Basque Country (UPV/EHU) to companies and institutions.

The University of the Basque Country is public university of medium size (40,000 students and 3,000 teachers/researchers), with a campus in each of the territories of the Basque Country and with similar characteristics to those of most Spanish universities and many European ones. The circumstances, problems and possible solutions detected in this diagnosis can therefore very possibly be extrapolated to the general situation for university institutions.

2 Methodology

The analysis and diagnosis of the process to generate and transfer scientific and technical knowledge from the UPV/EHU to businesses and organisations required information obtained from the main agents involved in this process: researchers and companies.

The performed analysis of the state of the art did not provide us with published works exactly matching the research in question that could be used as a reference, but there are some publications that study similarly processes [Bueno, 2002, 2003; Garnett, 2001; Oliver *et al*, 2003]. Consequently, the design of the research, selection of the research activities and of the habitual practices and the drawing up of the initial questionnaire were carried out exclusively by the multi-disciplinary research team. From this point onwards, the research was carried out in four different phases:

1) Exploratory study
2) Surveys on samples of researchers and companies
3) Analysis of findings
4) Diagnosis of strengths and weaknesses

2.1 Exploratory Study

We carried out an initial exploratory study with a group of renowned researchers external to the project (12 researchers with significant scientific production and with transference to companies, from different areas of knowledge), via personal interviews. Based on these scientists' answers and comments, we validated the research activities chosen (research projects with transference to companies, contracts with transference and research projects without transference), the practices initially selected and the questions referring to these practices for the researchers.

2.2 Surveys[1]

In the study we distinguished between four different strata or groups with specific questions for each of them, although with common questions for common activities. These groups and their random samples were as follows:

1- Main researchers of projects and contracts with transference of results to companies. Sample of 84 researchers (level of certainty 95.5% and maximum error 10 %)
2- Main researchers of projects and contracts without transference of results to companies. Sample of 81 researchers (level of certainty 95.5% and maximum error 10 %)
3- Companies that have been collaborating with the UPV/EHU in R&D activities via contracts and projects in the period 1998-2002. In the survey process, preference has been given to R&D directors and to general and functional directors. Sample of 83 companies and 7 institutions (level of certainty 95.5% and maximum error 9.7 %)

[1] The research team for these phases was formed by Jon Landeta (team co-ordinator), Ana Blanco, Macarena Larrauri, Ana María Martín, Arturo Rodríguez, Pilar Zorrilla and Stanislav Ranguelov.

4- Companies that have not been collaborating with the UPV/EHU in R&D activities but that do use other external R&D suppliers. Sample of 90 companies (level of certainty 95.5% and maximum error 9.72 %).

Information was gathered via telephone survey, carried out by a specialised firm during the months of June and July 2003.

The survey was oriented towards a rating of how the pre-selected tasks or activities are carried out by the UPV/EHU and a comparison with the actions and results of other agents supplying R&D to the companies. Clear, concise questions were drawn up (with YES/NO answers) on whether the proposed practices were carried out and about the quality of the transference (Likert scale questions).

Analysis phases/areas	RWT	RNT	EC	ENC
1- External R&D agents the company has a relationship with				
2- Reasons for Not having a relationship with the UPV/EHU				
3- Success factors in an R&D collaboration with other companies				
4- Ways of finding out about projects being planned				
5- Existence of lines of research prior to carrying out projects				
6- Ways of funding lines of research				
7- Frequency of the relationship UPV/EHU/Company or External R&D Agent/Company				
8- Ways of establishing first contact UPV/EHU/Company or External Agent/Company				
9- Satisfaction of company with results				
10- Follow-up by researchers of the industrial application of results				
11- University exploitation of results				
12- University or external agent participation in company exploitation of the results				
13- Comparison of UPV/EHU/Other suppliers in terms of quality of decisive variables in R&D transference				

Table 1: Phases in the transference process analysed and groups involved.

The questionnaire was adapted to each segment of the sample. The researchers working on projects without direct transference to companies answered questions on fewer activities, whereas the companies answered from their own perspective on how the activities were carried out constituting the transference process in which they were involved. Those with a relationship with the UPV/EHU answered on how this relationship was developed, and those who were not connected with the university answered on how they related to their R&D suppliers. The questionnaires for both types of companies were therefore similar but not identical. The questionnaires also

included items on the factors contributing to the success of a collaboration with an external R&D agent and a comparison of the quality of UPV/EHU's attributes with those of the other R&D suppliers regarding the transference process studied.

In Table 1, the marked areas shows the factors on which each group answered questions on (RWT: Researchers WITH Transference; RNT: Researchers WITHOUT transference; EC: Enterprises Clients of the UPV/EHU; ENC: Enterprises Not clients of the UPV/EHU)

2.3 Analysis of Findings

We carried out different analyses with the data obtained from the survey; comparative, statistical, descriptive and multi-variant, as well as by classification variables. Below we present a summary of the main findings.

2.3.1 Definition of the Line of Research

A line of research normally exists prior to the project or contract related to it (92% of the researchers confirm this). Various ways of funding of the research tend to be used, with preference for public funding (93%), followed by funding from contracts with companies (80.5%). The researchers have information about possible sources of funding by means of the University (86%) and by permanently search for open calls for research (70%), although researchers working with companies usually use more sources of information.

2.3.2 Company Relationship with the UPV/EHU or External R&D Centres

2.3.2.1 Establishing Contact

The most usual way of establishing contact is directly, between the research group and the company and, to a much lesser extent, via the University administration or its website. The way in which companies that do not collaborate with the UPV/EHU make contact with their R&D suppliers is relatively similar (see table 2 for results relative to the researchers “RWT”, the companies collaborating with the UPV/EHU “EC” and those working with other R&D centres “ENC”)

Forms of contact	**RWT**	**EC**	**ENC**
The company contacts a member of the research group	86.7%	68.2%	59.7%
The company uses the University website	21%	16.3%	6.5%
The company contacts the University and is directed to the research group	22.9%	39.1%	
The group itself offers its services to the company	60.2%	44.7%	44.1%
Other forms	27.7%	11.1%	31.4%

Table 2: Forms of contact Companies-R&D Agents

2.3.2.2 R&D suppliers with Whom Companies Have Relationship

The companies that have a relationship with the UPV/EHU show significantly different behaviour (with a maximum error level lower than 0.01- chi-squared comparison)

compared with those who do not have this relationship. In general, these companies have a more intense relationship with a wider set of external agents (principally technological centres and private universities) than those companies that do not work with the UPV/EHU.

In general, companies that have a relationship with the UPV/EHU have also some kind of collaboration with technological centres and, at a lower percentage, with other universities and external agents. Those companies that do not have a liaison with the UPV/EHU do not have a relationship with any university as an R&D provider and their external suppliers are technological centres and other external agents.

1. An analysis of the findings by classificatory variables reveals some statistically significant particularities:
2. Geographical proximity is a decisive factor in choosing an external supplier, in spite of the relatively short distance between all the companies and R&D suppliers under consideration (less than 100 km)
3. The legal form of the company also influences the choice, due especially to the behaviour of Foundations and Public Institutions (with relatively more relationships with universities) and cooperative companies located in the region (preferring to deal with their corporate university -Mondragon University-, and with technological centres.
4. Companies with a high technological level maintain significantly higher relationships with private technological universities and technological centres.
5. On the other hand, and as expected, the larger the company is, both in terms of turnover and employees, the more contact they have with all the agents under consideration.

2.3.2.3 Frequency of the Relationship

In general, the companies that work with the UPV/EHU have a less frequent contact with the university than that maintained with other R&D agents they also collaborate with, as for example the technological centres. The relationship held by business sphere with the UPV/EHU as a direct supplier of R&D is therefore of a more sporadic, individual nature than that with other external suppliers.

2.3.2.4 Reasons for the Lack of Relationship

Most of the companies that do not have contracts or projects with the UPV/EHU state that they do not use the UPV/EHU's services because there are other external research agents that offer these services (59.1%), 38.6% admitting that they are unaware of the services UPV/EHU might provide and 36.4% not knowing the way in which they could establish an initial relationship with this organisation.

2.3.4 Results of the Collaboration

2.3.4.1 Satisfaction with the Collaboration

After carrying out the collaboration, in most of the cases companies claim to be highly satisfied with the results (68%). This results are higher than the satisfaction

degree (only 54%) showed by companies that do not collaborate with UPV/EHU referencing theirs R&D suppliers.

2.3.4.2 Exploitation of the Results of the Collaboration

Approximately half the researchers normally follow up the business application of the results.

The ways in which the results are used afterwards by the company are not normally known, in part because, in many cases, there is no exploitation (41% in the case of the UPV/EHU, and 21% in the case of collaboration with other agents). Although when there is some exploitation, a relatively significant proportion of the companies (over 50%) state that they share the benefits with the university researchers (this proportion is four times higher than that for companies that collaborate with other R&D suppliers).

The researchers exploit the results academically, normally publishing in scientific journals (95%), and in about 50% of the cases in other publications and always like a complementary action.

Consequently, the results are not exploited sufficiently by the company and the university together, rather each of the parts does so in its own field, and this could be related to the low volume of permanent collaborations.

2.3.5 Comparison of the UPV/EHU with Other Suppliers

In the table 3 are showed the average scores μ and standard deviations σ of the assessments for services provided by the UPV/EHU and technological centres. In this comparison, the findings show that the UPV/EHU is in a favourable position regarding the key aspects of the transference process: human and physical resources, and the quality of the result related to its price. However, its position is weaker in variables defining the relationship during the research and transference process: communication language, information and deadlines. Lastly, its position is deficient with respect to the variables defining the initiation of the process: accessibility, speed of response and simplicity of the process. Another significant drawback over the capacity of the UPV/EHU is the greater standard deviation in the assessments for all the UPV/EHU's variables (with exception of the quality of its human resources). This reveals a lower institutional capacity to control the process *per se* and this is therefore an added difficulty in its improvement.

	UPV/EHU		**Technolog. Centres**			
Variables	μ	σ	μ	σ	**Sp.** μ	**Sp.** σ
Capacity of the staff to meet needs	3.94	*0.71*	3.9	*0.72*	0.04	-0.01
Value for money	3.74	*0.90*	3.17	*0.86*	0.57**	0.04
Availability of resources and equipment to carry out project	3.71	*0.80*	3.78	*0.69*	-0.07	-0.11
Understandable communication language between researchers and company	3.69	*0.88*	3.86	*0.72*	-0.17	-0.16*
Information and advice	3.36	*0.96*	3.52	*0.72*	-0.16	-0.24**
Compliance with deadlines	3.36	*0.99*	3.56	*0.81*	-0.20	-0.18*
Accessibility and response speed	3.18	*0.95*	3.71	*0.73*	-0.53**	-0.22**
Simplicity in documentation process	3.12	*1.12*	3.51	*0.92*	-0.39**	-0.20*

** significant differences with a maximum error level of 5%
* significant differences with a maximum error level of 10%

Table 3: Rating of the services provided by the UPV/EHU and Technological Centres

2.4 Diagnosis of Strengths and Weaknesses

Based on the empirical study data and via a group discussion of the researchers and university directors, we extracted the strengths and weaknesses of the process of generating and transferring knowledge from our university, which can be summarised as follows:

2.4.1 Strengths:

- Availability and well structures university research centres and groups throughout the Basque Country
- Existence of good infrastructures to carry out R&D
- Existence of sufficiently qualified human resources to carry out applied research, integrated in groups capable of establishing relationships with companies and institutions
- Better value for money in the services provided with respect to the other agents carrying out R&D
- Existence of excellent groups in the field of applied research that can act as a reference point for the rest of the university groups and for potential external clients
- Satisfaction of companies and institutions with the work carried out by the groups of the UPV/EHU, better than that achieved with other agents
- Greater confidence in the UPV/EHU to undertake basic research of a pre-competitive nature with greater scientific risk.

2.4.2 Weaknesses

- Deficiency in overall accessibility of the university for the business world in order to carry out R&D activities in cooperation
- Complicated administrative procedure establishing research contracts and projects
- Lack of common guidelines to certify the quality of the applied research collaboration activities. Weakness due to the lack of standardised quality procedures applied effectively
- Deficit in the external image of the university as a body that also carries out applied research and that possesses a wide range of services in this respect
- Weak institutional action by the university in the intermediation for collaboration with companies and institutions
- Less kind relationship on the part of the researchers with the companies during research compared with other R&D agents: slower initial response to a company request, worse information and advice to companies, less understandable language, less thorough in meeting deadlines
- Weak non-academic exploitation of the results on the part of researchers (patents and social divulgation).
- Less possibility of business and industrial application of the results of collaborations in research with companies
- Little attention paid by the researchers to the interests and needs of the market

3 Conclusions

The UPV/EHU, possibly like most public universities, is notable for its human and technical resources and for the quality of the research it carries out. Its professionals provide it with high potential to generate and transfer knowledge. However, the greatest difficulties in transferring the research results in an effective manner come from the lack of commercial orientation and institutional flexibility in order to attend quickly to the needs of companies. Also there is relatively little interest shown by many researchers in orienting their activity towards the requirements of companies and institutions. Greater commitment on the part of the university to become a true interface between companies and research groups could notably contribute to mitigating this weakness, together with a necessary reorientation of researchers' professional incentives, encouraging them to value this kind of applied research more highly.

Finally the main methodological innovation introduced with in the diagnostic analysis preformed here is related with the cause and effect relations of the knowledge collaboration and a process witch deals mainly with intangibles.

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