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DEVELOPMENT OF A SYSTEMATIC ANALYSIS FOR THE CHARACTERIZATION OF SPANISH PRODUCTIVE SME PERFORMING PROJECTS R&D&I

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Abstract: *Innovation in SMEs is a key to competitiveness and economic growth pillar. Currently, in Spain, the most important policy to support innovation is tax incentives for R&D&I, based on the issuance of Motivated Binding reports of the Ministry of Economy and Competitiveness.*
This work offers SMEs a quantitative and qualitative model of analysis, and enterprise-level projects, which aims to help them get a favorable structure for innovation. Specifically, a systematic analysis is proposed for Spanish SMEs that perform productive R&D&I, based on factors of company, projects and on both of them, and based on an interview for SMEs, on an analysis of the projects based Motivated Binding a Report and on a review of key data presented in the Mercantile Register.
The method developed has been endorsed by a panel of experts in the field: managers related to innovation, researchers from the University, Agents involved in Institutions binding Motivated management Reports, Managers of innovative SMEs, Business Associations, etc.
By providing a systematic analysis, it will be able to make a quantitative and qualitative empirical study of a representative sample of companies, based on the application of this method.
With all this, we will achieve the characterization and modeling of the Spanish productive SMEs performing R&D&I, obtaining, a model able to assist Spanish companies to achieve including the R&D&I, in its business strategy, which will generate new possibilities for improving competitiveness.

Key words: *research, development, innovation, company*

1. INTRODUCTION

Innovation in SMEs is a key to competitiveness and economic growth pillar. Currently, in Spain, the most important policy to support innovation is tax incentives for R&D&I, based on the issuance of Motivated Binding reports of the Ministry of Economy and Competitiveness. [1]

After an investigation, it is established that there are numerous quantitative studies on SMEs performing in R&D&I, but if a company decides to start innovating, there are no references on what its structure, organization, operation, etc. should be. [2], [3], [4], [5], [6], [7], [8], [9].

Also, after inquiring about the systematic analysis of existing companies, both explicit and implicit, it appears that they do not cover all aspects needed to characterize and model the Spanish productive SMEs performing R&D&I. [10], [11]. Therefore, the need to develop a complete specific systematic, that combines and integrates aspects of business, project, strategy, organization, etc. and relate these aspects together.

It is considered appropriate to raise a systematic that brings together the advantages of the existing ones, that is why it is decided that this work will be developed around two main axes:

- Personal and specific analysis for each company which aims to get specific information about the situation of each company and its projects.

- General analysis of each company based on data from which general information of the company can be obtained and some of the information obtained in the other axis can be validated.

It is considered that to characterize and model the Spanish productive SMEs performing R&D&I, the application of various statistics is not enough that reflect disparate aspects of the R&D&I. Since one of the main limitations of the prior art is that the existing studies are based solely on quantitative variables, so that important actors in the R&D&I are excluded. Therefore, it is intended that the scheme of analysis is able to work with both quantitative and qualitative indicators.

It is intended to find a solution based on the mathematical use of multiple variables both inputs as outputs, and even of the process itself, with the aim of providing a comprehensive and multifaceted vision.

2. DEVELOPMENT

To achieve the objectives, it is considered essential to raise a systematic able to study and relate company factors, projects and mixed, both qualitatively and quantitatively, and it is considered essential that the basic structure of systematic includes the following sections:

- Survey - SMEs personalized interview (included in the personal scan axis).
- Detailed analysis of the R&D&I performing companies (included in the personal scan axis).
- Assessment of the main data submitted to Mercantile Register (included in the axis of the general analysis).

The choice of variables in each of the sections is complicated, due to both its availability and representativeness, therefore, the most appropriate variables will try to be found considering the subsequent need for mathematical combination.

This routine is intended to correct defects and complement existing systematic deficiencies in the application of diagnostic models of Spanish SMEs in their R&D&I. This is based on the following considerations:

- We do not part from a developed or imitated model which has been used in totally different areas.
- The proposed systematic is based on research and previous experience in similar SMEs to be analyzed, but without giving up the use of existing universal concepts on the analysis of companies.
- Within the systematic proposal it is pretended to work always with the manager of the company, and the major directors of the different bussiness areas.

It is intended to achieve a systematic analysis that provides confidence in the results and facilitates the statistical treatment of the data collected so that it is considered adequate to sumarise the variables assessed in this methodology, so once the analysis process of the company and its projects is done, it will be necessary to capture information from a structured way for later work and to get statistically information so thah SMEs can be characterized.

The model includes a systematic questionnaire-interview with the following major sections: general information, organizational structure, HR and training, technology and innovation capacity, products and processes.

Detailed analysis of the R&D&I performed by firms study is based on existing information in the Motivated Binding Resports issued by the correspondent Ministry, such as the duration, planning, cost structure, support received, type of novelty etc.

The assessment of key data submitted to Mercantile Register will include aspects such as the evolution of turnover, profits, profitability, etc.

Bellow there is a table that includes variables both for projects and companies, which must be completed after and / or during the analysis of each of the companies and projects thus, it will be with this table with which the subsequent mathematical-statistical analysis will be proceeded.

Table 1. *Variables studied mathematically at the enterprise level.*

Sector.
Autonomous Community.
Workers number in years n, n-1, n-2 and n-5.
Created company year.
Billing years n, n-1, n-2 and n-5.
Benefit years n, n-1, n-2 and n-5.
Profitability (%) year n.
Financial Performance (%) year n.
Debt (%) year n.
Is there a strategic plan?
Reputation rating company in the market.
Most prominent feature of the company distinguished by customers.
Degree of export.
R&D&I Expenditure years n, n-1 and n-2.
Total expenditure on R&D&I (personal) accepted by the MINECO in different projects. Years n, n-1 and n-2.
Is there enough staff in the business?
Are there plans for more staff?
How is the working environment in the company?
Is teamwork encouraged?
Are internal communication mechanisms adequate?
Is the innovation encouraged in the company from management?
Manager training.
Business and manager bonding.
Is there an adequate learning environment?
How is the technological capability of the firm considered?
Is there strategic R&D&I ot technological plan?
How do you consider the level of professionalism of the company?
Number of R&D&I projects in years n, n-1, n-2.
Number of R&D&I management in the years n, n-1 and n-2.
Number of dedicated people (total or partial) to R&D&I. Years n, n-1 and n-2.
Number of Doctors dedicated (total or partial) to R&D&I. Years n, n-1 and n-2.
Number of Higher Degree dedicated (total or partial) to R&D&I. Years n, n-1 and n-2.
Number of Graduates dedicated (total or partial) to R&D&I. Years n, n-1 and n-2.
Number of Graduates in Vocational dedicated (total or partial) in R&D&I. Years n, n-1 and n-2.
Number of No Graduates dedicated (total or partial) to R&D&I. Years n, n-1 and n-2.
How do you consider the level of structure of the R&D&I?
Are sufficient human resources devoted to R&D&I?
Do you have management systems R&D&I?
Number of publications in professional journals in the last 3 years?
Does it have trouble to finance R&D&I?
Does it innovate in a structured way?
Do they use tools to improve R&D&I?
Rating novelty goods.
Rate the importance of the brand to the introduction of new products.
Rate the state for improvement / optimization of existing processes in the company.
Rate the degree of investment in recent years.
Does the company present projects every year? Or only sporadically?
Real average project duration (average of actual project duration in months).

Table 2. *Variables studied mathematically at the project level.*

UNESCO Code.
Expected duration of the project in number of months.
Real total project duration in number of months.
Total budget for the entire project (differentiating in years).
R & D budget for the entire project (differentiating in years).
Innovation budget for the entire project (differentiating in years).
Total cost justified the entire project (differentiating in years).

Justified cost on R & D of the whole project (differentiating in years).
Justified cost on Innovation of the whole project (differentiating in years).
Full accepted cost of the entire project by MINECO (differentiating in years).
Accepted cost on R & D of the whole project by MINECO (differentiating in years).
Accepted cost on Innovation of the whole project by MINECO (differentiating in years).
What is the cost accepted by MINECO for internal staff for the entire project? Specify R&D&I. Specify for years n, n-1 and n-2.
What is the cost accepted by MINECO for Universities and / or Innovation Centres for the entire project? Specify R&D&I. Specify for years n, n-1 and n-2.
What is the cost accepted by MINECO for external collaborations for the entire project? Specify R&D&I. Specify for years n, n-1 and n-2.
What is the cost accepted by MINECO for consumables for the entire project? Specify R&D&I. Specify for years n, n-1 and n-2.
What is the cost accepted by MINECO for depreciation for the entire project? Specify R&D&I. Specify for years n, n-1 and n-2.
What is the cost accepted by MINECO for other expenses for the entire project? Specify R&D&I. Specify for years n, n-1 and n-2.
Where is the innovation in the project?
Is there a new or substantially improved product / process?
Is the novelty of the project objective or subjective?
Does the project involve a national or international technological innovation? Or internal?
Is the project based on a radical, incremental or imitative innovation?
Is it a multiobjective project?
What is the final strategic objective of the project?
Total number of people dedicated to the project. Specify in years n, n-1 and n-2.
Total number of doctors dedicated to the project. Specify in years n, n-1 and n-2.
Total number of higher degree dedicated to the project. Specify in years n, n-1 and n-2.
Total number of graduates dedicated to the project. Specify in years n, n-1 and n-2.
Total number of graduates in vocational dedicated to the project. Specify in years n, n-1 and n-2.
Total number of no graduates dedicated to the project . Specify in years n, n-1 and n-2.
Total number of people solely on the project. Specify in years n, n-1 and n-2.
Type of people dedicated exclusively.
Does the manager participate in the project?
Has the project received state aid?
Quantity provided by a financial institution at market rate?
Quantity received as a grant?
Quantity received in the form of preferential loans?
Rating technicality of external collaborations of the projects
Is the project conducted in cooperation with other entities?
Are the results of the project protected by property rights?

From the combination of some of the above variables which are obtained others are identified as "outcome variables", both at company and project, which also work in statistical analysis. These variables are shown in the following tables.

Table 3. *Outcome variables at company*

% Workers assigned to R&D&I tasks in year n / total workers in year n.
% Workers assigned to R&D&I tasks in year n-1/ total workers in year n-1.
% Workers assigned to R&D&I tasks in year n-2 / total workers in year n-2.
% Profit in year n / Turnover in year n.
% Profit in year n-1 / Turnover in year n – 1.
% Profit in year n-2 / Turnover in year n – 2.
% Profit in year n-5 / Turnover in year n – 5.
% R&D&I costs in year n / Profit year n.
% R&D&I costs in year n-1 / Profit in year n – 1.
% R&D&I costs in year n-2 / Profit in year n-2.
% R&D&I costs in year n-5 / Profit in year n-5.
% R&D&I costs in year n / Turnover in year n
% R&D&I costs in year n-1 / Turnover in year n – 1.
% R&D&I costs in year n-2 / Turnover in year n-2.
% R&D&I costs in year n-5 / Turnover in year n-5.
% R&D&I costs in year n / Number of projects in year n.
% Cost for internal staff in R&D&I in year n / R&D&I costs in year n.

% Cost for internal staff in R&D&I year n-1 / R&D&I costs in year n-1.
% Cost for internal staff in R&D&I year n-2 / R&D&I costs in year n-2.
% Cost for internal staff in R&D&I in year n/ Number of people of R&D&I department in year n.
% Cost for internal staff in R&D&I in year n-1/ Number of people of R&D&I department in year n-1.
% Cost for internal staff in R&D&I in year n-2/ Number of people of R&D&I department in year n-2.
% Number of doctors of R&D&I department in year n/ Number of people of R&D&I department in year n.
% Number of doctors of R&D&I department in year n-1/ Number of people of R&D&I department in year n-1.
% Number of doctors of R&D&I department in year n-2/ Number of people of R&D&I department in year n-2.
% Number of higher degree of R&D&I department in year n/ Number of people of R&D&I department in year n
% Number of higher degree of R&D&I department in year n-1/ Number of people of R&D&I department in year n-1.
% Number of higher degree of R&D&I department in year n-2/ Number of people of R&D&I department in year n-2.
% Number of graduates of R&D&I department in year n/ Number of people of R&D&I department in year n.
% Number of graduates of R&D&I department in year n-1/ Number of people of R&D&I department in year n-1.
% Number of graduates of R&D&I department in year n-2/ Number of people of R&D&I department in year n-2.
% Number of graduates in vocational of R&D&I department in year n/ Number of people of R&D&I department in year n.
% Number of graduates in vocational of R&D&I department in year n-1/ Number of people of R&D&I department in year n-1.
% Number of graduates in vocational of R&D&I department in year n-2/ Number of people of R&D&I department in year n-2.
% Number of no graduates of R&D&I department in year n/ Number of people of R&D&I department in year n.
% Number of no graduates of R&D&I department in year n-1/ Number of people of R&D&I department in year n-1.
% Number of no graduates of R&D&I department in year n-2/ Number of people of R&D&I department in year n-2.

Table 4. *Outcome variables at project*

% Economic deviation.
% Cost accepted by MINECO for internal staff / total cost accepted by MINECO.
% Cost accepted by MINECO for Universities and / or Innovation Centres / total cost accepted by MINECO.
% Cost accepted by MINECO for external collaborations / total cost accepted by MINECO.
% Cost accepted by MINECO for consumables / total cost accepted by MINECO.
% Cost accepted by MINECO for depreciation / total cost accepted by MINECO.
% Cost accepted by MINECO for other expenses / total cost accepted by MINECO.
% Total number of Doctors dedicated to the project / Total Number of people dedicated to the project
% Total number of Higher Degree dedicated to the project / Total Number of people dedicated to the project.
% Total number of graduates dedicated to the project / total number of people dedicated to the project.
% Total number of graduates in vocational dedicated to the project / total number of people dedicated to the project.
% Total number of no graduates dedicated to the project / total number of people dedicated to the project.
% Amount financed by a financial institution / Total expenditure executed.
% Amount received as subsidy / Total expenditure executed.
% Amount received on preferential credit / Total expenditure executed.

By providing a systematic analysis, it will be able to make a quantitative and qualitative empirical study of a representative sample of companies, based on the application of this method.

Note that the method developed has been endorsed by a panel of experts in the field: managers related to innovation (Technology Centers, European Business and Innovation Centres, etc.), researchers from the University, Agents involved in Institutions binding Motivated management Reports, Managers of innovative SMEs, Business Associations, etc. With the panel of experts' participation we achieve to improve the method and demonstrate the efficiency of the results described throughout this work.

With all this, we will achieve the characterization and modeling of the Spanish productive SMEs performing R&D&I, obtaining, a model able to assist Spanish companies to achieve including the R&D&I, in its business strategy, which will generate new possibilities for improving competitiveness.

3. CONCLUSIONS

This work provides a systematic quantitative and qualitative analysis, and enterprise-level projects, suitable for analyzing any SMEs, regardless of size, sector, age, etc. It identifies and defines the influential variables and attributes in the innovation process of SMEs, both at the enterprise level, as individual projects; and is able to cover the necessary aspects to characterize and model the Spanish productive SMEs performing R&D&I.

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