Towards a Taxonomy of Firms Engaged in International R&D Cooperation Programs: The Case of Spain in Eureka

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Resumen

El proceso innovador enfrenta una serie de fallos de mercado y por esta razón – y por ser considerado uno de los principales agentes del crecimiento económico en el mundo – un significativo número de políticas gubernamentales y supra-nacionales son diseñadas para promover el progreso tecnológico. En Europa la situación no podría ser diferente y la "Paradoja Europea" es utilizada como principal argumento para la implementación de iniciativas relacionadas a la innovación. Junto con estas políticas hay una creciente preocupación con su continua evaluación, teniendo como objetivo proveer *feedbacks* para la adaptación y adecuación de estos programas con las necesidades de los agentes involucrados. En este sentido, el presente *paper* desarrolla una evaluación de los impactos del Programa Eureka para el caso de las empresas españolas participantes en esta iniciativa y con proyectos concluidos entre los años 2000-2005 (a través de análisis de los informes finales de los proyectos). Un total de 77 empresas fueron abordadas con métodos cuantitativos (correlaciones, testes chi-cuadrado, análisis discriminante y análisis de cluster). Los resultados demuestran que la participación española en Eureka suele tener altos niveles de logros tecnológicos. Los logros comerciales parecen estar definidos por la calidad del funcionamiento del proyecto y por la capacidad de las empresas en explotar sus resultados en el mercado ya antes del fin del proyecto. Una tipología introductoria de los participantes es propuesta en 3 conglomerados: (1) *Risky Innovators*; (2) *Inventors*; y (3) *Consistent Innovators*.

Palabras clave: Políticas de Innovación; Programa Eureka; Sistema de Innovación Español; Colaboración en I+D.

Abstract

Innovation is a process that faces several "market failure" situations and for this reason – and for being considered one of the main drivers of economic growth throughout the world – a large number of governmental and supranational policies are designed to foster technological progress. In Europe this situation could not be any different and the "European Paradox" is used as the main argument for the implementation of innovation related initiatives. Along with these policies, there is an increasing concern with their continuous evaluation aiming at providing valuable feedback for these program's adaptation and adequacy to the player's needs. In this sense, this paper develops an evaluation of Eureka Programme's impact for the case of Spanish companies participating in this initiative and that had projects finished in the period 2000-2005 (analysis performed through the information contained in Eureka's Final Reports). A total of 77 firms were assessed through quantitative methods, namely correlations, chi-square tests, discriminant models and cluster analysis. Findings show that Spain participates in Eureka mainly through SMEs, and that the overall rate of technological achievements is impressively good. Commercial achievements seem to be influenced mainly by the quality of the project's functioning and the capacity of firm's exploiting results in the industry by the end of the project. A basic typology of participants is offered in which three clusters are built: (1) Risky Innovators; (2) Inventors; and (3) Consistent Innovators.

Key words: Innovation Policy; Eureka Programme; Spanish Innovation System; R&D Collaboration.

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1. Introduction

Innovation policies are a matter of great concern worldwide and in the European Union this situation is not different. Much has been said about the "European Paradox", i.e., the difference between scientific capabilities and actual innovation performance[1] (Georghiou, 2001) and, therefore, several measures took place in order to modify this scenario since the EU realized that only through innovation a dynamic and competitive society could be achieved (Hidalgo, León & Pavón, 2002), reducing the gap with its main competitors in the global scenario: the US and Japan.

Broadly speaking, these programs that stimulate innovative activities take place to correct the market failures associated with R&D investments (Klette, Moen & Griliches, 2000). Nonetheless, unsatisfactory results in this area are mainly attributed to lack of R&D investment and to a low productivity of the resources invested (Benfratello & Sembenelli, 2002) showing a strong need for the analysis, evaluation and measurement of current innovation and technological policies[2] (Edler, 2010). But this cannot be regarded as a simple task depending solely on recognizing the underlying difficulties and designating funds for it. Despite important conceptual and methodological advances in the economics of science and innovation in recent years, there is still little agreement as to what 'good' science, technology and innovation (STI) policy should look like and which instruments should be used (Laranja, Uyarra & Flanagan, 2007), which gives an idea of the complexity involved not only in formulating innovation policies, but also in evaluating their impact.

What is known is that performance in terms of innovation varies greatly amongst the EU's countries, regions, firms and sectors. To accomplish with these differences regional or national policies in support of innovation have been introduced, starting in the beginning of the 80's (European Commission, 1995). In this sense, industrial policies in the European level regarding highly competitive sectors such as information and communication technologies, biotechnology and nanotechnology, require a higher level of integration in R&D efforts between firms and nations in the European Union (European Commission, 2004). But to what extent are the existent policies and innovation programs efficient? Innovation is a tremendously complex process, very hard to manage (as it is to measure), but that provides extremely relevant results both economically and socially. This implies that whichever policy is developed towards innovative activities must be well thought, designed and measured so it can be continuously improved and adapted to market needs.

Notwithstanding, actual evaluation efforts seem to be rather modest compared to the size of technological policies (Klette, Moen & Griliches, 2000). Another problem is the potential lack of adaptation of the evaluation frameworks considering the evolution of innovation itself. Arnold (2004) points out that even though theory about research, innovation and technological change has evolved to approaches based on dynamic systems, policies' evaluation systems still work based on an idea of direct and simple cause-effect relationships. However, approaching this complexity is not a feasible task in many situations when structured data, usual methodologies and deadlines do not allow for the evaluator to develop this sort of model of analysis. But this does not imply that more complex interactions are not considered in the evaluation, providing limitations and ideas for the results.

The scope of this paper lies in analyzing technological and commercial impacts at national level (the case of Spanish firms) of one of the most relevant technological programs that take place in the Europe and that has as its main goal fostering innovation through cooperation between organizations from different nations: the Eureka Programme. The objective is to understand the impact of Eureka in the business environment through an *ex post* assessment of its results in a set of companies that participated in the program, allowing for a

[1] The Green Paper published in 1995 by the European Commission is the more broadly known document that tackles this situation. It points out that in terms of scientific performance the EU stands in an excellent position in comparison to the US and Japan but the industrial and commercial performance (and its ability of transforming the results of technological research and skills into innovations and competitive advantages) in high-technology sectors has deteriorated (European Commission, 1995).

[2] As a matter of fact, recent studies show that apparently this Paradox may be a fallacy since the EU show signs of weakness with respect to the generation of both scientific knowledge and technological innovation in comparison to the United States and Japan and the belief in the "European Paradox" led to policies oriented towards innovation and market driven scientific activities (Dosi, Llerena & Sylos-Labini, 2006).

contribution regarding the evaluation of this initiative.

One has to be very careful when carrying out such an evaluation: effectiveness of technological policies is a deeply complicated aspect to assess. Imagine the situation in which the results are highly correlated with initial objectives proposed by firms (or any sort of agents), indicating a spectacular rate of success in innovation attainment. This would have to be addressed very cautiously, considering innovation's characteristics (specifically the uncertainty of the generation of innovations) – in the best scenario, this outcome would be likely to represent a large amount of innovations without real market relevance.

What is proposed here is a more process-oriented evaluation of outcomes. This means, analyzing the initiative in its internal consistency, most relevant indicators of performance, how they interact with themselves and with companies' characteristics. The ultimate goal of this effort is to provide knowledge on drivers of participants' achievements. It is expected that this might bring up some important insights for agents involved with the innovation context related to the Eureka initiative.

The analysis here undertaken is based on a quantitative approach of Eureka's Final Reports of projects completed by Spanish companies during the period 2000-2005. These reports are structured in a way that allows for the assessment of descriptive information (general features of the companies such as size and status of participation in the project), general impact of the project (technological achievements, commercial impact, industrial exploitation and employment impact) and some additional information regarding companies' view of Eureka's main benefits and the main obstacles faced during their participation. Data regarding companies' main characteristics (more detailed data of size and industrial sector) were also combined with the original database to provide a more consistent analysis. This specific period was chosen due to data availability and consistency of analysis, i.e., data for the period 2006-2008 is also available, but there has been a change in the questionnaire structure, which makes it difficult a good comparison for firms with projects finished after 2005.

In this sense, the methodological approach is divided in three parts: descriptive analysis, identification of associations and discriminant analysis & typology of participants. The descriptive section refers to an in depth analysis of the sample composition and the general outcomes firms achieved through their participation in the Eureka Initiative. When dealing with a country examination this might bring some valuable information not only about the general profile of Spanish participants but also regarding their general interaction with Eureka. The identification of associations consists in the use of correlation coefficients and cross-tabs (chi-square) to establish relationships between variables in the sample and, this way, to provide information about the dynamics of the companies' participation in the process involved with developing a project within the Eureka Programme. The discriminant analysis & typology of participants is the last part of this study and it consists in the development of discriminant models and cluster analysis. The objective is to assess what exactly influences both technological and commercial results for these firms and how they can be grouped according to their characteristics and performance.

The paper begins with a broad analysis of innovation policies, its main characteristics and goals, as well as some recommendations on its evaluations. This is followed by a section that deals specifically with cooperative R&D programs (which is the case of the Eureka initiative). The main features of Eureka are presented, as well as previous results of evaluations undertaken. Subsequently the methodology of the research is presented, introducing Eureka's Final Reports used for the statistical analysis and the methodology applied. After, results are presented and discussed and we finish with some concluding remarks.

2. Innovation Policy: Theory and Evaluation

The role that technology plays in the process of economic development and growth has been widely analyzed and discussed in economic theory, as well as its relationship with the existent institutional framework (for some of the most referenced works in this area see Solow, 1956; Arrow, 1962; Arrow *et al*, 1961; Lucas, 1988; Romer, 1990 among many others). Even though a serious and constructive debate remains regarding to what extent and how technology change affects economic systems, technological innovation policies seem to be present in governments' projects regardless of their political inclination or geographical relevance (national, regional, local or even supranational) which is a result of the role that innovation and technological change play in fostering economic growth and its characteristics of public goods that are likely to create market failures (Álvarez, 2004; Molero & Fonfría, 2008).

In all important aspects adaptive policy making is about facilitation (enabling innovation), understanding the existence of unpredictability and indeterminacy in the results of policy initiatives (Metcalfe & Georghiou, 1997) and it is pretty clear that innovation processes happen in conditions of uncertainty and (in the capitalist system) of competition and so must be approached in a holistic manner, considering not only technical capabilities but also the market environment and the social context (Pavitt, 2003; Kline & Rosenberg, 1986). More than that, innovation is also a costly process which can create market failures related to appropriability, risk, amount of R&D investment, spillovers and externalities. This justifies the need for public policies that approach these problems, allowing for an environment that better fosters innovative activities (Bayona-Sáez & García-Marco, 2010; Nelson, 1959; Sanz Menéndez, 1995).

In this sense, globalization and the shift towards knowledge as the source of competitiveness rendered the traditional policy instruments less effective (Gilbert, Audretsch & McDougall, 2004), creating an environment that demands adaptation in public policies and initiatives: technology policies are part of a complex economic landscape and must ensure that the main players, the firms, are able to realize their innovative potential (Molero, 2001), meaning that the appropriate R&D policymaking requires knowledge about context conditions, group behavior, instruments (and their mix) and policy effects (Ebersberger, Edler & Lo, 2006).

Therefore, since R&D policies can be considered fundamental for long-term development and are subject to an ever-changing environment, there is a strong need to continuously evaluate their effectiveness (Bayona-Sáez & García-Marco, 2010). Emphasis should be given to policy trials and their evaluation: the process of adaptation may consist in trials and errors (Metcalfe & Georghiou, 1997) and only through frequent assessments there can be actual improvements in the process. One example of misconceptions regarding innovation policies is given by Barañano (1995): European institutions seem to have been providing support to those firms that do not actually need it, leaving those actually dependent on governmental bodies without financial or networking support (Barañano, 1995).

While technology programs have focused increasingly in the promotion of innovation networks and linkages between innovation systems, evaluation methods and approaches have been developed to analyze and measure the outcomes of such policies, but it seems that evaluation of public technology policies work has had less of an impact in the literature than it deserves (Georghiou & Roessner, 2000). Research evaluation has been taking place in OECD countries since the 1970´s with a noticeable increase in the 1980's – among the first to address this activity were the Nordic countries (Luukkonen, 2002; Langfeldt, 2004). Evaluation activities consist basically in systematically and objectively determining the relevance, efficiency and effect of an activity considering its objectives, providing policymakers with feedbacks on the impacts of such initiatives and creating fundamental knowledge for the promotion of necessary adjustments for future policies' formulation and implementation (Durieux and Fayl, 1997). In addition to the capacity of providing feedback, a technological policy evaluation system must ensure the periodicity of analysis and guarantee the independence of evaluators (Georghiou, 1997). This implies the idea of permanent non-biased observation which in theory means the possibility of dynamic evolution of technological programs, but in reality also brings up questions related to the lack of interest of some policymakers in having their initiatives criticized – especially when criticisms happen to suggest the termination of a particular initiative for its low effectiveness.

But these evaluation activities and the identification of policy "best practices" in OECD countries is a complicated task given the myriad of technological initiatives that take place in these nations (ranging from direct support to basic research to more indirect measures aimed at improving the capacity of firms to innovate and use new technologies) (Durieux and Fayl, 1997). This situation highlights the importance of specific analyses at both geographical and industrial levels, since technological programs, in order to be successful, must fit the characteristics of the environment in which they take place.

In the European context this might represent some extra challenges for policymakers – promotion of bloc-wide policies must regard the idiosyncrasies of Member States in order to be fully effective. Again, it is important to remind that the effectiveness of innovation policies in general has to be carefully regarded. The simple input-output analysis (the famous linear model) does not necessarily allow the evaluator or researcher to assess innovation impacts thoroughly – For example, Luukkonen (2002) points out that there is skepticism towards the validity of many evaluation measurements due to difficulties in attributing impact to particular initiatives and lags between the time in which a project was undertaken and the time when the results arise. Also, a high rate of innovation projects' success may indicate not that the initiative is a sounding triumph, but that the data is not reliable or worse: the projects undertaken are not ambitious enough and deal more with mere improvements in products and processes than with groundbreaking innovations per se.

Some of the most well-known methods for innovation policy evaluation consist of independent expert panels, interviews, use of questionnaires, surveys, core indicators, case studies and micro-level econometric analysis – the use of these methods depend on what kind of program is being evaluated (Durieux and Fayl, 1997; Grupp, 2000). Like science in general, evaluation of technological policies faces an inevitable dualism between quantitative and qualitative approaches. Basically the distinction is made depending on the objective planned for the analysis: quantitative methods are focused on measurement of socioeconomic impacts and qualitative ones regard the evaluation of strategic importance of activities (Luukkonen, 2002). Technically, this situation means that the relationship between both approaches is complementary (Durieux and Fayl, 1997). Roessner (2000) points that any proposed opposition between quantitative and qualitative evaluation methods is a fallacy – the adequate methodological design must consider the objectives of the evaluation. The Eureka initiative, giving an example related to the scope of this article, carries out both quantitative and qualitative analysis, providing statistics on its impact and also a series of representative case studies[3].

Turning to a more theoretical approach, evolutionary economic theory influenced technological policies to become more oriented to adaptation of firms and markets in an environment of change (Nelson & Winter, 2002), providing the framework for a concern of the own system's changes over time. We can affirm then that existing institutional structures, including bodies of relevant law, and particular government policies and programs, never can be regarded as optimal and for this reason they are, and should be, always subject to evaluations and constructive criticism (Nelson, 2007). But it is important to recognize some improvements in the conception of innovation policies. In the European Union, until the 1990s, the complexity of research activities and knowledge creation preceding the introduction of an innovation as well as the interaction between suppliers and users were largely ignored (Pianta & Vaona, 2009).

Technological policy reforms, however, are needed for Europe to become a more research-friendly area (Georghiou, 2008). In the 1980s the main challenge for European companies was, in face of globalization, to move from a national to a continental scale (Georghiou, 2001) and currently a pan-European policy that maximizes the bloc's competitiveness in crucial industries and coordinates R&D efforts between national innovation systems is the main goal (Álvarez, 2004)[4]. This search for coordination and interaction between different innovation systems can be achieved through the promotion of R&D cooperation between agents (research centers, firms, etc.), which is the case of the Eureka Programme (a full description of this initiative's characteristics is provided later on in section 4.).

[3] Nonetheless, and setting the stage for the analysis to follow, we would like to remind that this article has a quantitative focus, which makes sense according to literature since it assesses technological and commercial impacts.

[4] Another fundamental focus should be given to market orientation of R&D output, since innovation depends not only on technical capabilities or network coordination: it must be successfully marketable (Lukas & Ferrell, 2000; Hidalgo, León & Pavón, 2002). On the other hand, Atuahene-Gima (1996) presents results that do not support the hypothesis that market orientation causes performance improvements regarding innovations.

3. International R&D Cooperation

All indicators, such as co-publications, co-inventions, and joint research projects, point in the direction of an increasing relevance of international collaboration in science and technology which is followed by a significant increase and broadening of international and transnational policy initiative and instruments to foster and shape international S&T collaboration (Edler, 2010).

History shows that R&D partnerships have been growing since the 1960s with a noticeable acceleration in the 1980s. This is the result of the increasing level of complexity of R&D projects in recent years, higher uncertainty surrounding R&D, increasing costs of R&D projects, stronger competition and shortened innovation cycles that favor collaboration in face of an environment with more specialized organizations in terms of knowledge production (Pavitt, 2002; Hagedoorn, 2002; Narula, 2001; Zeng, Xie & Tam, 2010; Barajas & Huergo, 2006; Katz & Martin, 1997)[5]. Other benefits from cooperative R&D come from the assumption that it increases the efficiency of R&D efforts, provides more flexibility to adapt to technological changes and eliminates wasteful duplication; also cooperative R&D agreement may serve as a mechanism that internalizes the externalities created by spillovers while continuing the efficient sharing of information (Katz, 1986; Hidalgo, León & Pavón, 2002). Moreover, the process of globalization itself has influenced firms' behavior and technological characteristics of innovations by increasing outsourcing and strategic alliances and also by promoting increasingly multi-technological products (Narula, 2004).

As a consequence of these trends there is an emergence of new forms of interaction between firms (Wagner & Edelmann, 2002), fostering an environment of "open innovation", meaning that many companies across industries externalize several R&D activities, focusing on their core competences and absorbing third parties' capabilities. This implies that firms use R&D partnerships to access knowledge, expertise or skills and build global R&D networks, being the choice of partners dictated by the complementary resources which the counterpart controls, allowing companies to improve their performance (Miotti & Sachwald, 2003; Georghiou, 1998; Nesta & Mangematin, 2004). One significant outcome of this scenario is that especially large companies are likely to become less self-sufficient in their processes, being able to incur in the division of innovative activities (Pavitt, 2003; Fritsch & Lukas, 2001) which according to economic theory should lead to scale economies[6].

Efforts on R&D cooperation are especially relevant in OECD countries, where the increasing number of R&D strategic alliances stands for a new organization in industrial technological structure focused on network promotion policies instead of direct financial assistance policies (De Jong & Freel, 2010; Hidalgo, León & Pavón, 2002). This interest from governments in promoting international research collaboration comes primarily from expectations of cost savings and other related benefits (Katz & Martin, 1997). Cooperative R&D policies gain even more importance when one considers that the extent to which a country's businesses, institutions and industries are linked with resources and capabilities located outside the country is likely to positively impact on the innovation performance of that country (European Commission, 2010), creating local externalities from global relationships.

Also, the idea of international scientific and technological cooperation can be regarded as fundamental for the development of products that demand joint R&D due to specialization patterns in different economies or regions, i.e., the idea of complementarities between firms should also be considered as promoting integration between technically and economically heterogeneous territories. In this sense, collaboration fosters knowledge transfer in a context of international economics. Narula and Santangelo (2009) hypothesize that R&D alliances might even act as a substitute for collocation, or as a complementary mechanism for it, clearly embedding the idea of international R&D cooperation in the economic geography

[5] Nelson (1959) mentions that the lack of incentives for individual firms to invest in new knowledge (due to mainly appropriability problems) was managed by many industries via the establishment of cooperative research organizations.

[6] This does not mean at all that R&D cooperation has no effect on SMEs. The point to be noticed here is that smaller firms are not likely to proceed to internalization of processes in the first place, making them more prone to outsourcing by their own organizational definition.

framework.

In Europe, the creation of the European Research Area stands for a coordination of closer R&D cooperation between organizations of EU's Member States (Georghiou, 2001). As it was mentioned in the previous section, it is interesting to highlight the adaptive role of the policies in this field – R&D cooperation did not follow governmental initiatives but the other way around. Also, An evaluation undertook by the European Technology Assessment Network (ETAN, 1998) concludes that European firms not only have a internationalized S&T profile, but are also increasing its technological alliances and international generation of innovations within Europe and beyond.

However, this growing interest in technological cooperation analysis is followed by a high level of complexity involved in studying it (Barajas & Huergo, 2006). Some models were developed in the past decade trying to cope with non-linear and non-direct relationships between the variables used in the evaluation. Crépon, Duguet and Mairesse (1998) wrote the most influent article in this sense – they approach this idea of complex interrelations with a model of simultaneous structural equations that allow for the analysis of indirect relationships (a similar approach has been undertook recently by Bogliacino & Pianta, 2010). Their results show that technological cooperation agreements have a positive effect in the achievement of innovations which leads to better economic outcomes, suggesting an indirect relationship between cooperation and economic performance via innovations. Similar results are found by Surroca Aguilar and Santamaría Sánchez (2006).

Conceptually, cooperative R&D consists of an arrangement among firms aiming at sharing costs and results of an R&D project and can be achieved through R&D contracts, consortia or Research Joint Ventures (Sakakibara, 1997)[7]. The idea of open innovation formalizes the importance of these networking initiatives and absorptive capacity while reducing the focus on internalization of R&D activities (De Jong & Freel, 2010). As a matter of fact, external sources of knowledge and skills play an increasingly important role in innovation and the capacity of accessing and exploring this knowledge is fundamental for companies' competitiveness in the described context (Cohen & Levinthal, 1990). Also, an important prerequisite to manage the permanently changing dynamic market requirements and to secure the competitiveness is the linking and cooperation of companies (Wagner & Edelmann, 2002).

In an environment of constant technological change and high levels of R&D complexity, the best way to minimize risks and achieve sustainable competitiveness seems to be through extreme specialization. It is impossible to imagine that this trend leads to economic growth if firms and agents do not interact with themselves (since they are all deeply specialized) or do not even have the capacity to do so. R&D cooperation practices have a twofold impact in this sense: on the one hand they create the possibility of firms addressing complexity in a multi-capability and multidisciplinary manner, promoting valuable innovations; on the other hand, R&D cooperation increases absorptive capacity and learning capabilities in the company, generating better prospects for future collaboration. This latter aspect is also pointed out by Barañano (1995). Therefore, promoting the strengthening of companies' technological skills through collaboration and therefore providing them with absorptive capacities is a fundamental focus that technological policies must consider (Molero, 2001; Hidalgo, León & Pavón, 2002; Luukkonen, 1998)[8].

But it is important to highlight that despite the increasing relevance of R&D cooperation and the growing literature about it in both the fields of management and industrial economics, there is little evidence on the performance effect coming from R&D collaboration (Belderbos, Carree & Lokshin, 2004). However, available analyses at the firm level show positive results. Zeng, Xie & Tam (2010) report that interfirm cooperation shows a significant positive impact on the innovation performance of SMEs in the Chinese environment. International R&D collaboration also seems to be positively associated with higher innovation expenditures (De Jong & Freel, 2010) and to provide firms with strategic flexibility to undertake short-term innovation projects with a variety of partners (Hagedoorn, 2002).

[7] The kind of cooperative agreement in which firms engage is largely determined by technological characteristics and sectors of industry (Hagedoorn & Narula, 1996).

[8] Hidalgo, León & Pavón, 2002 relate this aspect especially to SMEs.

Cooperative R&D structures can be seen as innovative *per se* as it creates a new institutional framework for companies cooperate in the generation of technological change. Policies fostering cooperation also show adaptive characteristics since they cannot be regarded as linear: they promote a more complex and holistic approach to innovative processes in opposition of direct funding initiatives. But one has to be very careful when analyzing collaborative R&D and its related initiatives. For many sectors, cooperation regarding innovation may be too dangerous for companies' appropriability strategies – as it is the case of the pharmaceutical sector which relies deeply on the launching of new products and in the intellectual property rights of these new drugs – sharing valuable information with competitors or even with agents from industries not directly related to the pharmaceutical sector might be too big of a threat for this organizations (which explains why this market is controlled by huge corporations with high degrees of internalization).

Also, cooperation may happen in different stages of R&D. Some projects are related to basic R&D, others to pre-competitive activities and lastly (as it is the case of the Eureka Initiative), close-to-market cooperation (the one which poses the biggest risks for companies). Conceptually, R&D alliances can be distinguished from production-based alliances in terms of its fixed-term horizon and the fact that it covers only a small part of the value-adding activities of companies (Narula, 1999). So as it can be noticed, collaboration in the area of innovation can not only take different shapes in the interorganizational relationship (contracts, research joint ventures, etc.) but can also apply to R&D activities with different purposes. When dealing with evaluation of technological policies one cannot neglect these aspects.

4. The Eureka Programme: an overview

The Eureka Programme emerged as part of a concerted effort to bridge the widening technological gap observed since the 1960s between Europe and its global competitors: notably the USA and Japan (Eureka Secretariat, 2005). It was created in 1985 by a French initiative as a complementary structure for the Framework Programmes[9] aiming at enhancing collaboration between companies in a market oriented, non-bureaucratic, bottom-up approach promoting cooperative projects for national funding (León, 2006; Hidalgo, León & Pavón, 2002; Stubbs, 2001; Georghiou, 2001; Marín.& Siotis, 2008).

It became a Europe-wide network that aims at increasing its participant's competitiveness through the promotion of cross-border ``market-driven'' R&D projects in which firms may seek entry for any projects that meet the broad criterion of developing advanced technology with a market orientation (Georghiou & Roessner, 2000; Bayona-Sáez & García-Marco, 2010; Trabada, 2000; Molero & Fonfría, 2008; Marín.& Siotis, 2008). It is important also to highlight the relevance of the bottom-up approach of this initiative: unlike programs that have clearly defined areas of interest for R&D projects, in Eureka, the nature and scope of proposals is defined by the proponents themselves.

Eureka is present in 38 countries plus the European Commission and acts not through financial support but providing projects with a seal of approval that facilitates access to governmental funds in the national level as well as support in finding funding opportunities which makes it a fairly decentralized program (Molero, 2001; León, 2006; Hidalgo, León & Pavón, 2002; Stubbs, 2001; Georghiou & Roessner, 2000). Even though Eureka does not entitle firms to EU subsidies (it should be noted that Eureka is not an EU program), obtaining the Eureka "seal of approval" enhances firms' ability to receive support from their respective national authorities (Marín & Siotis, 2008). By conferring an objective seal of quality on a project, EUREKA labeling greatly aids the process of negotiation with public sources of finance[10]. Many member countries accord preferential treatment to labeled proposals by giving access to specifically reserved funding (Eureka Secretariat, 2005).

[9] Eureka has a "nearer to the market" position relative to the Framework Programme even though some level of overlapping exists (Georghiou, 2001). It is important noticing, though, that Eureka is not part of the Framework Programme or a European Union body.

[10] Edler (2007) points the importance of signalling policies regarding innovations and there are several other authors that analyze signaling strategies and adverse selection risks in the context of R&D and innovation funding. For examples see Beatty, Berger & Magliolo, 1995; Takalo & Tanayama, 2010; Plehn-Dujowich, 2009; Janney & Folta, 2003; Bagella & Becchetti, 1998.

Eureka's focus is on improving European competitiveness and productivity through an enhanced cooperation between companies and research centers in high-tech areas (Molero, 2001). Under Eureka, cooperation often consists of occasional meetings between firms at which information is shared (Fölster, 1995), but more formal ways of cooperation also take place[11].

GSM mobile technology, car-navigation systems, smartcards to support mobile and electronic commerce, special effects software for cinema, state-of-the-art medical devices and technologies to monitor and limit environmental pollution are some of Eureka's previous projects (Eureka Secretariat, 2008)[12].

Eureka carries out its own evaluation system through periodic reviews. In its first decade of existence, evaluations of projects were responsibility of the Member State holding the Chair for that year and in 1992-1993 Eureka had its first major evaluation, involving teams from 14 countries working together and carrying out a survey with all of the participants[13] (Georghiou & Roessner, 2000).

However, besides its internal evaluations, Eureka is the focus of several academic analyses. Some examples:

a) Bayona-Sáez and García-Marco (2010) demonstrate that participation in a Eureka Programme has a positive effect on firm's performance both in manufacturing and non-manufacturing sectors[14] (which is in accordance with Benfratello & Sembenelli, 2002 results – they also highlight an increase in labor productivity and price-cost margins for participants);

b) Barañano (1995) suggests that Spanish Eureka participants see the improvement of the organization's public image as one of the most important features of the program;

c) Marín and Siotis (2008) result's tell that it seems that Eureka serves the purpose for which it was designed, namely to correct the market failures associated with the generation of economically valuable knowledge;

d) Fölster (1995) hypothesizes that, given that Eureka projects require cooperation but do not require result-sharing agreements, the likelihood of cooperation is not increased while do promote incentives to conduct R&D to the same extent as subsidies that do not require cooperation;

e) Georghiou (2001) points that Eureka started with major projects but a decline since then took part driven by its divergence with national innovation policies.

So as it can be noticed, Eureka is a relevant target of innovation policy evaluation. But it is important to take into account that even though the results presented are mainly positive, continuous assessments and even different research foci might not only identify weaknesses of the program, but also provide information necessary for adaptations and changes in the initiative's characteristics.

5. Methodology

The methodology developed in this paper has a quantitative focus divided into 3 parts: ***descriptive statistics***, ***identification of associations*** and ***discriminant analysis & typology of participants***. The ***descriptive statistics*** aim at creating a profile of the samples used, thus generating some insights on the subjects of the analysis and building general knowledge on the database. For the ***Identification of associations*** we use mainly correlations and cross-tabs. The goal here is to search for trends and significant associations that allow for some conclusions about the sample. The ***discriminant analysis & typology of participants*** part is approached with both discriminant analysis and cluster analysis. The intention in this part is to verify influential variables in the achievements of companies as well as identify latent groups within the sample and what are their main characteristics.

[11] Companies can participate in projects with different goals: end users of resulting technology, producers, research institution, supplier, other non-specified roles or even multiple roles – also firms are defined as the main agent of the cooperation or as partner.

[12] It is important to remind that Eureka does not focus on a particular set of technologies (Marín & Siotis, 2008).

[13] This evaluation influenced the very evaluation traditions in Europe according to Luukkonen (2002).

[14] They also find that there is a 1-year lag between project completion and performance improvements (Bayona-Sáez & García-Marco, 2007).

5.1 THE SAMPLE

The sample consists in a subset of Eureka's database of Spanish participants in the initiative for the period 2000-2005. However, some adjustments had to be made for this database (consisting originally of 330 observations). The selection of this specific period is mainly due to both data availability and comparison issues. The available datasets comprehended the perioda 2000-2005 and 2006-2008. This discrimination occurs because of a change in the structure of Final Reports, thus hampering the possibility of organizing a joint analysis. Future developments of this research contemplate using the 2006-2008 dataset as a control sample for the results presented in this document.

Thus, the first stage consisted in three steps:

1. Eliminating participants that did not respond the Final Report since information regarding their participation in the Eureka project was not available.

2. Selecting those participants which were either Large Companies or Small and Medium Size Enterprises (SMEs) given the scope of the analysis. Research Centers, Universities and other institutions were then dropped from the database.

3. For those participants with more than one project, a new observation was created based in the combination of answers of the distinct projects of the same organization which replaced the original observations. The original observations were dropped from the database[15].

After these adjustments the 2000-2005 database was left with 77 firms. A last effort was made to categorize companies according to their sector (NACE 2 digit Rev. 2) using the Amadeus database and to identify actual number of employees: 2 companies from the 2000-2005 subset could not be classified in this regard.

5.2 VARIABLES OF ANALYSIS

This section consists in an analysis of Eureka's Final Reports for the period 2000-2005. This does not mean that the projects were undertaken within this time frame since it refers to the date of completion of the projects. From this analysis we gathered the most relevant to use as variables in the statistical approaches developed[16]. Those items that are in the Final Reports' structure but are not in the scope of this article were omitted.

According to the basic structure of Eureka's Final Reports, the questions are gathered into groups. Trying to respect this organization of data we present the variables in their original groups (groups not used are excluded).

a) **Organization description** – refers to aspects as size and sector of the organization. It is used in this study as a mean of obtaining characteristics of the sample.

b) **Participation in the Project** – It assesses the role of the company in the project (Producer, End User, Supplier, Research or Other[17]) and if the company is a Main player in the project or a Partner. Also, the functioning of the project (1=Excellent; 2=Good; 3=Weak; 4=Bad), duration (in months) and total cost (in million) were assessed.

c) **Technological Achievements** – Consists of a general overview of results (1=Excellent; 2=Good; 3=Weak; 4=Bad) and a more detailed part in which a group of indicators is analyzed regarding Initial Objectives, Achieved and Expected within three years. The indicators are:

- New products;
- Improvements to existing products;
- New processes;
- Improvements to existing processes;
- Demonstrators, prototypes or pilot phase;
- New licenses;
- New patents;

[15] This procedure allows for an analysis at the company level rather than working with results from specific projects.

[16] Further information regarding the variables used in the analysis is provided in Appendix I. Variables of Analysis.

[17] For the purposes of this analysis, whenever a company responded that it had more than one role in the project it was defined as having Multiple Roles.

- Publications;
- Improved/new knowledge or skills;
- Improved management/quality of work;
- New (or improved) strategic industrial alliances;
- New services.

d) **Industrial exploitation** – It gathers information regarding expected industrial exploitation as a result of the project (by the company, by another company or no industrial exploitation). Also, it was assessed if results from the project were Already on the Market.

e) **Commercial Impact:** Commercial impact is assessed with a general overview on this matter (1=Excellent; 2=Good; 3=Weak; 4=Bad; 5=Nil).

f) **Employment Impact** – It assesses increase in employment (inside and outside the company), generation of safeguards and absence of employment effects. The 2000-2005 questionnaire also approaches the possibility of employment decrease.

g) **Eureka Benefits** –It consists in questions regarding aspects related to Eureka's support, features and characteristics that motivated the company to relate the project to this institution.

h) **Main Obstacles** – It basically consists in assessing the companies' main obstacles from a set of potential problems participants may have had.

From this description of the constructs from Eureka´s Final Reports a basic distinction of the variables can be made. This division into different constructs allows for a more structured interpretation of statistical results:

1. **Technological Achievements, Industrial Exploitation, Commercial Impact** and **Employment Impact** are ***impact constructs*** and represent results from the project.

2. **Organization Description, Participation in the Project and Financing** are ***descriptive variables*** and allow for a categorization of the participants and description of the sample composition.

3. **Eureka Benefits** and **Main Obstacles** provide some supplementary information and are defined as ***support variables***.

5.3 DESCRIPTIVE STATISTICS

The Descriptive Statistics in this analysis have an exploratory character regarding the database, thus providing some insights on the participants and their interaction with Eureka's projects. Frequency statistics are developed for the three constructs of analysis. Some cross-frequencies are developed for **descriptive variables**, trying to identify how different sorts of companies (e.g. Large Companies or SMEs) participate in Eureka (e.g. their Role in the project). Information about the pattern of firms participating in Eureka regarding their specific sector is also offered.

The descriptive analysis of **impact variables** allow for a general idea of Spanish firm's achievements when participating in this initiative for each of the variables approached. The **support variables'** analysis provides information on companies' consideration about benefits originated from their participation in a Eureka Project and the main obstacles faced. Lastly, a compilation of descriptive statistics is compared to data from the whole set of participants in Eureka's projects extracted from the 2005-2006 Annual Impact Report of Eureka.

5.4 IDENTIFICATION OF ASSOCIATIONS

The statistical methods for the identification and analysis of associations between variables are correlation coefficients and cross-tab analysis chi-square tests). The correlation coefficients provide some further exploratory information in addition to those achieved through the descriptive approach. Cross-tab analysis with chi-square tests already represents a step ahead in the identification of associations, allowing for some inferential propositions. The approach described in this section is developed according to the following structure:

1. Correlation coefficients:

   a. Within constructs – it is analyzed if whether variables are associated with other variables in the same construct.

For **impact variables** the relationship between Initial Objectives, Achievements and Expected Results (Technological Achievements group) is analyzed, searching for a proxy of the rate of success in the projects.

2. Cross-tabs:

   a. Between constructs – descriptive variables are analyzed according to impact variables. The objective of this approach is to generate some knowledge on how variables such as company's size and its role in the project interact with the results achieved.

It is worth noticing that statistical interactions proposed in this section obey logical and theoretical propositions. When analyzing **impact variables**, it is relevant for the study of innovation aspects to relate it to variables representing companies' size and their role in the technological project, as well as how technological achievements may influence commercial results, for example. Working with this set of Spanish companies we can, through this specific methodology described in this section, be able to identify some valuable trends in the sample.

5.5 DISCRIMINANT ANALYSIS & TYPOLOGY OF PARTICIPANTS

The discriminant analysis & typology of participants approach of this study consists in evaluating through statistical methods how the companies behave according to their characteristics and outcomes from their participation in the project. In a first moment, discriminant analysis is performed in an attempt to identify how a set of variables determine firms' technological and commercial results. The second step undertaken is a cluster analysis that aims at verifying latent groups of companies with similar profiles either regarding their structure (size for example) or the impact of their participation in Eureka. More than the previously mentioned approaches, this part of the research undertaken aims at generating in-depth knowledge on aspects that might contribute for the policy-making process at the Eureka (and maybe other similar initiatives) level.

The discriminant analysis is developed in a two stages structure. In the first model *Technological Achievements* (see Appendix I. Variables of analysis) is taken as the dependent variable. The idea is to assess which other variables influence in the generation of innovations. Therefore, the following variables are included in the model: *Companies' Size*, *Role in the Project*[18] and *Functioning of the Project*. The second discriminant model is oriented towards a performance view of the participation in the project. Thus, the dependent variable is *Commercial Achievements*[19] and the set of independent variables included comprehends *Companies' Size*, *Role in the Project, Functioning of the Project*, *Product Already on the Market*, *Industrial Exploitation by the Respondent's Company* and *Overall Technological Achievements* (now considered as independent variable). The idea of these two models is quite simple: assess the main drivers of technological evolution for Spanish companies participating in Eureka with projects completed in the period 2000-2005 and develop an introductory knowledge about what affects their outcomes from a market-oriented perspective. Both models are analyzed in a stepwise way, aiming at identifying the most relevant explanatory variables for technological and commercial impacts of Eureka without running the risk of building an unstable model (considering the relatively small number of observations).

The cluster analysis developed in this paper has a rather exploratory character – instead of a confirmatory one. The objective is to provide some insights on a preliminary typology of Spanish participants in the Eureka Initiative based on a set of **descriptive** and **impact variables.** For this approach, the TwoStep Cluster (SPSS) method was used – this method is an exploratory tool designed to reveal natural clusters in the dataset according to the parameters indicated. As auxiliary tests showed, the TwoStep Cluster method performs better than the K-means method – the Hierarchical method was also tested but its results did not seem to be analyzable. The Ratio of Schwarz's Bayesian Criterion (BIC) Changes was the test used for establishing the optimal number of clusters for the sample. Chi-square tests for the classification relevance of variables were

[18] This includes two variables: one referring to the role of the firm as Producer, End user, Supplier, Research, Other or Multiple roles and the other referring to the company as a Main player or Partner in the project.

[19] As it can be seen in Appendix I. Variables of Analysis, the commercial achievements variable can have the values: 0=no answer; 1=excellent; 2=good; 3=weak; 4=bad; 5=nil. For consistency of this analysis the cases listed as "no answer" were dropped (2 observations).

also performed.

The specific variables included in the settings of the cluster are: *Companies' Size, Role in the Project* (as Main player or Partner and as Producer, End user, Supplier, Research, Other or Multiple), *Functioning of the Project, Overall Technological Achievements, Industrial Exploitation by the Respondent's Company, Product Already on the Market and Commercial Achievements.*

6. Results

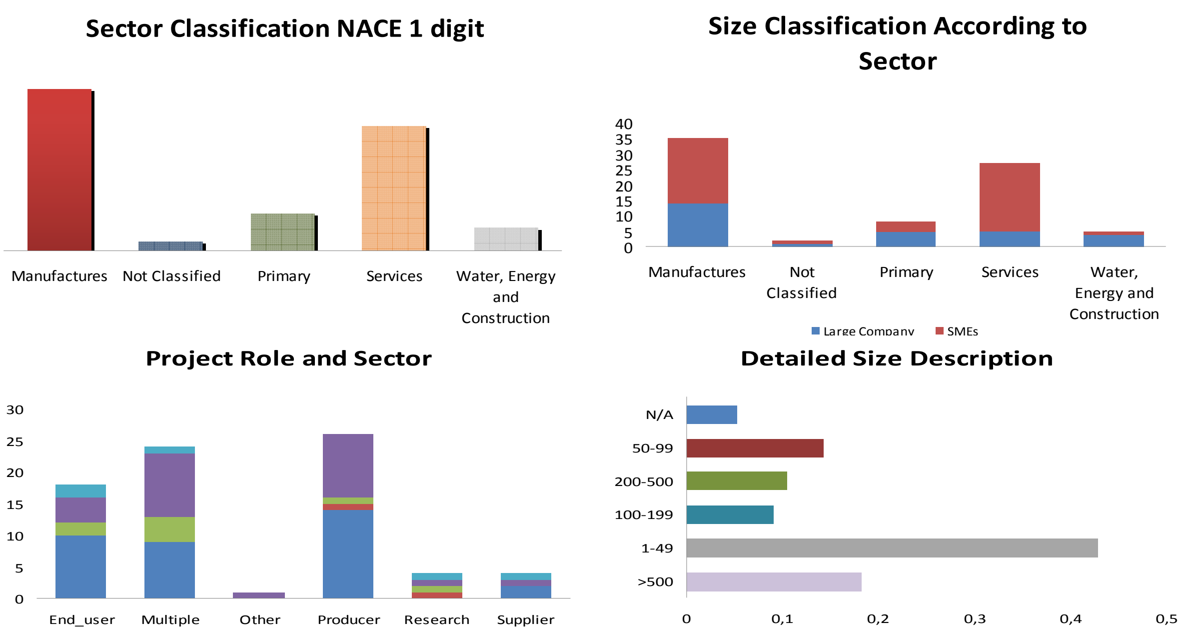
This section brings the results of the analysis performed. Sections follow the same order as they are explained in the methodology section: Descriptive statistics of the sample are provided together with some graphs, the identification of associations is presented in two parts – first the correlation coefficients are exposed and discussed followed by the cross-tabs (chi-square) – and lastly we offer both the discriminant and cluster analysis' results.

6.1 DESCRIPTIVE STATISTICS

In Graph 2 companies are firstly described according to their broad sector of activity. It can be noticed that the majority of Spanish firms participating in Eureka are either in the manufacturing sector (46%) or Services industry (35%). Furthermore, analyzing this distribution and relating it to firms' sizes, the sample is composed by a majority of SMEs in comparison to Large Companies (even though organizations in the Primary Sector and Water, Energy and Construction are mainly Large Companies). In the detailed analysis of companies' sizes (by number of employees), there is a strong concentration of firms with less than 50 employees indicating that not only SMEs are in bigger number, but that there is a relevant representation of purely Small companies. Still in Graph 2 the distribution of companies according to their broad sector of activity and Role in the Project is provided and it should be noticed that mainly firms from the sample interact with Eureka as Producers of Technology, End Users or with Multiple roles. In accordance with the characteristics of the sample described above, these roles are mainly played by manufactures or service firms.

Graph 3 brings a more detailed industrial analysis of the sample (NACE 2 digit Rev. 2). There is a myriad of different sectors of activity when participants are analyzed in this sense (32 sectors for 77 firms) which complicates any analysis of this approach. However, there is a slight predominance of agrifood related industries - this can be drawn from the fact that 11.7% of firms are manufactures of food products (the biggest participation by one single sector), 6.5% are in the crop and animal production sector and 2.6% in the fishing and aquaculture industry. This accounts for nearly 20% of the sample and suggests some interesting insights on profile of Spanish companies participating in Eureka.

Graph 2. Sample Composition



Graph 3. Sample's sector classification

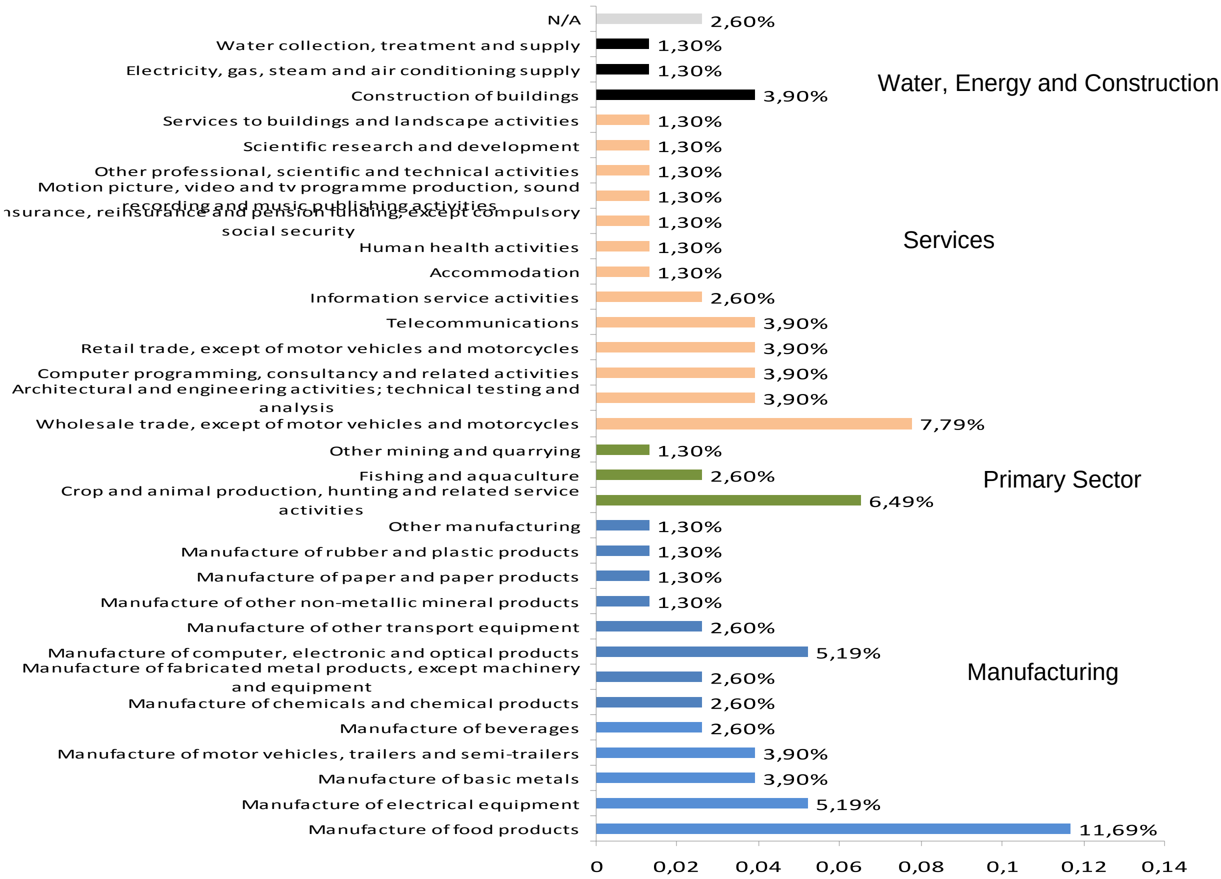


Table 1 provides information on two aspects of Eureka projects' undertaken by Spanish companies and finished in the period 2000-2005. Regarding total cost of projects, the mean is 3.11 million euro with a standard deviation of nearly 5 million euro. As for duration of projects, they vary between 1 and 8 years with a mean of nearly 2 and a half years and a standard deviation of 15.61 months.

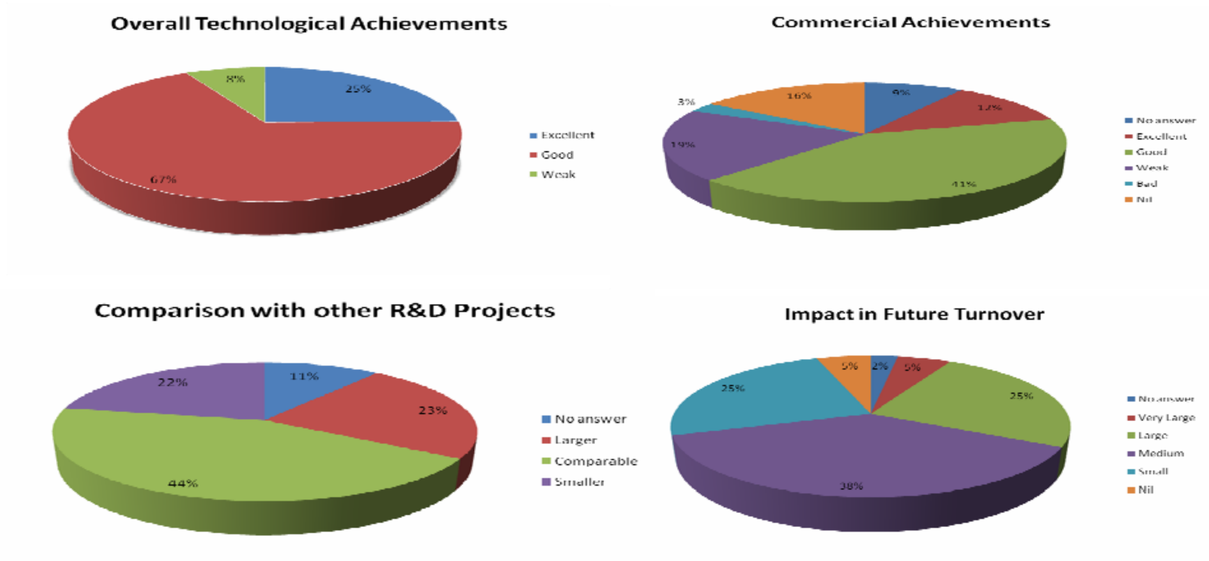
Table 1. Descriptive parameters of project's duration and total cost

	N	Minimum	Maximum	Mean	Std. Deviation
Total Cost (million euro)	70	0.15	32.04	3.11	4.96
Duration (months	70	12	96	37.1	15.61

In Graph 4 a general overview of companies' results is offered. As it can be seen, most companies regard their participation as being technologically satisfactory – 92% of firms say that their overall technological achievements are either excellent or good. It is worth noticing that while 8% of firms assess the technological impact of the initiative as weak, none has responded that they were bad. Nonetheless, it is interesting analyzing that firms' vision towards commercial achievements is not as optimistic as the one regarding the technological achievements. Even though the majority of firms interpreted the commercial outcome of their participation in Eureka as being excellent or good - 53% - there is now a clear division since 44% responded that they had weak, bad or nil (the latter accounting for 16% of the respondents) commercial impacts[20]. When analyzing the expectations of participation's impact in future turnover respondents seem to be slightly inclined to a conservative view – 38% believe the impacts will be of a medium level and 25% preferred believe they are going to be small.

[20] 3% of participants did not respond this question.

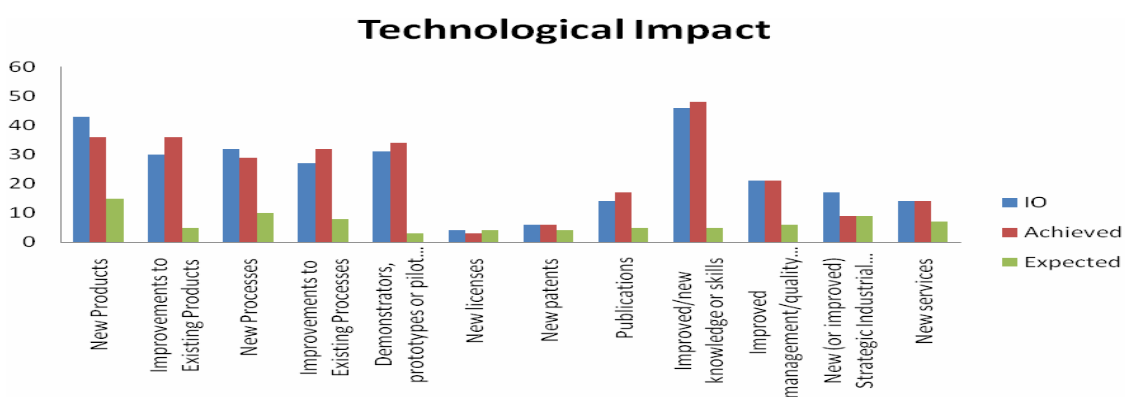
Graph 4. Eureka's Impact Overview



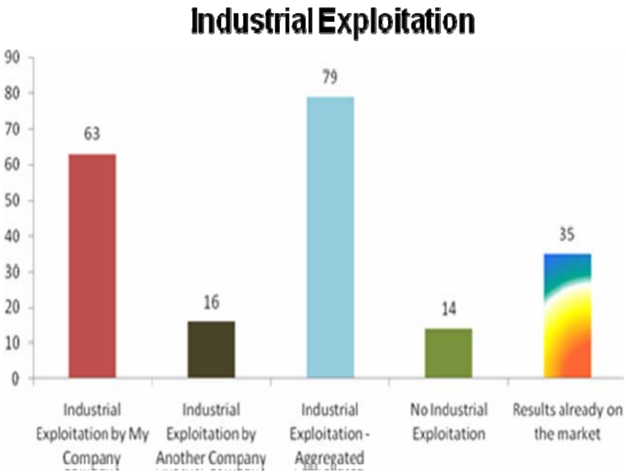
In the case of size of R&D undertaken for Eureka projects in comparison to general R&D projects developed by the companies, descriptive statistics indicate that the Spanish companies included in the sample are usually familiar with R&D projects – 66% consider their participation in Eureka smaller or comparable to other R&D activities they have. Nonetheless, 23% of firms believe Eureka represents a bigger R&D opportunity for them.

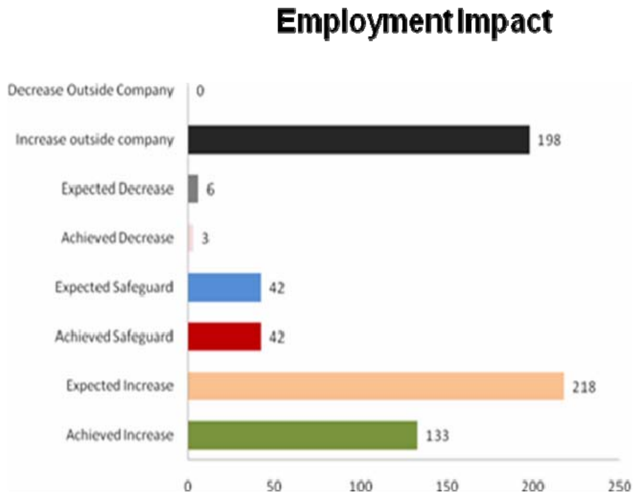
When turning to specific constructs of technological achievements (Graph 5) a clear idea of why the overview of technological achievements is so positive: six out of twelve constructs have relatively high rates of achievement by the companies – especially the acquirement of new knowledge and skills which is obtained by 62.3% of the respondents. Notwithstanding, one would expect a higher relationship between new and improved products and patents – which does not occur and only 7.8% of firms reported having patents as a result of their participation in Eureka while 46.8% informed the achievement of new products and improved products. Another interesting aspect of this analysis is that the generation of new strategic alliances is rather low (11.7% of companies) in a context of the realization of cooperative R&D projects – apparently the relationship between firms is prone to be specific to the goals proposed for the Eureka Initiative. Further analyses regarding the relationship between Initial Objectives (IOs), Achievements and Expected Achievements can be found in section 6.3 Identification of Associations where some correlation analyses of these interactions aiming at assessing Eureka's outcomes are developed.

Graph 5. Detailed Technological Achievements Overview



Graph 6. Industrial Exploitation and Employment Impact results





Industrial exploitation results are quite attention-grabbing (Graph 6). We have pointed before the results of commercial achievements and one would expect some relationship with the capacity of firms to exploit their technological industrially. But this seems not to be -Industrial exploitation results are quite attention-grabbing (Graph 6). We have pointed before the results of commercial achievements and one would expect some relationship with the capacity of firms to exploit their technological industrially. But this seems not to be the case since 63 participants (81.8%) reported that they were apt of exploiting results in their respective industry (16 also mentioned – 20.7% - the case of industrial exploitation by another company). What can explain this feature might be the rate of firms with products already on the market – 45.4% - which is closer to the rate of positive evaluations of commercial impact as a result of the companies' participation in Eureka. It can be also seen in Graph 6 the employment impact of Eureka in Spanish Companies – apparently the participation in this program has a rather positive employment outcome.

As the main benefits companies see as having the Eureka Label five stand out: the prestige of the label (75.3% of the sample), improved access to resources (58.4%), non-bureaucratic procedures (54.5%), being close to market (54.5%) and providing funding opportunities (50.6%). Fascinatingly this is in perfect accordance with Eureka's main characteristics and proposals described in section 4. As a result of these perceptions, 87% of companies included in the sample affirmed their interest in participating in another Eureka project.

Regarding the main obstacles faced by companies, it is not surprising that technical difficulties appear as the most often reported obstacle (49.4% of respondents) – when dealing with innovation and technological progress, technical matters usually represent a relevant barrier. Change in partners strategies (28.6%) also come out as an important obstacle for Spanish companies participating in Eureka – again, this is expected since the initiative promotes cooperative R&D projects and this sort of problem is a risk inherent to the process. Also, public funding of companies' participation is mentioned by 26% of the sample as a relevant obstacle, which poses some weakness on Eureka's signalling capabilities.

As the last part of this descriptive analysis we offer table 1, which brings a comparison between main results of Spanish companies and the total of participants in Eureka across Europe – results from the Eureka Annual Report 2006.

First, some limitations should be regarded: a) the period of analysis of Eureka's report is 2001-2005; b) the results are provided for the total of participants and not only firms – this was overcame with the combination of detailed results provided in the report expect for the case of Technological Achievements since this aspect only had aggregated results. Furthermore, not all of the variables were available at the report so the extension of the comparison was limited. Therefore we recommend that the analysis of table 2 should have a suggestive character only.

Graph 7. Main Benefits and Obstacles

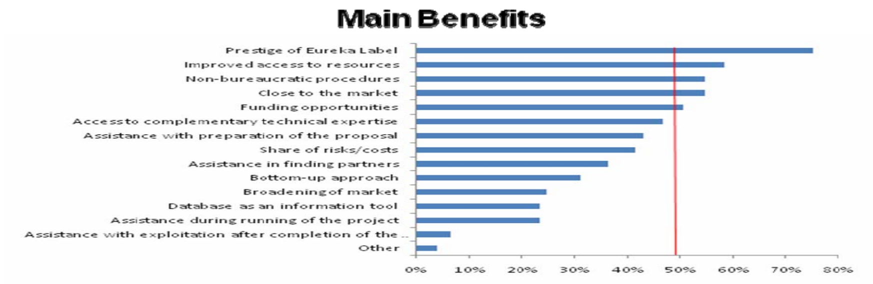


Table 2. Comparison between Spanish Firms and Total of Participants in Eureka

Aspect		TOTAL	SPAIN
Composition	SMEs	63%	62%
	Large Companies	37%	38%
Overall Technological Achievements	***Excellent***	***19%***	***24,7%***
	Good	***62%***	***67,5%***
	Weak	9%	7,8%
	Bad	2%	-
	No answer	8%	-
Technological Achievements - total participants	***New Products***	***36%***	***47%***
	Improved Products	***32%***	***47%***
	New Processes	34%	38%
	Improved Processes	***27%***	***42%***
	Prototype/demonstrator	43%	44%
	New services	***11%***	***18%***
	New strategic alliances	***19%***	***12%***
	New licenses	3%	4%
	New Patents	10%	8%
Technological Achievements - expected within 3 years - total participants	New Products	24%	20%
	Improved Products	10%	7%
	New Processes	13%	13%
	Improved Processes	8%	10%
	Prototype/demonstrator	5%	4%

	New services	10%	9%
	New strategic alliances	10%	12%
	New licenses	4%	5%
	New Patents	7%	5%
Industrial Exploitation	No industrial exploitation	22%	18%
Already on market	***Results already on market***	***31%***	***46%***
Actual Commercial Impact	***Excellent***	***6%***	***11,7%***
	Good	42%	41,6%
	Weak	20%	19,5%
	Bad	4%	2,6%
	Nil	17%	15,6%
	No answers	10%	9,1%
Employment Impact	***Increase***	***34%***	***44%***

The composition of groups seems to be rather similar which might indicate a trend in the size of companies participating in Eureka. The overall technological achievements construct provide information that Spanish companies either perform better than the European average or have a more optimistic view of their technological accomplishments. This better perception of technological achievements by Spanish companies can also be noticed in the comparison of individual constructs (except for New Strategic Alliances and Patents). When assessing the technological results expected within three years, however, Spain's firms do not seem to have a relevant difference with the European average.

Spanish firms apparently have also a higher rate of industrial exploitation in the comparison with the total of participants in Europe and introduce products to the market by the date of completion of the project more often. The commercial impact also seems to be significantly better, especially for those that consider the outcomes as being excellent. Lastly, it should be noticed that the employment impact of Eureka in Spanish firms has a higher impact than in the aggregated analysis of European firms.

6.2 IDENTIFICATION OF ASSOCIATIONS

The first approach developed in this section uses correlation coefficients to approximate the rate of technological success of Eureka in Spanish companies. For this we have analyzed the companies' Initial Objectives and how they relate to Achievements and Expected Achievements for every technological construct. Beforehand, however, it is important to notice that the results should be regarded carefully. While high correlations might provide indications of a sounding technological success as a result of companies' participation in Eureka, they may also have a statistical and a practical alternative explanations.

The statistical explanation is somewhat obvious. A high correlation between objectives and achievements could represent the lack of both – the companies did not intend on achieving results in a given construct and so they did not. Fortunately the descriptive statistics section provides some helpful information for this analysis.

The practical explanation has already been discussed to some extent previously in this paper and it concerns the very definition of innovation. Not to repeat all of the arguments once again, let's just say that a high rate of technological achievements according to previous plans might suggest that the advances cannot be considered actual innovations.

Turning to the actual results (Table 3) it can be seen that five out of the 12 constructs show relatively high correlation coefficients between Initial Objectives (IOs) and Achieved Results – *Improvements to Existing Products* (0.692), *Improvements to Existing Processes* (0.761), *Demonstrators, prototypes or pilot phases* (0.710), *Improved management/quality of work* (0.671) and *New Services* (0.651). *New Products* (0.519), *New Processes* (0.595), *New Licenses* (0.557), *New Patents* (0.457), *Publi-*

cations (0.561) and *Improved Knowledge or Skills* (0.564) show rather moderate correlations between IOs and Achievements. Lastly, *New (or improved) Strategic Industrial Alliances* has a quite low correlation between these two variables.

On the other hand, however, all of the constructs show low correlation coefficients between IOs and Expected Results – except for *New Processes* which has a moderate coefficient (0.380).

These results provide some hints on the outcomes of companies participating in the Eureka Initiative. Apparently there is a good rate of achievements according to planned goals. Nonetheless, in some cases it is evident that IOs are not achieved but results occur to companies which did not intend *a priori* to reach some specific goals. One clear example is the *New Products* construct. Even though 36 companies reported achievements in this construct (out of 43 that reported it as an IO), the correlation coefficient between IOs and Achievements is only moderate (0.519). Analyzing the database it can be seen that 13 companies that reported *New Products* as an IO did not achieve these results by the end of the project and 6 companies that did not have developing a new product as an original plan did in fact achieve it.

One other interesting particularity of this analysis concerns *New (or improved) Strategic Industrial Alliances*. First of all, the number of companies that reported this as an IO is rather low (17 participants) when one thinks about the structure of Eureka that promotes joint R&D projects between companies. This aspect of the analysis reveals a trend amongst Spanish companies of having a one-time relationship in order to achieve specific goals instead of developing long term technological cooperation.

Regarding the expected results the simple descriptive analysis (Graph 5 on page 25) already made it pretty clear that Spanish companies participating in Eureka do not foresee many possibilities of technological achievements related to the specific project in the future after its completion. This trend can also be identified using the correlation coefficients presented and it might validate the point of view offered for the generation of lasting relationships with R&D partners: if the goals intended are project-specific, once it is terminated, no remaining goals or inter-firm collaboration can take place.

Table 3. Technological Achievements' Correlation coefficients

		Achieved	Expected
New Products			
	Initial Objective	0.519**	0.107
Improvements to existing Products			
	Initial Objective	0.692**	0.114
New Processes			
	Initial Objective	0.595**	0.380**
Improvements to existing processes			
	Initial Objective	0.761**	0.196
Demonstrators, prototypes or pilot phase			
	Initial Objective	0.710**	0.108
New licenses			
	Initial Objective	0.557**	0.208
New patents			
	Initial Objective	0.457**	0.149
Publications			
	Initial Objective	0.561**	0.286*
Improved/new knowledge or skills			
	Initial Objective	0.564**	0.109
Improved management/quality of work			
	Initial Objective	0.671**	0.366**
New (or improved) Strategic Industrial Alliances			
	Initial Objective	0.294**	0.294**
New services			
	Initial Objective	0.651**	0.202

* Correlation is significant at the 0.05 level

** Correlation is significant at the 0.01 level

Table 4. Cross-tabs controlled for company size

	Variable 2	Chi-Square Sig.	Main Significant Results
Company Size	Technological Achievements	0.774	-
	Industrial Exploitation by the respondent's company	0.292	-
	Industrial Exploitation by another company	0.552	-
	Product Already on Market	0.577	-
	Commercial Achievements	0.096*	Good and Excellent results are related to SMEs; Poorer results are related to Large Companies.
	Future Impact in Turnover	0.187	-
	Employment Increase	0.072*	Positive Impact is associated with SMEs.
	Employment Decrease	0.434	-

* Difference is significant at a 0.10 level.

Following the analysis we develop a series of tables that show associations (cross-tabs and chi-square) between a set of descriptive variables and impact variables. The first results are shown in table 4 and report the relationship between companies' size and a set of variables representing results obtained by the companies from their participation in the project. For the first part of this analysis, results show that the size of the companies (SMEs or Large Companies) have an association with *Commercial Achievements* and *Employment Increase*. For the *commercial achievements*, SMEs seem to show a greater commercial impact as a result of their participation in the project than Large Companies. Also, SMEs show a greater level of employment increase as an impact of Eureka.

When analyzing the association of results of the participation in the initiative with companies' sectors, it can be noticed (table 5) that only *commercial achievements* show a statistically significant relationship. Regarding this result, Manufacturing and Services firms achieve a better performance.

Table 5. Cross-tabs controlled for Broad Sector of activity

Variable 1	Variable 2	Chi-Square Sig.	Main Significant Results
Broad Sector	Technological Achievements	0.858	-
	Industrial Exploitation by the respondent's company	0.917	-
	Industrial Exploitation by another company	0.151	-
	Product Already on Market	0.758	-
	Commercial Achievements	0.048**	Good and Excellent results are associated with Manufacturing and Services firms. Poorer results are related to Water, Energy and Construction sector.
	Future Impact in Turnover	0.861	-
	Employment Increase	0.449	-
	Employment Decrease	0.943	-

**Difference is significant at a 0.05 level.

Table 6. Cross-tabs controlled for Role (as Main or Partner)

Variable 1	*Variable 2*	*Chi-Square Sig.*	*Main Significant Results*
Role (Main or Partner)	*Technological Achievements*	0.288	-
	Industrial Exploitation by the respondent's company	0.195	-
	Industrial Exploitation by another company	0.160	-
	Product Already on Market	0.542	-
	Commercial Achievements	0.518	-
	Future Impact in Turnover	0.113	-
	Employment Increase	0.160	-
	Employment Decrease	0.460	-

Table 6 brings the results of the analysis that takes the role of companies as a Main player or as a Partner in the project as the descriptive aspect of the evaluation of the impact variables. In this case no statistically significant result could be found, indicating that this characteristic of participants does not seem to influence their outcomes (at least not in the specific case analyzed).

Table 7 repeats the approach contained in the previous tables and analyzes the companies' Role in the Project (as Producer, End User, Supplier, Research, Other or Multiple Roles) together with the participations' results. In this case, Technological Achievements appear to be related to companies' characteristics – Excellent achievements are obtained by firms playing the role of Producer; Good achievements are related to both Producers and companies that have Multiple roles in the project; and the poorest results can be associated with those companies that report having Other roles in the project (which might be an indication of smaller participation in Eureka). Also, it was found a significant relationship for firms that participate as End Users associated to Industrial Exploitation by Another Company.

Table 7. Cross-tabs controlled for Role in the Project

Variable 1	*Variable 2*	*Chi-Square Sig.*	*Main Significant Results*
Role in the Project	*Technological Achievements*	0.073*	Excellent Technological Achievements are associated with Producers; Good Technological results are associated with both Producers and participants with Multiple Roles. Poorest results are related to Other roles.
	Industrial Exploitation by the respondent's company	0.422	-
	Industrial Exploitation by another company	0.038**	Positive exploitation by other companies is associated mainly with the role End user.
	Product Already on Market	0.762	-
	Commercial Achievements	0.106	-
	Future Impact in Turnover	0.769	-
	Employment Increase	0.195	-
	Employment Decrease	0.651	-

* Difference is significant at a 0.10 level.
**Difference is significant at a 0.05 level.

6.3 DISCRIMINANT ANALYSIS

We start this section with the analysis of results related to the Discriminant Models built. As mentioned in the methodological steps, the first stage concerns the identification of discriminatory variables regarding companies' technological achievements. A summary of the results obtained is presented in table 8. The exploratory nature of this approach led the analysis to use a stepwise method – which suggested that a one-function model is adequate for explaining the variance in the dependent variable. As it can be noticed, only one variable was included – Functioning of the Project.

It is interesting to see that the variable Functioning, performs a unitary influence on Technological Achievements for the sample analyzed in a model that predicts correctly 71.40% of cases. In terms of evaluation of the Eureka Initiative in the Spanish case this result is quite valuable and, in spite of its obvious limitations, it should be regarded carefully in the future.

Furthermore, the relevance of the variable Functioning of the Project allows for the conclusion that projects that are undertake in the better environments, facing less problems, are more prone of resulting in the achievement of technological results.

The following approach takes *Commercial Achievements* as the dependent variable in the analysis, building a model that allows understanding better what influences companies economic outcomes from their participation in the Eureka Initiative. Like the first discriminant model, this one also was built according to a stepwise methodology that suggested two functions and two explanatory variables (table 9 presents a summary of the results). Unfortunately this model is not quite as robust for the sample as the first one as it is capable of classifying correctly only 55.7% of cases. This might be an indication of the more complex situation that commercial results face in comparison to purely technical achievements.

Again, Functioning of the Project was included in the analysis, but it has a rather low coefficient in both functions, which suggests its role as a catalyst of commercial achievements. Nonetheless, the *Industrial Exploitation by the respondent's company* was not only included in the discriminant model but also shows high coefficients in both functions. This aspect makes perfect sense when one remembers that this approach is specifically directed to commercial results – it is hard to think that the

Table 8. Discriminant model 1: Technological Achievements as dependent variable

Variables included in the model	*Percentage of Variance Explained by Functions*	*Significance of Functions*	*Canonical Discriminant*	*Percentage of Cases Correctly Classified*
	Function 1	Function 1	Function 1	
	100%	0.000		
				71.40%
Functioning			1.000	

Table 9. Discriminant model 2: Commercial Achievements as dependent variable

Variables included in the model	*Percentage of Variance Explained by Functions*		*Significance of Functions*		*Standardized Canonical Discriminant Function Coefficients*		*Percentage of Cases Correctly Classified*
	Function 1	Function 2	Function 1	Function 2	Function 1	Function 2	
	75.70%	24.30%	0.000	0.001			
Industrial Exploitation by the respondent's company					1.004	1.005	55.7%
Functioning					0.044	0.069	

market exploitation of the project's results would not have a significant importance in this context. We remind that firms' technological achievements were also included in this analysis – but excluded from the final model – and they do not seem to have a representative influence in companies' commercial impact (which can be regarded as a fairly interesting result of this analysis). The absence of the variable *Product Already on the Market* can also be considering rather surprising in this context.

6.4 TYPOLOGY OF PARTICIPANTS

In this last part of this assessment of Spanish companies' participation in the Eureka initiative for projects completed in the period 2000-2005, an attempt of developing an exploratory typology of firms included in the sample is performed. As it has been already mentioned in the methodological section, the set of variables used to define the characteristics of the clusters are *Companies' Size* (Large company or SME), *Role* (as Main player or Partner), *Role in the Project* (Producer, End User, Supplier, Research, Other or Multiple Roles), *Overall Technological Achievements, Functioning of the Project, Industrial Exploitation by the Company, Product Already on the Market* and *Commercial Achievements*.

Table 10 brings a summary of the structure of the clusters built based on a TwoStep Cluster approach. One first aspect that has to be commented is that the outcome of the analysis suggested the division of cases in 3 clusters with rather similar sizes. Nonetheless, it is evident that some of the variables used in the classification do not necessarily perform a considerable separation between clusters as it can be seen in the composition of clusters and also through chi-square results for the variables. Results were kept in the original structure since this assessment has exploratory interests (and the cluster analysis itself is not an exact science).

As results show, the size of companies does not correspond to a good separation variable between clusters – Cluster 1 and 3 both have a similar structure and no particular cluster correspond to the set of Large Companies – which are divided in small groups within clusters. A very comparable situation is provided by the Role as Main player or Partner – in this case, both clusters 1 and 3 are predominantly composed by Main players, while cluster 2 shows no defined characteristic in this sense. These observations are supported by chi-square tests that do not provide either variable with a significant classification power.

The cluster analysis starts taking shape when considering Role in the Project as a separation variable. In this case each cluster has a clear predominance of each one of the three most common roles played by Spanish companies participating in Eureka for the period analyzed. Cluster 1 is mainly composed by Producers; Cluster 2 by End Users; and Cluster 3 by companies playing multiple roles. Nonetheless, chi-square results do not allow for an inferential confirmation of these patterns so Role in the Project performs as a rather suggestive variable instead of a confirmatory one.

Following this variable, Technological Achievements seem to provide some interesting level of discrimination between clusters: while Cluster 1 is mainly made of companies with excellent results, both Clusters 2 and 3 show companies with good technological results – this should be no surprise since 92,2% of the sample classified their technological achievements as either excellent (24,7%) or good (67,5%), but cluster 2 also shows the presence of weak technological results, which does not happen for either of the two other clusters. In this regard, the chi-square coefficient indicates that this variable represents a good classification aspect between groups. Functioning of the project, a variable that deals with internal aspects of management of the project, does well in separating cluster 1 from 2 and 3 in a similar manner to that generated by Technological Achievements (even though chi-square results show a good fit for this variable only for clusters 1 and 3).

Table 9. Results of the TwoStep Cluster analysis

Cluster Distribution			
	Cluster 1 – *Risky Innovators*	28 observations (36.4%)	
	Cluster 2 – *Inventors*	26 observations (33.8%)	
	Cluster 3 – *Consistent Innovators*	23 observations (29.9%)	
	Missing	0 observations	
Cluster Profile			
	Cluster 1	**Cluster 2**	**Cluster 3**
Size (Large or SME)	Predominance of SMEs (70% of cases)	No predominance (50% of cases are SMEs and 50% are Large Companies)	Moderate Predominance of SMEs (70% of cases)
Role (Main or Partner)	Predominance of Main players (80% of cases)	No predominance (50% of cases are Main Players and 50% are Partners)	Moderate Predominance of Main players (65% of cases)
Role in the Project	Predominance of Producers (40%) and End Users (30%)	Predominance of End Users (35% of cases) and firms with Multiple Roles (30%).	Predominance of companies with Multiple roles (50%) and Producers (40%).
Technological Achievements	Excellent Technological Results (65% of cases)*	Good Technological Results (80%) and Weak Technological Results (20%)*	Good Technological Results (100%)*
Functioning of the Project	Functioning of the project rated as Excellent (60% of cases) or Good (nearly 40%).*	Functioning of the project rated as Good (60% of cases) or Weak (25% of cases).	Functioning of the project rated as Good (100%). *
Industrial Exploitation by the Company	Yes (95%)	No (55%)*	Yes (95%)
Product Already on the Market	Yes (70%)*	No (100%)*	Yes (65%)
Commercial Achievements	Excellent Commercial Results (30%), Good Commercial Results (20%), Weak Commercial Results (20%), Nil Commercial results (5%)*	Nil Commercial Results (40% of cases), Weak results (35%)*	Good Commercial Results (100%)*

*Clusterwise Importance (chi-quare at 95% confid.)

Regarding Industrial Exploitation of results, Clusters 1 and 3 represent groups of companies that do have some level of exploitation, and Cluster 2 seems to be composed by both companies that exploit their project outcomes and those firms that do not (chi-square tests show a significance only for the latter case). A clearer division is provided by the variable Product Already on the Market: both Clusters 1 and 3 have the characteristic of having commercial activities already by the end of the project which does not happen with Cluster 2 (chi-square significant for groups 1 and 2). Lastly, the variable Commercial Achievements shows that Cluster 1 represents companies with a myriad of different results: while it is the only group containing firms with excellent results, it also comprehends companies with good commercial results, weak commercial results and even nil commercial outcomes. This structure is rather complicated to analyze as there is no definite pattern (Excellent and Good results only account for 50% of cases). Cluster 2 is composed mainly by those firms with weak and nil commercial outcomes and Cluster 3 is related to those with good commercial achievements.

Focusing in those aspects that successfully divide clusters, the results indicate a general structure according to the following cluster profile:

1. **Cluster 1 – *Risky Innovators* -** SMEs which participate in the project as Main Players, playing the role of Producers or End Users, that achieve excellent technological results through an excellent functioning of the project, exploit their results in the industry, have products being commercialized by the end of the project and this generates excellent commercial achievements for a group of companies comprehended in this cluster. The name of this cluster makes reference to the fact that companies comprehended in it have the best technical outcomes out of the three clusters, but only partially they can obtain satisfactory market results.

2. **Cluster 2 – *Inventors* -** Large Companies and SMEs that play Multiple roles or the role of End Users in the project, that achieve good technological results through a good or weak functioning of the project, that do not necessarily perform industrial exploitation of results, that are not commercializing the outcomes of the project by the time of its completion, thus having nil and weak commercial achievements. These companies are classified as inventors for showing fair technical results without taking advantage of it in the market – which does not allow us to define them as innovators *per se*.

3. **Cluster 3 – *Consistent Innovators* -** SMEs which participate in the project as Main Players, playing Multiple roles or the role of producer in the project, that achieve good technological results through a good functioning of the project, exploit their results in the industry, have products being commercialized by the end of the project and this generates good commercial achievements. These companies have poorer technical results than the *risky innovators*, but truth of the matter is that they consistently achieve good commercial results.

An interesting exercise is to compare results of previous analyses to these presented for the cluster approach. Since this is an exploratory view of the situation, other statistical tests may help in providing it with robustness. Firstly, it was shown in the cross-tabs analysis that better commercial results were significantly related to SMEs while poorer results seemed to be linked to Large Companies. This is supported in the cluster structure for while Clusters 1 and 3 are predominantly composed by SMEs and have excellent and good commercial outcomes, Cluster 2 has no predominance of company size (indicating a larger presence of Large Companies than in the other clusters) and shows poorer commercial achievements.

In the same sense, it has been argued before that Producers were related to excellent Technological Achievements (which is consistent with cluster 1) and companies playing multiple roles were related to good technological results (consistent with cluster 3). In this scope cluster 2 cannot be justified.

Turning to the discriminant analysis, in the second model (commercial achievements as dependent variable) functioning of the project seems to influence the perception towards overall commercial outcomes which is partially supported by the clusters: while Cluster 1 represents companies with an excellent functioning of the project, Cluster 3 rates both the functioning of the project and technological achievements as good; Cluster 2, which shows the poorest functioning of the project rate shows worse commercial results.. Also in the second discriminant model, Industrial Exploitation of results is a significant variable of separation for commercial achievements, which is supported by the structure of the 3 clusters (even though chi-square tests only support the relevance of this variable for Cluster 2).

One last aspect of this analysis concerns a quite obvious result according to theory, but that deserves some attention. Spanish companies participating in Eureka for the period 2000-2005 are mostly well satisfied with their technological attainments, which is an important aspect of the evaluation of any technological initiative. However, this is only part of the story: the companies' capacity of introducing their results in the market and exploiting the technical outcomes of the project clearly influence the point of view towards commercial achievements – and when dealing with an innovation-driven approach (and not invention-driven), this latter part of the analysis is the one that matters the most.

7. Concluding Remarks

Technological policy evaluation is a process of utmost importance in any economic context that aims at fostering economic growth through technological progress and innovation. This is an exercise of constructive criticism with the ultimate goal of providing information and feedback that allow the continuous improvement of any kind of initiative – private, governmental or even supranational.

The work developed and presented in this paper represents an effort in this sense. An exhaustive quantitative appreciation of a database composed by Spanish companies participating in the Eureka Initiative with projects finished in the period 2000-2005 made possible some interesting exploratory insights about not only the participants analyzed, but also on specific internal aspects of the program that must be thoroughly regarded if the intention is for Eureka to achieve ever increasing rates of success.

The methodology used in the analysis reported in this paper had an obvious quantitative character aiming at taking the step beyond purely descriptive analysis. Obviously, in a first moment, the description of the sample was considered relevant for the reason of establishing the background for further developments. It could be noticed that Spanish companies participating in Eureka are mainly SMEs in comparison to Large Companies, which might suggest that these firms are more prone to engage in long-distance R&D collaboration, which makes sense considering their lower capacity of internalizing the development of technologies that become more and more complex. However, an analysis controlling for the participation of each type of organization in the whole economy would be necessary to confirm this point of view.

In general, it could also be noticed that Spanish companies show a better appreciation of the outcomes from their participation in Eureka than the aggregated figure for the whole set of participants. This can be related to the profile of Spain's innovation system – since the country lags behind technological and innovation leaders, it would be expected that players from this nation would benefit more (as it would also be the case for countries in similar positions) from international cooperation than a more advanced nation. Again, this is a speculation and the confirmation of this idea would have to be through research and some inferential analysis based on existing data.

Another remarkable aspect shown in the descriptive analysis is related to firms' perception of Eureka's benefits. It is surprising the perfect coupling between what is reported by participants and the advantages the program claims to offer. It must be highlighted though that the most important feature for most participants is the image of the Eureka label, i.e., the quality information that it transmits to the market and funding institutions[21], acting as an important signalling device that reduces adverse selection – and this shall be especially important for small companies competing for financing opportunities of uncertain innovation projects.

But how uncertain are these projects developed by Eureka companies? We have seen that the overall rate of technological achievements is amazingly high and even the commercial achievements can be considered outstanding in a context of innovation. While this might indicate that Eureka is doing a really good job in selecting potentially successful projects, it might also suggest that companies may not be taking the level of risk necessary for introducing major relevant innovations in the market, which corresponds to Georghiou's (2001) criticism, already presented in this article, that the quality of Eureka's innovation projects seem to be diminishing over time. Or it could also mean that the questionnaires are failing in capturing the real complexity involved in the process (Georghiou, 1997) or are simply influenced by too optimistic respondents.

A fairly robust cluster structure was presented for the sample, dividing participants in 3 groups. This step also allowed for the confirmation of the idea that commercial achievements are strongly affected by the insertion of results in the market before or by the end of the project. In this sense, Clusters 1 could be classified as *risky innovators*. One interesting aspect of this group in particular is that it seems to perform better than the other clusters

[21] It is important noticing, though, that Public Funding appears as one of the most relevant barriers according to Spanish firm's perceptions.

except for the case of commercial results, which shows a very heterogeneous pattern. Cluster 2 represents companies with poor market performance by the end of the project (for the specific results related to Eureka) but with satisfactory technical results, therefore *Inventors*, and Cluster 3 would be composed by moderately successful companies or *consistent innovators*. Cluster results also showed that both technological (marginally) and commercial (significantly) achievements are quite strong separation variables for groups of firms within the sample. Crossing this analysis with other Eureka samples (from different periods and territories) can be an interesting exercise for future validation of a Eureka-wide typology of participants.

The results of the discriminant analysis performed also showed that companies' inherent characteristics such as size, sector or role played in the project do not seem to influence largely the impacts of firms' participation in the initiative. As a matter of fact, what was gathered was that the quality of the project's functioning and the capacity of firms exploiting their results in the industry seems to determine the ultimate measure of success: the actual commercial achievements. Notwithstanding, this perspective is rather limited because it considers only the situation when the project is completed and it is recognized that potential effects as results of the projects may take a considerable time to become evident (Georghiou, 1997). Nonetheless, one cannot help but noticing a certain level of overlapping between the cluster structure and the discriminant analysis, since both approaches suggest the importance of the variables Functioning of the Project and Industrial Exploitation by the Respondents' Company as ultimate factor of success, i.e., the commercial achievements realized by Spanish firms. It also becomes evident that concern should be given to the process of project management throughout its realization: the quality of its functioning is a significant variable in every aspect analyzed in this paper regarding firms' outcomes.

But again, these results can be misleading if one considers the potential impacts that might unravel in the future. As pointed out in this paper, studies show that most likely performance impacts originated from Eureka have a 1 year lag between project completion and the achievement of actual improvements. Unfortunately this approach cannot be confirmed with the data analyzed here, since it is based on reports provided at the moment when the project is finished. Notwithstanding, companies' perception on achieved impacts and expected impacts for the future are statistically related - as the chi-square test showed, companies with better rates of commercial achievements by the end of the project expect better impacts in the future. A joint analysis of this outcome and Bayona-Sáez & García-Marco's (2010) can be interpreted as complementary rather than antagonistic: even though firms have a lag between project completion and performance improvements, those firms that already achieve some level of success by the end of the project seem to achieve better performances in the future than those firms that have poorer results when the Eureka project is finished. This proposition implies that time lags in actual performance may exist, but the latter is directly related to attainments reached during the project development period.

Efforts in the sense of continuously evaluating the Spanish participation in Eureka have to be performed in order to complement and even provide a different perspective than the one presented in this paper, which has a purely exploratory character. Nonetheless, the results achieved are quite insightful and do well in offering an assessment of Spain's participation in Eureka. The Spanish Economy still has a long way to go in technological and innovative areas of economic activity – contributions in this sense are fundamental in order to find the right path (which usually is very nation-specific). In this sense, future research should be directed to a combination of data contained in both Eureka's reports and objective economic data available at the micro level. Structural equation modeling based on the Crépon, Duguet and Mairesse (1998) framework can be developed for this case and provide more robust and inferential information regarding these matters. Also, comparing innovation impacts between different technological initiatives would result in even more relevant knowledge regarding policy evaluation.

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Appendix I. Variables of Analysis

a. Descriptive Variables

Variable		Description
Sample Composition		
	BroadSector	Companies´ Broad Sector of activity (Manufactures, Primary Sector, Services and Water, Energy and Construction)
	NACE_Rev2_2digit	Companies´ Broad Sector according to NACE 2 digit Rev. 2
	Large	Definition of the company as a Large Company (1 if Large; 0 if SME). SME is understood as a company having less than 250 employees.
	SME	Definition of the company as a SME (1 if SME; 0 if Large Company). SME is understood as a company having less than 250 employees.
	Size	Classification according to number of employees (0 to 49; 50 to 99; 100 to 199; 200 to 500 and more than 500). It provides more detailed information about the size of the company.
Status of Participation		
	Main	Definition of the company as main player in the project
	Partner	Definition of the company as partner in the project
	ROL_TOT	Definition of companies' role in the project as Producer, End User, Supplier, Research, Other or Multiple roles)
	TOTAL_COST Project	Total cost of the project in million €.
	DURATION permonths	Duration of the project in months.
	FUNCTIONING	Rating of the functioning of the project team (1=excellent; 2=good; 3=weak; 4= bad)

b. Impact Variables

Variable		Description
Technological Achievements		
	ACHIEVEMENTS	Overall technological achievements (1=excellent; 2=good; 3=weak; 4=bad)
	IO_NEWPROD	Initial objective New Product
	AC_NEWPROD	Achieved New product
	EX_NEWPROD	Expected New product
	IO_improv_NEWPROD	Initial objective Improvement to existing products
	AC_improv_NEWPROD	Achieved Improvement to existing products
	EX_improv_NEWPROD	Expected Improvement to existing products
	IO_NEWPROCESS	Initial objective New processes
	AC_NEWPROCESS	Achieved New processes
	EX_NEWPROCESS	Expected New processes
	IO_improv_NEWPROCESS	Initial objective Improvements to existing processes
	AC_improv_NEWPROCESS	Achieved Improvements to existing processes
	EX_improv_NEWPROCESS	Expected Improvements to existing processes
	IO_DEMO	Initial Objective Demonstrators, prototypes or pilot phase
	AC_DEMO	Achieved Demonstrators, prototypes or pilot phases
	EX_DEMO	Expected Demonstrators, prototypes or pilot phases
	IO_LICENCES	Initial objective Licenses
	AC_LICENCES	Achieved Licenses
	EX_LICENCES	Expected Licenses
	IO_PATENTS	Initial objective Patents
	AC_PATENTS	Achieved Patents
	EX_PATENTS	Expected Patents
	IO_PUB	Initial Objective Publications
	AC_PUB	Achieved Publications
	EX_PUB	Expected Publications
	IO_SKILLS	Initial objective Improved/New knowledge of skills
	AC_SKILLS	Achieved Improved/New knowledge of skills
	EX_SKILLS	Expected Improved/New knowledge of skills
	IO_MANAGEMENT	Initial objective Improved Management/Quality of work
	AC_MANAGEMENT	Achieved Improved Management/Quality of work
	EX_MANAGEMENT	Expected Improved Management/Quality of work
	IO_ALLIANCES	Initial objective New (or improved) strategic industrial alliances
	AC_ALLIANCES	Achieved New (or improved)strategic industrial alliances
	EX_ALLIANCES	Expected New (or improved)strategic industrial alliances
	IO_SERVICES	Initial objective New services
	AC_SERVICES	Achieved New services
	EX_SERVICES	Expected New services
Industrial Exploitation		
	YES_MYCOMPANY	Industrial exploitation as a result of the companies´ participation in the Eureka project by its own organization.
	YES_ANOTHER	Industrial exploitation as a result of the companies´ participation in the Eureka project by another organization.

	NO	No expectations of industrial exploitation as a result of the participation in this Eureka project.
	ALREADY_ON	Results already on the market
Commercial Impact		
	commercial_achiev	Rating of overall commercial achievements as a result of the project (1=excellent; 2=good; 3=weak; 4=bad; 5=nil)
	Future_Impact	Impact of project on future turnover (1=very large; 2=large; 3=medium; 4=small; 5=nil)
	RD_compare	Comparison of the project with other R&D projects in the company (1=larger; 2=comparable; 3=smaller)
Employment Impact		
	Increase	Employment impact – increase
	Ac_Increase	Achieved increase (FTE)
	Ex_increase	Expected increase - 3 years (FTE)
	Safeguard	Employment impact – safeguard
	ac_safeguard	Achieved safeguard (FTE)
	ex_safeguard	Expected safeguard - 3 years (FTE)
	Decrease	Employment impact-decrease
	ac_decrease	Achieved decrease (FTE)
	ex_decrease	Expected decrease - 3 years (FTE)
	noeffect	No employment effect
	ac_noeffect	Achieved no effect
	ex_noeffect	Expected no effect
	noinfo	No information available
	out_increase	Employment impact outside organization - increase
	out_increase_num	Employment impact outside organization - increase – number
	out_decrease	Employment impact outside organization – decrease
	out_decrease_num	Employment impact outside organization - decrease – number

c. Support Variables

Variable		Description
Eureka Benefits		
	supp_partners	Assistance from Eureka in finding partners
	supp_preparation	Assistance from Eureka with preparation of proposal
	supp_opportunities	Assisitance from Eureka with funding opportunities
	supp_running	Assistance from Eureka during the running of the project
	supp_after	Assistance from Eureka with exploitation after completion of the project
	supp_database	Assistance from Eureka with database as an information tool
	supp_other	Assistance from Eureka with other issues
	reas_prestige	Reason for participation - prestige of Eureka label
	reas_ressources	Reason for participation - improved access to internal/external resources
	reas_broad	Reason for participation - broadening of market
	reas_techn	Reason for participation - access to complementary technical expertise
	reas_share	Reason for participation - share of risks-costs
	feat_close	Attractive features of Eureka - close to the market
	feat_procedures	Attractive features of Eureka - non-bureaucratic procedures
	feat_approach	Attractive features of Eureka - bottom-up approach
	another_part	Would you consider participating in another Eureka Project?
Main Obstacles		
	obs_techn	Obstacle - Technical difficulties
	obs_changes	Obstacle - Market changes
	obs_strategies	Obstacle - change in strategies
	obs_partners_strategies	Obstacle - change in partner´s strategies
	obs_withdraw	Obstacle - withdrawal of partners
	obs_diverg	Obstacle - divergence between partners
	obs_communication	Obstacle - communication problems
	obs_management	Obstacle - management of the consortium
	obs_public	Obstacle - public funding of your participation
	obs_private	Obstacle - private financing of your participation
	obs_synchro	Obstacle - lack of synchronisation in the public funding of partners
	obs_legal	Obstacle - Legal problems between partners
	obs_other_legal	Other legal problems
	obs_other	Other

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