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Towards a taxonomy of firms engaged in international R&D cooperation programs: the case of Spain in Eureka[1]
Una propuesta de taxonomía para empresas involucradas en programas cooperación internacional en I+D: el caso de Espala en Eureka

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ABSTRACT:
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. A total of 77 firms were assessed through quantitative methods, namely discriminant models and cluster analysis. Findings show that 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*.

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

RESUMEN:
Este trabajo desarrolla una evaluación de los impactos del Programa Eureka en el caso de las empresas españolas que participan en esta iniciativa con proyectos concluidos en el periodo 2000-2005. Un total de 77 empresas fueron analizadas a través de métodos cuantitativos (modelos discriminantes y análisis de conglomerados). Los resultados indican que los logros comerciales son influenciados por la calidad del funcionamiento del proyecto y por la capacidad de

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las empresas en explotar sus resultados ya cuando se terminan los proyectos. Una tipología básica de los participantes es propuesta: (1) *Risky Innovators*; (2) *Inventors*; y (3) *Consistent Innovators*.

Palabras-clave: Políticas de Innovación; Programa Eureka; Sistema Español de Innovación; Cooperación en I+D

JEL Classification: O2; O3

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[2] (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[3] (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

[2] 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).

[3] 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).

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 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.

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[4]. In this sense, the methodological approach is divided in two parts: discriminant analysis & typology of participants. 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 the main characteristics of the sample, 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

[4] Efforts in this sense are being carried out and should be made available shortly.

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[5].

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

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[5] 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.

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)[6]. 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. 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)[7]. 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).

[6] 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.

[7] 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.

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[8].

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 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

[8] 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.

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)[9]. 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

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

technological policies must consider (Molero, 2001; Hidalgo, León & Pavón, 2002; Luukkonen, 1998)[10].

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).

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

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

Framework Programmes[11] 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[12]. Many member countries accord preferential treatment to labeled proposals by giving access to specifically reserved funding (Eureka Secretariat, 2005).

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[13].

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)[14].

[11] 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.

[12] Edler (2007) points the importance of signaling 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.

[13] 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.

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

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[15] (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[16] (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. 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 period 2000-2005 and 2006-2008. This discrimination occurs because of a change in the structure of

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

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

Final Reports, thus hampering the possibility of organizing a joint analysis[17]. 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[18].

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.

A general description of the sample used is depicted in Table 1 where the most relevant features of Spanish companies participating in Eureka with projects finished in the period 2000-2005 are compared in relative terms with the global average of Eureka's participants for the same period.

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%***

[17] Nonetheless, as previously mentioned, efforts are being made in this sense in order to overcome this issue.
[18] This procedure allows for an analysis at the company level rather than working with results from specific projects.

	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%***

Table 1. Comparison between Spanish Firms and Total of Participants in Eureka

7. Towards a Taxonomy: Methodological Approach

Given the central purpose of this evaluation, the applied methodology consists basically in quantitative techniques that allow the construction of relatively homogeneous groups out of a sample and based on a set of defined variables. Hence, 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. This approach 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*[19] 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*[20] 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 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*.

8. Discriminant Analysis' Results

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 2. 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

[19] 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.

[20] 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).

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.

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 2. Discriminant model 1: Technological Achievements as dependent variable.

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 3 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.

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	

Table 3. Discriminant model 2: Commercial Achievements as dependent variable.

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 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.

9. 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 4 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.

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.)

Table 4. Results of the TwoStep Cluster analysis

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).

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. ***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. ***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. ***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. In this sense, 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.

10. 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. A 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 a quantitative character aiming at taking the step beyond purely descriptive analysis. We have seen that the overall rate of technological achievements is impressively 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 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.

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. Simultaneous 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 A. 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[21]. Those items that are in the Final Reports' structure but are not in the scope of this article were omitted.

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

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[22]) 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;
    - 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.

[22] 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.

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***.