PROFILE AND PERFORMANCE OF THE UNIVERSITY RESEARCH GROUPS

Authors:

Frederic Marimon (corresponding author)
International University of Catalonia. Social Science Faculty
C/ Immaculada, 22, 08017 Barcelona (Spain)
e-mail: fmarimon@cir.uic.es Tel: +34 932 541 800 Fax: +34 932 541 850

Pilar Aparicio
University of Barcelona. Social Science Faculty
Diagonal 690, 08034 Barcelona (Spain)
e-mail: pilaraparicio@ub.edu Tel: +34 934 021 963 Fax: +34 934 024 580

Xavier M Triadó
University of Barcelona. Social Science Faculty
Diagonal 690, 08034 Barcelona (Spain)
e-mail: pilaraparicio@ub.edu Tel: +34 934 021 963 Fax: +34 934 024 580

ABSTRACT

This paper profiles the "research groups" at the University of Barcelona in order to identify the key success factors of the best groups. A factor analysis was carried out to determine the groups' defining characteristics, which are stability, size, quality of publications, and quantity of scientific output. Then, a cluster analysis was applied to the 169 groups, and three cluster types were identified. One of the clusters stood out by virtue of the impact of its publications and in terms of the general quality of its output. A comparison was carried out between the Excellent cluster and other groups.

KEY WORDS

Management in education; Higher education Teamworking; Team Effectiveness; High-level Research; Universities research organization

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1. INTRODUCTION

The growing interest in academic research in the universities can be seen in all areas of knowledge, and it appears to stem from the increased number of specialised publications and the emergence of impact as a factor for measuring the quality of research. The shift also reflects a change in the role of the university. In addition to creating accreditation agencies or bodies to ensure the quality of research, the university can also foster research in groups or teams by changing the conditions for advancement and the incentives that prevail within the university system. As a result, there arises a paradox. While university policies and planning are devised to promote the potentialities and synergies of teamworking synergies, the system of advancement largely centres on individual achievement. To what extent are these two aims compatible?

One of the challenges in summarising the literature on teams remains the difficulty of identifying the variables that have an influence on team output in organisations. The literature on the subject is extensive, and a number of models from diverse perspectives have been put forward to analyse the relationship between the distinct variables and output (Campion et al., 1993; McGrath et al, 2000; West, 2001; Kozlowshi and Bell, 2003; Salas et al., 2004; Gil et al., 2005).

Salas et al. (2004) has, for the most part, grouped and classified the models under two overarching theoretical frameworks. The first group takes a functional perspective (Hollingshead et al., 2004, Wittenmaum et al., 2004) and the theoretical model is the Input-Process-Output[1] (IPO) model of team productivity. The main contribution of this model are McGrath, 1964; Hackman and Morris, 1975; Wittenmaum et al., 2004.

[1] The IPO model is used to analyze entrances (inputs) and results (outputs) required for a system. This model tray to answer questions as: What kind of inputs needs the system? What kind of products could produce this system? How achieve better results in a system?

The second group is based on the models of Campion and his collaborators (Campion et al, 1993; Campion el at, 1996). They define five broad categories of variables affecting team results: job design, interdependence, group composition or heterogeneity, context and, lastly, process.

After the review of this literature, no article has been found focused on the different profiles that describe these research groups, specifically in the university research field. Nowadays, with a universities scoreboard based on publishing indicators, the study of research teams becomes more relevant. This is not only to know the performance of its employees, but because an important fund transfers comes from the outputs measurement of each university. The closest references are Triadó et al. (2007, 2008).

Following this research, this paper marks the third and final phase of a study begun in 2005 and builds on papers read at earlier conferences (Triadó et al. 2007, 2008). The first question was to clarify whether the UB research groups were teams or work groups[2] and to determine how to characterise the various groups, identifying their defining variables and analysing correlation patterns. We adopted the IPO model, built on three premises: work groups pursue defined objectives; group behaviour varies in quality and quantity and that variation can be measured; and there are both internal and external factors influencing process behaviour and output. The findings showed that the groups are not small, but rather exceed twenty researchers. On average, they generally include two chaired professors, five professors and seven visiting researchers. It appears that the presence of a person from

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[2] In a work group, each member pursues individual goals and any output or result is a product of the individual's effort, as is any measure of efficiency or effectiveness. This description fits the university's approach to how research groups function. We think that individual measurement of effectiveness and/or efficiency—researchers are judged and assessed based on their individual progress—is precisely one of the determinant factors in judging whether a research group can be classified *a priori* as a group, and not a team.

Administration and Services Staff (A&SS), normally a technical expert, boosted group productivity, and the most productive groups had at least one in their ranks.

The second phase of the broader work set out to identify whether the need to collaborate with colleagues was the same in all areas of knowledge. It focused on identifying which variables are directly related to the output of research groups. The conclusions were clear in demonstrating that researchers in the sciences showed greater potential for publication than did their counterparts in the humanities. When quantifying the quality of each group's scientific output, the impact of other factors was also apparent, including research momentum (work published by the same group in previous years), assessment and impact of the research, and group size.

This paper sets out to identify the characteristics of Excellent research groups. For the National Evaluation And Foresight Agency (ANEP)[3] the excellence is measured mainly by the quality of their production and in the academic filed there is a common agreement that the JCR (Journal Citation Report, of Thomson Editorial) is a general accepted index. The profile of these Excellent groups is analysed to see whether any conclusions can be drawn regarding key success factors. We aim to show the group characteristics that lead to a cluster of excellence and ensure greater success in research, backed up by publication in prestigious journals[4].

Summarizing, the aim of this empirical paper is twofold: firstly finding out the different profiles of university research group. When the best behaviour has been found, a

[3] The ANEP (unit of the Ministry of Science and Innovation) evaluate the scientific/technical quality of proposals for which public funding is requested, including those from the Department and other public or private bodies, wants to enhance the capacity of the public Science and Technology system, try to contribute to R&D+i resource allocation decisions on the basis of criteria of excellence and scientific/technical quality.

[4] It is a matter for future study in another area to establish any relationships between a scholar's quality of research and quality of teaching, in the context of new graduate and postgraduate programmes within the EHEA (European Higher Education Area) framework.

benchmarking analysis is conducted to compare the best practices with the performance of other groups.

2. METHODOLOGY

The study makes use of a database on the research groups formally constituted by the University of Barcelona. A portion of the data, the most quantitative part, has been provided thanks to assistance from the UB's Office of Research and its GREC system[5], while the more qualitative information comes from a questionnaire devised by the authors and aimed at the directors of the research groups. The sample universe was made up of the 348 research groups at the University of Barcelona (RGUB), which are spread across twenty faculties and involve a total of 4,730 researchers.

<<Table 1>>

The methodology followed in the study can be summarised in four stages. The first stage involved study of each of the analysed variables (a univariate analysis). Building on previous studies, it made use of variables allowing measurement of group composition, the characteristics or attributes of group tasks, and group efficiency. Identifying which variables influenced work teams involved dividing the *input* variables (from the IPO model) into two groups. The first group was comprised of the variables known as "biodemographic[6]" and the other group included those related to task attributes[7] (Gladstein, 1984; Hackman and Morris, 1975; McGrath, 1986; LaFasto and Larson, 2001) and organisational variables[8] (Campion et al, 1996). Finally, these variables relate to the production of every group of research.

[5] GREC is a Research Management database developed at the University of Barcelona and currently in use at several research institutions and bodies. It contains a wide array of items that describes the research groups.
[6] Under this term we gather variables related to personal data of each researcher –age, sex,...– as a group member.
[7] Variables related with tasks attributes.
[8] Variables related with team management o corporate management.

The biodemographic variables affecting groups were identified as age, sex, race/ethnicity, group size and group composition. The variables related to task attributes were found to be research area, group momentum, and number and percentage of civil servants in the group.

Before the description of the organisational variables, it is interesting to note that he Spanish Public Administration employees have two kinds of labor contract: "civil servant" and civil labor contract. The civil servants are under an administrative relationship, and constitute the main core of the Spanish Public Administration personnel. They acceded through open competition, than assure a permanent contract –for live in fact– and have specials guaranties for job stability. Beside them are other employees (civil labor contract.) under labor contract, and without special job guaranties.

The organisational variables included the existence within a work group of internal rules and regulations and of subgroups. Lastly, the production variables contain the output between 04-05, productivity, agregated impact factor of their publications, the qualitative evaluation of these articles, number of read thesis, the avarage impact factor of each component.

Previous studies have gathered 31 variables defining the characteristics of research groups, and they can be split into the three areas set out in Table 2.

<<Table 2>>

The second stage of the study involved a factor analysis which was carried out in order to reduce the number of variables without information loss, limiting the initial variables of the study to a few driving factors. The factor analysis did not include all UB research groups, but rather focused on the 169 groups that responded to the questionnaire. From these 169 groups, the questionnaire collected full and valid data on all 31 variables under analysis.

Once the factors were established, the third stage involved a cluster analysis to identify the most common patterns of factors. The aim was to describe each cluster group clearly and to be able to separate out the Excellents groups.

Finally, in the fourth stage of the methodology, an in-depth study was carried out to identify how Excellents groups worked and why they were so successful.

3. RESULTS

The analysis of the findings begins with the second stage of the methodology depicted above. The analysis of previous work is set out in earlier papers and the findings are not reiterated here Triadó et al. (2007, 2008).

Based on the sample, a factor analysis was carried out to reduce the number of variables under study. 169 groups proved to be useful and the 31 variables contributing data on them were reduced to six factors. As can be seen in Table 3, the sampling adequacy of the KMO factor analysis was 0.706 and Bartlett's test of sphericity was significant at a level of .000. Both indicators suggest that the factor analysis that will be conducted might render good results.

<<Table 3>>

The method chosen to take the analysis forward was the principal components analysis with varimax rotation. It is a very common method used because it usually gathers the items in a easy way to interpret the measured concept. Only four factors were extracted so as not to disperse the analysis too much, while capturing almost 70% of the variance. Table 4 sets out the matrix of rotated components for the four selected factors, and this matrix will serve as the basis for interpretation, which is simplified by only displaying loads over 0.45.

<<Table 4>>

The interpretation of the four factors coming out of the analysis is as follows:

The first factor (F1) positively incorporates the variables for the number of grant recipients, total grants received in the last two years, the presence of international researchers and the number of A&SS staff connected to the research group. It has an inverse correlation to the percentage of civil servants and to the average age of the research group. Without doubt, these

variables all measure aspects related to age and job stability. As a result, this first set of variables shall be designated the "youth or job stability" factor.

The second factor (F2) gathers variables that measure the number of people linked to each research group. Obviously, this includes the number of chaired professors and other professors. In addition, the historical output levels of the group to 2003 are an element, since the variable reflects the sum total of contributions made by the group since its inception. Since the second factor clearly includes all the variables related to group size, it shall be designated the "group size or stature" factor.

The third factor (F3) encompasses the variables that appear to be linked to the quality of scientific output: the impact factor of each individual group member and of the overall output in the period 2004-2005, the qualitative assessment of output in the same period, and the ratio of impact to output. All of these variables refer to the quality of published work of the group (impact factor, qualitative assessment, etc). Here are found variables about the personal quality of the members of the group and variables that measure the quality of the entire group. A straightforward designation of this factor is the "quality" of output factor.

The fourth and final factor (F4) appears to gather the variables the describe the effort put into publication, that is, the output of selected groups, irrespective of quality, both on an individual level (each member's productivity) and on the group level (total group output for the period 2004-05). It also includes the sum total of doctoral theses defended in the period under analysis. It is interesting to note that the doctoral students provide specific features to the group that make its behaviour different from other groups. These students provide a great capacity of work, mingled with a desire to get results in the short term, due to the necessity to stabilize his or her position in the University. As a result, since the factor captures the group's capacity for output, it shall be designated simply the "output" factor.

Having reduced the original 31 variables to four factors, the third stage of the methodology was to conduct a cluster analysis. Using cluster analysis, the research groups were put into internally homogenous clusters with statistically significant differences between these clusters. Each cluster is an array of groups with common features. This resulted in clusters of research groups that could be independently analysed and gave rise to a cluster of Excellent research groups.

The analysis of the conglomerates of k-means yielded three clusters. This technique gather together the groups with similar variables, thus there are three pattern group behaviour identified. Applying the appropriate tests, it could be seen that the four factors were statistically distinct and that the means of each cluster, by factor, are as shown in Table 5.

<<Table 5>>

Having concluded the statistical analysis above, the classification analysis identified three clusters, whose profiles are shown in Table 6[9].

<<Table 6>>

The first cluster (Cluster 1) contains the research groups that are considered "standard" as they do not stand out either in terms of quality or quantity of output. This is the most numerous cluster and includes 107 groups, or 63% of the sample. The research groups in this cluster may be characterised as smaller and contain a greater percentage of civil servants in their ranks. They have the lowest overall levels of output, productivity and quality. They also have fewer grants and doctoral theses in the last two years than the other groups do.

The second cluster (Cluster 2) brings together UB research groups that place concern on their volume of output, although output volume could also be attributed to group size. This group

[9] This table underpins the subsequent description and analysis of each cluster in the fourth stage of the methodology used in the study.

is labelled as “productives”. This cluster contains 45 research groups whose levels of individual and overall output are the most significant, leaving aside the quality of their output.

The third and final cluster (Cluster 3) is made up of the groups designated “Excellent” research groups. They stand out both because of the quality of their publications and in terms of the qualitative assessment and impact of their publications. This cluster contains 17 groups, representing 10% of the sample. In the final section of the paper, more detailed attention will be given to the Excellent cluster in order to make some interesting comparisons.

In order to study the relative positions of the three clusters in terms of the four factors obtained in the factor analysis, each cluster has been plotted on axes representing the intensities of the factors. In the graphs that follow, the clusters are represented as bubbles, and the size of each bubble is proportional to the number of research groups contained in it. In other words, the largest bubble corresponds to Cluster 1 (with 107 groups), while the smallest bubble represents the least numerous cluster, which is made up of the Excellent groups and only contains 17 in total. The Excellent bubble is further differentiated by appearing darker.

Graph 1 clearly shows that the Excellent cluster has, by far, the highest quality of output, when compared to other two clusters, which have a similar level of quality and are vastly different in size. The most numerous cluster, which is the standard one, brings together research groups that may be considered small. They have an average of 10.65 team members and 6.45 full-time equivalents, while the second cluster, the productive groups, can be found at the opposite end of the size range, with 19.80 members on average, or 11.056 full-time equivalents.

<<Graph 1>>

Graph 2 shows the positions of the clusters with respect to the factors of quality and youth. The relative cluster positions coincide with those in the previous graph. This is because the y-axis is exactly the same, and the two x-axes of youth and size establish the same relative positioning of the "standard" and "productive" clusters.

<<Graph 2>>

Lastly, Graph 3 shows the relative positions of the clusters in another map that is similar to the two preceding ones. The *Excellent* cluster stands out in terms of the quality of its output, whereas it is located in an intermediate position between the other two clusters in terms of the other factors.

<<Graph 3>>

The positioning maps above graphically support the summary conclusion that quality of output is the factor that differentiates the Excellent cluster. As a result, quantity of output, group size and group youth are not explanatory factors.

4. PROFILE OF EXCELLENT CLUSTER AND DISCUSSION

Tables 7 and 8 show the breakdown of variables and the cluster profile, respectively, of the research groups in the Excellent cluster. One factor they all have in common is that they belong to faculties in experimental areas linked to the sciences. This fact reaffirms the conclusion drawn back in phase two of the larger study (Triadó et al, 2008), namely that the research groups most closely tied to the sciences achieved a higher rate of publication and could reach a higher level of excellence than research groups in the humanities. As these groups were created in 1993 on average, they may be said to have established a certain "track record in research". After all, they average fifteen years' experience in doing research.

Excellent research groups appear to demonstrate a high level of quality in their output both at a group level and at an individual level. (They have a group impact factor of 126.29 over the last two years and an individual impact factor of 18.07.)

<<Table 7>>

Regarding to the group composition, Excellent groups have an average of 17.24 members, and it is equivalent to 7.38 full-time. It is remarkable the presence of 5.35 visiting researches on average, as well as 3.82 grant recipients and one person providing administrative support.

<<Table 8>>

In addition to any broader application of benchmarking afforded by the Excellent cluster profile above, Table 9 presents a comparison between the UB's Excellent research groups and the other UB groups divided by area of knowledge, in the widest sense. The groupings fall into human sciences; law, economics and social sciences; experimental sciences and mathematics; health sciences; and education sciences. The purpose of the comparison is firstly to analyse the composition of the research groups by area and then draw attention to the differences that now exist between the research groups in each area and the best-in-class groups.

<<Table 9>>

The number of researchers in each RGUB varies between 10.75 and 17.24. The latter number is for Excellent groups, whose full-time equivalents are roughly 7.42±0.95. Another aspect of the composition of Excellent groups, as well as those in health sciences and mathematics, is that they have an A&SS person, while the other areas have only about 0.2 A&SS. As for visiting researchers, there is a similar disparity, although it is less marked. Lastly, the number of grant recipients and civil servants in each group is notable. Excellent groups contain 24.6% civil servants, the lowest level across all groups, while the maximum number of 54.9% arises

in law and social sciences. The number of grants received repeats a similar pattern. Excellent groups received thirteen grants in the years 2005-2006, which is the highest number, while the approximate breakdown for the other groups was, by area, four for law and social sciences, six in human and social sciences and ten in mathematics and health sciences[10].

The quantity of output generated by the Excellent groups and the education science groups was roughly 70 during the years 2004 and 2005, while the other areas generated output of approximately 50. However, the impact factor during the same period was sharply different as can readily be seen in Table 9. The average output per person was 8.3±2.4 outputs, and differences in productivity at the researcher level were not especially significant.

5. DISCUSSION

The groups in the study are highly heterogenous and show broad differences across biodemographic, attribute and effectiveness variables. In our earlier papers (Triadó et al. 2007, 2008), three hypotheses were validated that form the basis of the current study:

a) There is a positive relationship between average group age and a group's productivity. Similarly, average group age is positively related to a group's historical levels of output. By contrast, lower average group age boosts the quality of a group's output.
b) There is a difference in the quality of publications between groups in the sciences and groups in the humanities. The faculties of Physics, Chemistry, Biology, Geology and Mathematics achieve the highest quantity and quality of output.
c) Lastly, there is a direct, positive relationship between group size and output, and there is also a relationship of the same sign between group size and quality (both in number of articles and their impact factor). It can be observed in table 6, seeing the variables "number of people in the groups", "total output between 2004 and 2005". Its

[10] The Excellent groups have been treated as a separate group and do not affect the averages of the five areas used in the analysis.

correlation is .537 and significant at .05 level. Analogous correlation is detected between size and quality.

Based on a factor analysis of the 33 variables in the information matrix, four factors were identified as follows: factor 1 was the "youth or job stability" factor; factor 2 related to group size or stature; factor 3 pertained to the quality of group output; and factor 4 captured the quantity of group output. The subsequent cluster analysis produced three clusters of research groups: standard, productive and Excellent. Table 10 summarises the main features of each cluster.

<<Table 10>>

The cluster studied in the greatest detail contains the Excellent research groups, whose main features are:

a) Research in experimental areas linked to the sciences; this link is important.

b) Fifteen years of track record, on average.

c) Average group composition of 7.3 full-time equivalents and 17.24 group members (irrespective of level of dedication); 5.35 visiting researchers, 3.82 grant recipients, and an administrator; and a low percentage of civil servants, who make up only 24.59% of their ranks.

d) High quality of output at a group and at an individual level (they have a group impact factor of 126.29 over the last two years and average individual impact factor of 18.07).

By using the Excellent groups as a benchmark, it is possible to note four differences between them and other UB research groups:

i) Scientific output per researcher shows little difference between the distinct areas of knowledge, but the impact factor of their output does. For Excellent groups, the

impact factor is 126.3. In the sciences,[11] the impact factor is roughly 51.2±6.2, while it is approximately 2.37±2.7 in the humanities. Perhaps this point ought to give rise to thoughtful consideration.

ii) The number of grant recipients reflects a similar pattern. On average, Excellent groups have 3.82 each, which is similar to groups in the sciences (3.71) and double the number in humanities groups (1.48). A similar comment could be made concerning A&SS staff in the research groups. These aspects also merit thoughtful consideration.

iii) The composition of the groups differs in their percentage of civil servants. Excellent groups number one in four members as civil servants, which is similar to groups in the sciences, while standard group has approximately two in four members who are civil servants.

iv) The final difference concerns the quality of output. This difference between the sciences and the humanities is significant both in the qualitative assessment of output and in its impact factor. Excellent groups achieve a qualitative figure of 35.8 for the years 2004-05, while groups in the sciences achieve 16.4 and those in the arts manage 2.13. Similarly, Excellent groups have an impact factor of 126.3, while groups in the sciences and humanities have an impact factor of 51.17 and 2.4, respectively. Research groups from the humanities are exemplars in their respective areas, and their levels of productivity resemble the productivity of the other groups (8.3±2.4 outputs per person). We think that this aspect merits special attention when policies are being designed to promote and disseminate research.

[11] They are grouped merely by similarity: Experimental Sciences and Mathematics; Health Sciences; Human and Social Sciences; Law, Economics and Social Sciences; Education Sciences.

After the analysis performed, we may give a piece of advice to those groups that are emerging because are in the first steps: aiming a high quality standard in their research. If these groups are looking for quality, they will get at the same time high productivity. In the other hand, if they focus on productivity, they will get productivity, but not quality. It is important to prioritize from the beginning. It is similar phenomenon that was found out in the car makers industry of the last century. Those companies that were working on the mass production style had to choose between quality and productivity, whereas those companies that were on the lean production paradigm could attain both at the same time: quality and productivity. This could give some clues to the academic managers in order to develop and implement an incentive system for the research.

Some of the limitations of this paper come mainly from the database available: there is information from only one university and the information is codified according to the design of the database. For instance, the database only records the absolute number of research outputs, but there are no criteria to establish the relative importance of these outputs.

This paper close a new step in the research line that the authors are following in the last decade. At this point, new questions arise. The future research has two directions. Firstly, what are the facts that make "Exellents" groups different from others? To answer this, a Delphy study combined with some interviews with the directors of these groups will be performed. Secondly, there is another question that needs to be addressed: Which is the profile of the "Excellent" groups in humanities. There is no evidence about it in this paper.

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Table 1: Study Fact Sheet

CHARACTERISTICS	POPULATION
Universe	348 Research Groups at UB (RGUB)
Selected Sample	169 Research Groups Sample selection was determined by which research groups responded to the questionnaire.
Geographical Area	Barcelona
Time Period	Winter 2005 and Autumn 2006
Data Studied	1994-2005

Source: Own elaboration

Table 2: Description of biodemographic variables, task variables and organisational variables

Biodemographic variables

Age (*average group age*)	Youth in the team can tend to facilitate communication by virtue of similar mindsets or knowledge levels (Tsui et al., 1992), and this could lead to lower membership turnover. Groups with the youngest researchers should be expected to be most aggressive in producing output and, as a result, groups of below-average age ought to achieve higher levels of output (Hambrick, 1994).
Sex; *race/ethnicity; culture or nationality*	Following the literature, the second demographic variable to study is gender and its effects on teams (Rogelberg and Rummery, 1996).
Group size	Size is another variable characterising groups. (Dennis and Valacich, 1994). Two variables measured size: the first is the absolute *number of group members* and second is the *number of full-time equivalents* (FTEs) that make up each RGUB.
Group composition	In addition to the two group size variables, the composition of the group was also analysed: *number of chaired professors*, *number of professors, contracted teaching staff, visiting researchers and A&SS staff*. Also important is the presence of *international researchers* in the group as well as researchers from other areas, who bring an interdisciplinary approach. Another important aspect of group composition is the *number of doctoral theses* and *research grants*.

Source: Own elaboration

Task attributes variables

Research area	This variable contributes information on the number and quality of the group's *outputs.* Research groups were divided into two overarching groups, based on their proximity to *sciences or humanities*. Those two classical divisions—sciences and humanities—were used to assess the impact of the knowledge area on the quality of the research groups.
Research momentum or historical output levels	This refers to the number of earlier studies. It acts as a momentum or experience variable (Guzzo et al., 1986) and reflects the learning curve of the groups that are most productive and have the greatest imapct. With more projects and papers in hand, groups boost their ability to achieve greater successes in future.
Total *number and percentage of civil servants in group*	This variable analyses group composition. The literature on the matter is limited, because civil servants are widespread in Spanish organisations.

Source: Own elaboration

Organisational variables

Structure	These variables contribute information on group structure and organisation. The identified variables include written *rules and regulations in a group*, the *presence of subgroups* and their stability, the formality or *informality of communications*, the *existence of internal coordinators* or other similar figures …
Group administration and updating tasks	This set of variables analyses how current the group's data are and how committed the group is to keep the information up to date. It reflects the quality of the update process used for GREC data.

Source: Own elaboration.

Production variable

Total output between 2004-2005	Total output have been measured as a total of book chapters, doctoral thesis, papers, or papers acepted in congreses in the years 2004 and 2005.
Productivity	This variable provides information about the average production of each component of the team.
Qualitative assessment of output (04-05)	This is a measurement of the quality of the output. It is the number of articles published in SCI (Institute for Scientific Information) journals.
Individual Qualitative assessment (04-05)	With this information we want identify the average output quality for each researcher.
Impact factor of output (04-05)	This variable is gathering information about impact of output, without any consideration about how many researchers are in each group.
Individual impact factor	This variable is gathering information about impact of papers and output for each individual researcher.
Impact/output ratio	These variables give a measurement of the output impact.

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.706
Bartlett's Test of Sphericity	Approx. Chi-Square	2524.61
	df	190
	Sig.	.000

Source: Own elaboration.

Table 4: Matrix of rotated components (a)

	Factors			
	1	2	3	4
Grant recipients	.758			
Percentage of civil servants	-.727			
Total grants received in last two years	.709			
Average group age	-.682			
Presence of non-Spanish researchers	.516			
A&SS researcher	.469			
Total of full-time equivalents		.886		
Number of chaired professors		.703		
Number of professors		.659		
Number of people in group		.649		
Contract academic staff		.620		
Momentum: total output to 2003		.559		
Individual impact factor			.921	
Impact factor of output (04-05)			.891	
Qualitative assessment of output (04-05)			.837	
Impact/output ratio			.716	
Productivity				.831
Total output between 2004 and 2005		.518		.741
Total doctoral theses defended in last two years				.550

Extraction method: Principle components analysis. Rotation method: Varimax with Kaisar normalisation.
(a) The rotation converged in 8 iterations.

Table 5: Analysis of cluster averages by factor

Cluster		F1 Youth	F2 Size	F3 Quality	F4 Output
1 Standard	Mean	-.23	-.30	-.192	-.41
	Std. Deviation	.869	.764	.533	.601
	N.	107			
2 Productive	Mean	.53	.68	-.40	.93
	Std. Deviation	1.075	1.190	.637	1.150
	N.	45			
3 Excellent	Mean	.04	.10	2.28	.15
	Std. Deviation	1.063	.892	1.126	.901
	N.	17			

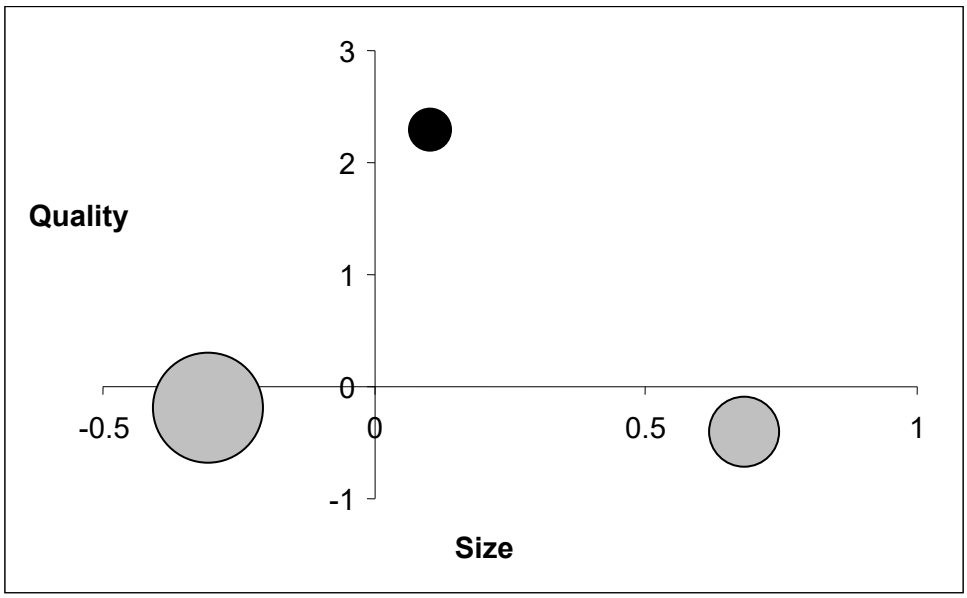
Source: Own elaboration.

Table 6: Cluster profiles

	Cluster 1 Standard	**Cluster 2 Productive**	**Cluster 3 Excellent**
Number of people in group	10.65	19.80	17.24
Percentage of men	39.33	41.82	42.50
Number of chaired professors	0.88	1.76	1.71
Number of other professors	2.94	5.29	2.12
Grant recipients	2.08	4.53	3.82
A&SS group members	0.34	0.73	1.00
Average group age	42.17	41.94	41.37
Contract academic staff	2.23	3.62	3.24
Visiting researchers	2.18	3.87	5.35
Total full-time equivalents	6.44	11.05	7.38
Total output between 2004 and 2005	33.83	101.04	73.24
Momentum: total output to 2003	343.75	783.18	824.59
Qualitative assessment of output (04-05)	5.40	11.76	35.82
Impact factor of output (04-05)	13.46	26.26	126.29
Individual impact factor	2.14	2.21	18.07
Impact/output ratio	0.55	0.27	1.91
Percentage of civil servants	40.90	39.65	24.59
Productivity	5.82	11.34	10.63
Specialisation	0.45	0.37	0.70
Sum total of grants in last two years	5.52	11.68	13.11
Sum total of doctoral theses defended in last two years	8.06	17.64	8.47
Presence of non-Spanish researchers	0.55	0.77	0.64

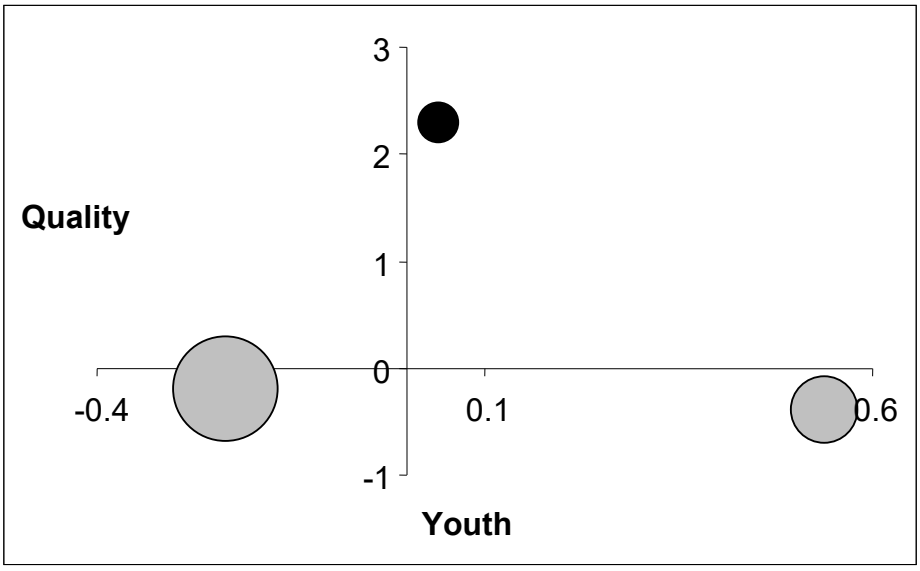
Source: Own elaboration.

Graph 1: Positioning three clusters against quality and size factors



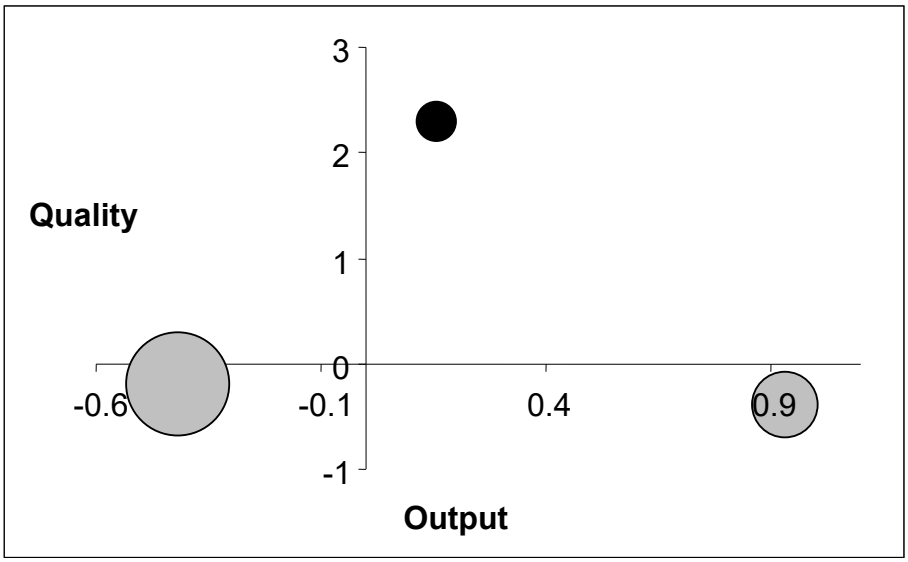
Source: Own elaboration.

Graph 2: Positioning three clusters against quality and youth factors



Source: Own elaboration.

Graph 3: Positioning three clusters against quality and quantity of output factors. .



Source: Own elaboration.

Table 7: Breakdown of variables for Excellent cluster

	Faculty	Size	Average Age	Chairs	Profs	Grant Holders	Output	Impact Factor	Individual Impact Factor	Productivity	Impact/ Output Ratio
1	Physics	7	32.16	0	1	3	24	79	26.33	8.00	3.29
2	Biology	15	35.36	1	3	6	72	87	12.43	10.29	1.21
3	Physics	12	33.71	1	0	2	20	80	13.33	3.33	4.00
4	Chemistry	12	43.08	3	3	3	148	276	30.67	16.44	1.86
5	Biology	25	33.81	1	2	10	52	141	14.10	5.20	2.71
6	Chemistry	20	39.00	3	2	8	69	132	18.86	9.86	1.91
7	Chemistry	26	35.36	2	2	10	71	179	17.90	7.10	2.52
8	Pharmacy	23	34.56	3	5	11	65	105	21.00	13.00	1.62
9	Geology	18	44.07	4	2	3	95	115	8.85	7.31	1.21
10	Chemistry	14	39.83	1	4	4	73	172	19.11	8.11	2.36
11	Medicine	31	51.83	2	3	1	87	100	11.11	9.67	1.15
12	Medicine	15	54.20	0	1	0	56	67	22.33	18.67	1.20
13	Physics	16	37.80	3	3	3	111	106	9.64	10.09	0.95
14	Biology	5	38.80	1	2	1	77	85	24.29	22.00	1.10
15	Medicine	25	47.80	1	1	0	34	76	19.00	8.50	2.24
16	Medicine	12	51.80	1	1	0	128	292	29.20	12.80	2.28
17	Medicine	17	50.22	2	1	0	63	55	9.17	10.50	0.87

Source: Own elaboration.

Table 8: Profile of Excellent Cluster

	Excellent groups
Visiting researchers	5.35
Presence of non-Spanish researchers	0.64
Year research group was founded	1993.5
Average group age	41.37
Grant recipients	3.82
A&SS group members	1.00
Sum total of grants received in last two years	13.11
Percentage of civil servants	24.59%
Number of people in group	17.24
Percentage of men	42.50%
Number of chaired professors	1.71
Number of other professors	2.12
Contract academic staff	3.24
Total full-time equivalents	7.38
Momentum: total output to 2003	824.59
Qualitative assessment of output (04-05)	35.82
Impact factor of output (04-05)	126.29
Impact/output ratio	1.91
Individual impact factor	18.07
Total output between 2004 and 2005	73.24
Sum total of doctoral theses defended in last two years	8.47
Productivity	10.64

Source: Own elaboration.

Table 9: Group profiles, by area

	Excellent Groups	Human Sciences groups	Law, Economics and Social Sciences groups	Experimental Sciences and Maths groups	Health Sciences groups	Education Sciences groups
Visiting researchers	5.35	2.83	1.53	3.23	6.04	1.83
Number of non-Spanish researchers	0.64	1.33	1.65	1.27	1.38	1.48
Average group age	41.37	45.86	43.69	39.06	42.87	46.57
Grant holders	3.82	1.68	1.14	4.48	2.94	1.63
A&SS team members	1	0.26	0.1	1.1	0.7	0.17
Sum total of grants received in last 2 years	13.11	6.45	3.61	10.64	10.29	4.38
Percentage of civil servants	24.59%	42.09	54.87	30.76	27.29	53.91
Number of people in group	17.24	10.75	11.73	16.48	16.55	11.94
Total full-time equivalents	7.42	6.08	8.07	8.77	6.70	7.57
Momentum: total output to 2003	824.59	119.31	150.08	151.6	153.53	167.13
Qualitative assessment of output (04-05)	35.82	0.26	2.43	15.97	16.85	3.69
Impact factor of output (04-05)	126.29	0.26	1.37	44.37	57.96	5.48
Total output between 2004 and 2005	73.24	40.72	57.18	50.98	42.21	72.42
Sum total of doctoral theses defended in last two years	8.47	11.32	7.09	11.68	8.97	14.35
Productivity	10.64	7.67	7.46	6.01	6.04	11.65

Source: Own elaboration.

Table 10: Summary of the main features of the three clusters

	Outstanding in ...	Number of groups
Cluster 1 Standard	Neither quality nor quantity of output	107 research groups
Cluster 2 Productive	In quantity of output, irrespective of quality	45 research groups
Cluster 3 Excellent	In quality of output	17 research groups

Source: Own elaboration.