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Abstract: The aim of this work was to classify the business incubators in Spain according to the four phases of startups incubation. Taking into account that the graduation rate implies greater survival and business success of the incubated companies, they have been identified at each stage of the incubation (spread of entrepreneurship, pre-incubation, advanced incubation, and graduation). The activities that present higher impacts on the success of the incubated companies and the activities carried out by the incubator that have a greater relevance on the graduation of the companies have concretely been considered. Principal component (PC) cluster analysis have been applied. All the incubation variables were used simultaneously, reducing their number, and grouping them into factors, finally the cases were grouped according to these latent variables. Principal components analysis reduced dimensionality to 8 factors with a 74 % of explained variance. Factor 1 was positively related to pre-incubation variables, factor 2 was linked to training and collaboration variables within the entrepreneurship diffusion phase. Factor 3 called activity monitoring and control and was related to phase 3 or basic incubation variables. Clusters analysis facilitates the grouping of incubators into three clusters: Group 1 (16 % of the total), incubators with strong deficits in incubation phases 1, 2 and 3. They are small Business Incubators, often located in rural areas or cities and low graduation rate. Group 2 (30 %), business incubators with very high graduation rate, and strongly positive values in factor 1 and 2. Factor 3 although positive is susceptible to improvement. They are the largest incubators and usually located in industrial and technological parks. Group 3 (54 %) is the majority, with values close to cluster 2 and 3.

Keywords: startups; business incubators; entrepreneurship; advice; pre-incubation; incubation; graduation; viability; sustainability

1. Introduction

Startups are an engine of social and economic development [1]; that influence the reduction of unemployment [2, 3] and poverty [4], and favour investment, the growth of the local economy and the improvement of the quality of life [5, 6]. Currently, small and medium-sized enterprises (SME) represent 90% of the business fabric in developed countries, a figure that increases to 95% in developing countries. In addition, startups are strategic in innovation, technological advancement, and the viability of ventures [7, 8].

Entrepreneurship support during the incubation stage constitutes a priority activity in business incubators and means a strategic factor in the success of the venture and its sustainability [9]. This phase favours the creation of value, technology transfer, the promotion of innovation, cluster development and the coordination of participation of universities, research institutes and the business community [10].

There are multiple nomenclatures to refer to business incubators; such as germinators, business hotels, business incubators, business boutiques, entrepreneur centers, innovative business center,

entrepreneurship center, business innovation center, new business centers, business promotion centers, business development support centers, business school, etc. [11,12]. In each case, depending on the country, the socioeconomic context, and other factors, there will be differences between them. However, business incubators are frequently non-profit entities [13] and whose purpose is to support entrepreneurs from the initial idea to their full establishment in the market.

The EU (DG XVI) defined business incubators as public and private interlocutors, which develop a complete and integrated system of activities and services of excellence for small and medium-sized enterprises, with the aim of creating and developing innovative activities [14].

Business incubators provide entrepreneurs with information, advice, management guidance, accommodation spaces; whether shared (pre-incubator or coworking) or individual (office), training programs, networking, events and connection activities, networks of mentors and other resources, and have become an important element of the business ecosystem, contributing greatly to the value generation [15, 16].

A strategic objective of the incubators was to facilitate the ideal framework for the creation, development, and maturity of business initiatives. They provide services to their clients and configure an ecosystem that increases the chances of success and venturer's survival. Through incubators, companies receive training, advice, technological and financial links in their initial stage, a time of greatest vulnerability [17]. In addition, the incubator promotes the culture of innovation, business promotion and the training of new entrepreneurs [18].

The success of the business incubator is measured by the survival rate of the companies incubated or hosted in it [19]. According to the Small Business Administration in the United States (2008) the success rate of incubated companies was 80%, while this percentage dropped to 38% in startups not incubated in a business incubator [20]. In this sense, ventures linked to incubators showed a greater probability of survival [21].

According to the National Business Incubation Association (NBIA), business incubation is an efficient and dynamic process that provides managerial help, aimed at obtaining economic resources and exposure to "Critical Business" that reduces between 10% and 15%. failure rate in the early stages of the company [20].

Several authors considered the role of business incubators to be positive in the economic transformation of territories [21, 22]. In addition to promoting the strategy of support lines for entrepreneurs, they also function as a canter of attraction, retention and expansion of companies. Business incubators develop services for entrepreneurs and act as a focus for innovation of new projects, products, and services. The coordination of the different business incubators favours an efficient system of aid to entrepreneurs that guarantees a dynamic and sustainable flow [23].

In Spain, business incubators offer business advice and subsequently monitor the venture for several years. Furthermore, since COVID 19, virtual incubators have proliferated, which support the entrepreneur without providing a physical space to carry out their activity [24, 25].

According to [13, 26, 27] there are different phases that the entrepreneur goes through in the business incubator: Phase 1. Initial advice, First contact. Doubts are resolved, the idea is presented, the resources available are optimized, etc. It is accessed through the appointment service. Phase 2. Pre-incubation, in this phase the business plan is carried out in an interval of 4 to 6 months and with a technical advisory team. In the early stages of launching a project is where the idea is generated, the business model and the value proposition are defined. In this stage the commercial and business opportunities are assessed [28], but on the other hand, in this phase the abandonment rate is higher [29].

Once the pre-incubation phases and the Business Plan are completed, the "birth of the entrepreneurship" begins, where it reaches a legal entity to operate in the market. Incubators facilitate the establishment of the company, streamlining administrative procedures, with a reduction in time and costs [30]. After the establishment of the venture, the Incubation phase begins. Incubation is divided into two phases, depending on the services provided by the incubator: basic and advanced incubation. Phase 3. Basic Incubation, in this stage the incubator provides spaces (coworking), infrastructure, tools, resources and contacts necessary for the creation and development of products

and services. Phase 4. Advanced Incubation, the incubators provide additional services to those of the previous phase, such as: training, networking, participation in events, connection activities, mediation, testing laboratories, among others. During this phase, agreements with partners and strategic partners are promoted; both for financing, scaling of production and internationalization of the venture. The services provided by business incubators are variable depending on the type of services, the clients, and the structure of the organization [31].

Business incubators are differentiated by the services offered; from those focused-on technology, to others focused on business development [32]. However, all of them provide active support to entrepreneurs through training, administrative support, office space and infrastructure, technology transfer, assistance to help reduce time to market, consulting services, networking, and the funds needed to help grow the new business [33].

Finally, the startups will abandon business incubators and the incubation will be assessed through the viability of the company. Graduation rate is the response variable most frequently used to measure incubators' success [34].

Several references on business incubators were found [35], although few were focused on the phases that make up business incubators and the business model [36, 37]. To deep knowledge of it is of great interest since the incubation phases could be associated with the viability of the ventures [38]. In this sense, when it comes to incubator business models, the nuances of the value creation perspective are largely ignored and treated as a "black box" [39].

The effect of business incubators on the ventures' success has been widely analyzed, but there is a gap regarding the role played by the incubation phases. In this sense Alayoubi et al. [40] related the effect of knowledge of strategic objectives on the achievement of technological innovation at the Palestine Technical College. The reported results indicated a strong positive elevation between the strategic requirements and the innovation achieved (leadership, pioneering thinking, pioneering culture, strategic resource management).

Shahada et al. [41] were focused on how to improve the performance of business incubators in the Gaza Strip. Owda et al [42] identified personal variables and their effect on promoting job creation in the Gaza Strip through business incubators. In this case, the researchers analyzed 92 projects in business incubators in the Gaza Strip, addressing the study of gender and technical knowledge.

Benavides-Sánchez et al. [43] studied business incubators and the role developed by universities as a catalyst between student entrepreneurs, teachers, researchers, and investors. The need was found to build multidisciplinary work teams, with collaborative work networks.

Habiburrahman et al. [44] delved into the concept of incubators and identified critical success factors, such as synergistic products, processes, innovation management, communication, culture, experience, information technologies, innovation skills, functional skills and implementation skills. The eleven factors were similar in incubators and startups, although with a different order of priority.

Consequently, incubators constitute key elements in incubators and are fundamental for business development [45, 46], sustainable development [47], and territorial cohesion [48- 51]. Likewise, it is complex to quantify the success of business incubators, because there are different metrics, indicators and approaches, such as: business innovation [52], efficiency [53], performance [54], the entrepreneur's perspective [55], among others.

Although there are few studies that analyze business incubators with the incubation phases approach [56,57]. In this research we considered the business incubators in Spain globally, assuming their diversity, and their stage of development. Their grouping according to their variability and the incubation plan they are developing is of great interest; both for the development of in situ improvements and for the development of specific sectoral policies that enhance their development [58] and improve survival or graduation rates [59].

Therefore, this research seeks to deepen knowledge of the stages that startups go through in business incubators during the incubation phase. How have the business incubators as facilitating institutions of entrepreneurship been determinants for the survival of startups? For this purpose, a typology of business incubators in Spain was developed in relation to the incubation phases of the start-ups incubated.

The typology was built based on the activity of the incubators, and they were subsequently characterized. The incubators were classified according to the indicators of the different phases of entrepreneurship incubation: 1: Spreading Entrepreneurship; Phase 2: Pre-incubation; Phase 3: Basic-Incubation and Phase 4: Advanced incubation. The characterization of the typology of incubators was carried out with the graduation variables and other operational variables.

This research will help to identify the different types of incubators existing in Spain according to its four incubation phases (Spreading entrepreneurship, Pre-incubation, Basic incubation and Advanced incubation). The results will favour to improve the business incubators, acting on the key factors in increasing the graduation rate. This work will serve to promote specific policies and strategies in business incubators.

After this introduction and objectives, this article will be organized as follows: in Section 2, the methodology will be presented; the population, the survey applied, and the multivariate statistical analysis used. In Section 3, the results will be described, firstly the typology of business incubators and then its characterization. Section 4 will provide a discussion of the results. To end, Section 5 will describe the conclusions, with the limitations of the study and future lines of research.

2. Materials and Methods

For the drafting of this work, the Surveys that were sent to all the incubators of companies in Spain were used for the preparation of the Funcas report "The services provided by incubators and accelerators of companies in Spain. Ranking 2022/2023". Funcas is a center of analysis -a think tank- dedicated to economic and social research and its dissemination, promoting the interaction between the academic sphere and the real economy. It is part of the CECA Social Work.

Funcas has been, for many years, a benchmark in the field of economic forecasting and in the analysis of Spanish and EU public policies. At present the Foundation is also very active in the field of finance – financial regulation and digitalisation, financial markets... – and in a variety of social issues.

The Funcas ranking on incubators and accelerators of companies, which has taken ten editions, becomes a benchmark in the analysis of best practices in business incubators and accelerators in Spain.

2.1. Population and Survey

412 business incubators from Spain in 2022 were taken as population [60]. 88 business incubators that participated in the Funcas' report (21.36 % of the whole) were selected. Data were collected by using Funcas' survey applied in Spain in 2022. The interview questionnaire included 62 questions relating to the following aspects: operative and general data (20 items), phases of the business incubators (33), and survival's indicators (9).

Table 1. Business incubation phase variables.

Variable	Variable description
SPREADING ENTREPRENEURSHIP **(SP)**	
1.Advice	Provide an information and advisory service to the general public.
2.Advice$_{free}$	Offering a service for free.
4.Events	Number of events per year.
5.Nb$_y$	How many events does the nursery hold per year?
6.Channels	There are channels of information/communication/promotion of services.
7.Publicat$_{Frec}$	Publication frequency in communication channels.
8.Traing	Offering transversal courses and entrepreneurship support courses.
9.Traing$_{Frec}$	Number of courses offered per month.
PREINCUBATION **(PRE)**	
10.Shar$_{spac}$	Existence of preincubator or coworking facility
11.Spac$_{free}$	Existence of free spaces to work

12.Space$_{req}$	Are there any requirements to enter the preincubation phase?
13.Proj$_{nb}$	Number of pre-incubated projects per year.
14.Proj$_{advice}$	Having expert consulting sessions for pre-incubators.
15.Proj$_{mon}$	There is monitoring of pre-incubated projects.
16.Proj_$_{traing}$	There are cross-sectional training workshops.
17.Proj_$_{Mtime}$	Number of years spent in preincubate
18.PAE	Is the incubator an Entrepreneur Care Point (PAE)?

BASIC INCUBATION (INC)

19.Entry	There are selection criteria for access to incubation.
20.Entry$_{crit}$	Which are the selection criteria for access to incubation?
21.Servic	Services included in the rate.
22.Nt_$_{Frec}$	Frequency of networking meetings
23.C_$_{Frec}$	Frequency of consultancy sessions
24.Ment$_{Frec}$	Frequency of mentoring sessions.
25.Mon_$_{Frec}$	Frequency follow-up or monitoring sessions.
26.Traing	Offer of training courses adapted to the needs of clients.
27.Traing$_{nb}$	Number of courses offered per month

ADVANCED INCUBATION (ADV)

28.Nc_$_{agree}$	Interest groups with which the incubator has an agreement/collaboration agreement.
29.Comp_$_{exp}$	Percentage of hosted companies exporting their products.
30.Comp_$_{fd}$	Number of hosted companies have raised funding while hosted.
31.Comp$_{job}$	Average number of jobs generated by the hosted companies.
32.Inc_$_{disc}$	A special rate is offered on technology services or products.
33.Inc_$_{agree}$	Interest groups with which the incubator has an agreement/collaboration agreement.

Table 2. Outcome and operative's variables of incubators.

Variable	Variable description
GRADUATION (GRD)	
34.Agree	Does the incubator have agreements to facilitate the installation of companies abroad once outside the nursery? 0, No; 1, Yes
35.Crit	Graduation criteria. 1, Non-compliance with objectives and others; 2, Limited period of time; 3 Meeting objectives
36.Com_$_{nb}$	Total number of companies graduated since the incubator opened. 1, <10; 2, 10- 50; 3, 51-100; 4, >100
37.Com_$_{Iv}$	Of the graduate companies, what is the percentage that continues their activity abroad now? 1, <25; 2, between 26-50; 3, 51-75; 4, >76
38.Com_$_{dd}$	Percentage of companies that ceased their activity during their stay. 1, >76; 2, between 51- 75; 3, 26-50; 4 <25
39.Com_$_{fd\_Pb}$	Percentage of graduates who have obtained funds/public funding. 1, <20; 2, between 21-40; 3, 41- 60; 4, 61-80; 5, >81
40.Com_$_{fd\_pr}$	Percentage of graduates who have obtained funds/private funding. 1, <20; 2, between 21-40; 3, 41-60; 4, 61-80; 5, >81
41.Mon	Contact with graduates is maintained. 0, No; 1, Yes
42.Mon_$_{act}$	There are specific actions/initiatives with the graduates. 1, Nothing specific is done or frequent contact with them is maintained; 2, Survival and Evolution Tracking; 3, Networking events between graduates and entrepreneurs/professionals of interest; 4, Trainers/Lowers of Hosted Enterprises; 5, Networking meetings or events between graduates and hosted.
OPERATIVE (GA)	
43.Network	Belong to a network. 0, No; 1, Yes
44.Offices_$_{nb}$	Capacity of the incubator (Nº of offices). 1, <10; 2, 11-20; 3, 21-30; 4 >30

45.Newslett_Frec	Shipping Frequency. 1, Not send; 2, Quarterly; 3, Monthly; 4, Weekly
46.Staff	Staff required for daily operations (N° persons). 1, <3; 2, 4-5; 3, >5 persons
47.Expenses	Annual operating expenses budget (€/y).
48.Revenues	Annual operating revenue budget (€/y).

2.2. Statistical Analysis

In a first stage, 33 business incubators phases' variables were selected (9 items linked to phase 1 of Spreading, 9 to phase 2 of Pre incubation enterprises, 9 associated to phase 3 of Basic incubation phase and finally 6 items to phase 4 of Advanced incubation). According to Niammuad et al [32] the criteria of coefficient of variation higher than 60%, uncorrelated variables and non-linear dependence, for the selection, of the variables were considered. A principal component analysis (PC) was used to reduce the number of variables and summarise most of the variability [61]. Based on the partial correlation matrix and the initial PC models, the number of variables was reduced to 23. In this research, 8 factors were selected, the orthogonal varimax rotation was applied to relate more easily the selected variables to the extracted factors. The Bartlett sphericity test and the Kaiser-Meyer- Olkin index KMO>0.7 [62].

In a second stage, the business incubators were classified using cluster analysis. Firstly, hierarchical groupings were developed based on Ward's method, using the Euclidean, squared Euclidean and Manhattan distances. The optimal number of clusters was selected using the Elbow method (Syakur et al., 2018 [63].; Shi et al., 2021) [64]. It was chosen the clustering whose discriminant function correctly classified the highest percentage of cases and generated significant differences in the largest number of original variables.

Additionally, the characterization of the business incubators was carried out using the preliminary variables (Table 2). Quantitative variables (original and adjusted) were analyzed by means of a one-way analysis of variance (ANOVA) and Tukey's multiple range test. Qualitative variables were compared with the Chi^2 test. All statistical analyses were performed using the Statgraphics Centurion versión XVI.1. software https://www.statgraphics.com/download-statgraphics-centurion-xvi

3. Results

3. 1. Typology of Business Incubators

Principal Component Analysis (PC)

8 factors were extracted, corresponding to an eigenvalue greater than 1 [32]. These factors explained 73.47% of the data variability. Table 3 shows the matrix of factor loadings after rotation. 21 variables were selected in the PC analysis of the 33 business incubators variables, which were exclusively assigned to one extracted factor.

The first factor explained 32% of the variance and grouped variables related to Phase 2 of business preincubation. The variables with a strong degree of association were Pre_proj_mon and Pre_proj_advice. These variables are related to carrying out monitoring and follow-up of the projects, having experts in project development. The variables that showed a moderate link with the factor were the transversal training of the incubator (Pre_proj_traing), the number of projects incubated per year (Pre_proj_nb) and the existence of coworking in the bussines incubator (Pre_shar_spac). All these variables were linked to phase 2 of the incubators or Pre-incubation.

The second factor picked up 9.91% of the explained variance and grouped 4 variables: two corresponding to Phase 1 of the incubation, relating to the dissemination of information, transversal training, and its frequency (Sp_Traing and Sp_Traing_Frec). The other two variables that made up the factor were linked with basic and advanced incubation. One from phase 3 of basic incubation of startups: number of courses offered per month (Inc_traing_nb) and another from phase 4 of advanced incubation related to the number of agreements with other entities (Adv_inc_agree). This factor was related to training and the degree of collaboration offered by the business incubator.

The third factor explained 6.65% of the variance through variables strongly associated with Phase 3 of incubation, with coefficients greater than 0.7. The variables identified were: Frequency of consulting sessions (Inc_c_Frec), frequency of mentoring sessions (Inc_ment_Frec), and frequency of entrepreneurship monitoring follow-up (Inc_mon_Frec). They are variables linked to the monitoring and control of activity. The first three factors explained 48.7% of the accumulated variance and collected 12 variables.

Factors 4, 6 and 7 collect the variables from phase 1 of the startup incubation and were linked to the spreading entrepreneurship. These three factors only explained 15% of the variability and will be related to spreading. The rest of the factors, from the fourth to the eighth, individually explained a percentage of variance of less than 6% and were associated with one or two variables directly. The values of the variables used in the equation were standardized by subtracting their means and dividing them by their standard deviations. Also shown in Table 3 are the communalities considered as estimators of the proportion of variability in each variable attributable to the extracted factors [32, 61].

Table 3. Principal components (PC) loading matrix of rotated.

Items	Loading	Eigenvalue	Explained variance (%)	Acumulate	PC
10.Shar_spac	0.61	8.00	32.01	32.01	1
13.Proj_nb	0.68				1
14.Proj_advice	**0.82**				1
15.Proj_mon	**0.83**				1
16.Proj_traing	0.65				1
8.Traing	0.62	2.47	9.91	41.91	2
9.Traing_Frec	0.77				2
26.Traing	0.70				2
32.Inc_disc	0.64				2
23.C_Frec	0.76	1.71	6.86	48.77	3
24.Ment_Frec	0.71				3
25.Mon_Frec	0.76				3
6.Channels	0.71	1.37	5.46	54.22	4
7.Publicat_Frec	0.67				4
22.Nt_Frec	0.72				4
19.Entry	0.84	1.36	5.43	59.65	5
20.Entry_crit	0.86				5
1.Advice	0.82	1.26	5.03	64.68	6
3.Advice_nb	0.63	1.13	4.52	69.20	7
18.PAE	0.80				7
11.Spac_free	0.91	1.07	4.27	73.47	8

Cluster Analisys

The scores of the eight factors selected for each of the business incubators analyzed were used as independent variables. This statistical procedure generated 3 clusters from 76 observations provided (Figure 1). The clusters obtained showed homogeneity within the group and heterogeneity between them. The procedure began with observation in separate groups that were subsequently grouped into close pairs to form a new group (Shi et al., 2021) [64]. After recalculating the distance between groups, the two now closest groups are combined. This process was repeated until finally reaching the three groups shown in Figure 1. The number of clusters was selected based on the distribution of the data, the experience of the analyst and the congruence of the results (Syakur et al., 2018) [63].
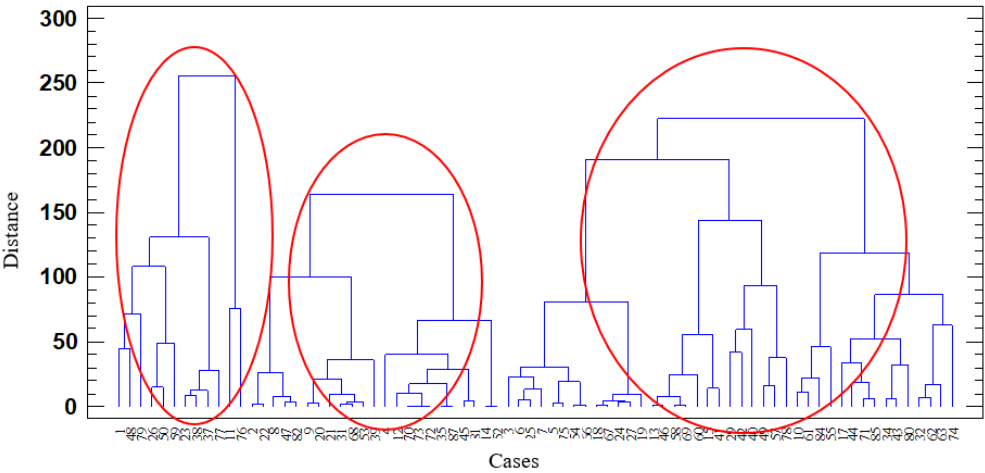
Figure 1. Clusters of business incubators.

Table 4 shows the scores obtained by the centroids of each group and disaggregated by factors. Likewise, Figure 1 shows the dendrogram. Through cluster analysis, 3 groups were obtained; the first with 16% of the business incubators, the second with 30% and the third with 53% of the cases.

Table 4. Scores of centroids for each cluster.

PC	Cluster		
	1	2	3
1	-7.4766	4.1812	-0.1573
2	-8.2974	3.9628	0.2054
3	-6.2827	1.4973	0.9989
4	-5.5285	2.8182	0.03716
5	-2.5355	2.4939	-0.6569
6	-3.5733	1.5787	0.1602
7	-2.7583	1.9444	-0.2835
8	-0.9970	0.4338	0.0485

Group 1 is a minority (15.79% of cases); In this group, business incubators were incorporated with very low and negative values regarding preincubation (Phase 2), negative values of training and collaboration (Spreading Phase) and strong negative values regarding the monitoring and control of the ventures (Phase 3). The business incubators included in Cluster 1 would have to focus their efforts on improving the practices included in Phase 2 and 3 of the incubation. It is recommended to start improving services from the variables identified in Table 3.

Group 2 represented 30.26% of the business incubators. They were incubators that show the highest values in Pre-incubation (4.2), Training and collaboration (4.0) and Incubation (1.5). This group was the leading group, although the values were high in these factors, they should focus their efforts on improving Phase 3 and other variables linked to the remaining factors (Table 3).

Group 3 was made up of 53.95% of the cases. With intermediate values between the previous groups. Negative values or values close to zero stand out in the first three components, which are the most relevant (Table 3). The practices associated with the variables of phases 2, 1 and 3 of the incubation form their strategic improvement objectives.

The construction of the typology and knowledge of these groups is necessary to propose specific measures for each of them, seeking their strengths and weaknesses and how to correct their behavior in the most effective and appropriate way [22, 32].

3.2. Characterization of the Typology of Business Incubator

31.58% of business incubators had a network to share data and resources, compared to 68.42% that did not offer the service ($p < 0.05$). Incubators with networks were mainly distributed in clusters 2 and 3 (Table 5). The strength of network connections over time is associated with business benefits [65].

Table 5. Incubator typology's characterization according to qualitative variables.

Variables		Cluster			
		1	2	3	p-Value[1]
43.Network (%)	0	10.53	5.26	15.79	*
	1	5.26	25,00	38.16	
44.Offices $_{nb}$	1	9.21	5.26	17.11	*
	2	1.32	7.89	22.37	
	3	2.63	6.58	6.58	
45.Newslett $_{Frec}$ (%)	1	14.47	2.63	18.42	***
	2	0.00	0.00	0.00	
	3	1.32	1.32	1.32	
	4	5.26	5.26	5.26	
46.Staff	1	1.32	1.32	1.32	***
	2	0.00	0.00	0.00	
	3	0.00	0.00	0.00	
	4	14.47	14.47	14.47	
34.Grd_agree (%)	1	15.79	15.79	15.79	*
	2	15.79	15.79	15.79	
41.Grd_mon (%)	1	7.89	7.89	7.89	**
	2	1.32	1.32	1.32	
42.Grd_mon_act (%)	1	12.00	12.00	12.00	***
	2	4.00	4.00	4.00	
	3	24.00	24.00	24.00	
	4	2.67	2.67	2.67	
	5	2.67	2.67	2.67	
[1]p-Value: *p < 0.05; ** p < 0.01; *** p < 0.001					

The variable size of the business incubator (44.Offices_nb) showed significant differences by cluster ($p < 0.05$) (Table 5). Incubators with the largest size and greatest capacity to host ventures were concentrated in cluster 2 and secondarily in cluster 3. On the contrary, the smallest incubators correspond to cluster 1 and to a lesser extent a business incubators group of cluster 3. The size of the business incubator is a variable of great importance [66] and is also related to the survival rate [61].
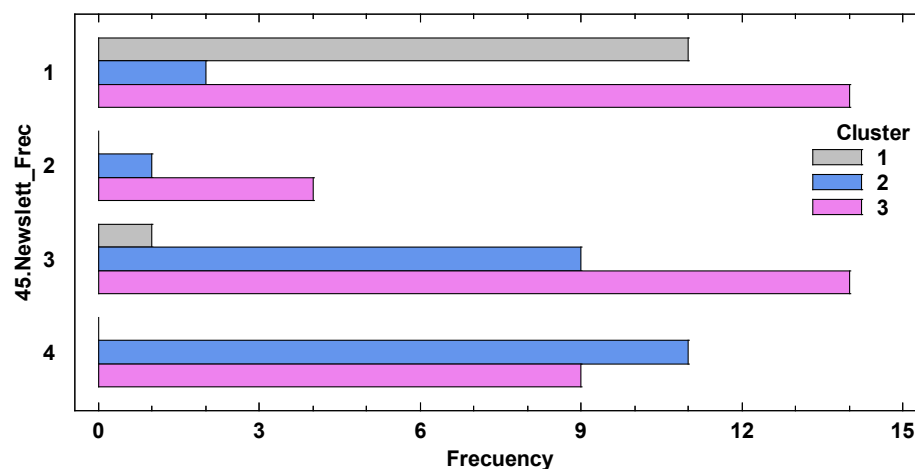

Figure 2. Newsletter frequency according to cluster.

The variable frequency of communication between the business incubator and the startups for each cluster (45.Newslett_Frec) obtained significant differences with a high level of confidence ($p < 0.001$). The startups in cluster 1 did not have frequent communication in 35.53% of the cases and similar behavior in large part of startups from cluster 3 was observed. On the contrary, in cluster 2 the incubators with high (3) and very high frequency of communication (4) were concentrated (Table 5 and Figure 2). According to Paniagua-Rojano [67], the frequency of communication and the type of communication, according to the theory of dynamic capabilities, was linked to an increase in business results [68].

Figure 3 shows the classification of business incubators according to the number of people that make up the operational staff (46.Staff) and the cluster. Significant differences are obtained with a high level of significance ($p < 0.001$) (Table 5). 77.64% of the incubators were very small size. They had, at most, one person on the staff for their daily operation. On the other hand, the largest incubators, with more than five people for their operational operation, represented 14.47% of the total.

The business incubators belonging to cluster 1 showed very low dimensions with respect to the number of people, while in cluster 2 those with a greater organizational structure were concentrated. These results were significant and are associated with the viability of the startups [69, 70].
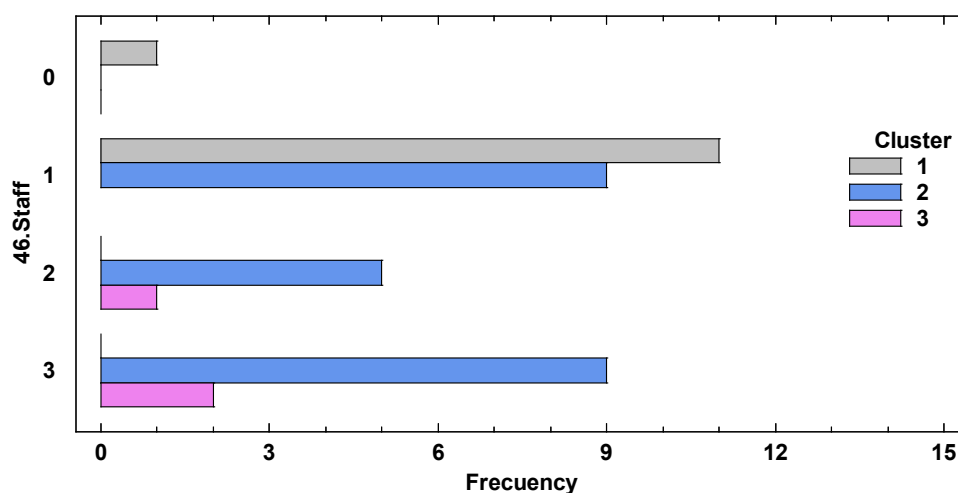

Figure 3. Organizative staff size according to cluster.

The graduation or survival rate was used in this research as a response variable for the business incubators. Tables 5 and 6 show the main economic results and the graduation rate of the incubators regarding to cluster. 89% of the incubators declared that the startups housed in their facilities did not generate profits, compared to 10% that did declare profits. Regarding costs, the results reported that 82% of the cases showed high fixed costs, compared to 13% with a predominance of variable costs. The predominance of the variable cost structure was mostly associated with the incubators of cluster 2, in 40% of the sample. The results were according to [71].

The graduation rate was evaluated based on the indicators in tables 5 and 6. The first one that showed significant differences ($p < 0.05$) was the existence of protocolized agreements that facilitate the installation of the company outside the incubator (34.Grd_agree) (Table 5). 67% of the incubators did not have these agreements and were grouped entirely in clusters 1 and 3. On the contrary, the incubators with protocolized agreements were located in cluster 2 and slightly in cluster 3. Authors such as Peña et al [72] indicated the importance of these agreements for the development and growth of startups.

Table 6 shows how the clusters were characterized based on the general and quantitative graduation variables. ANOVA and Tukey's multiple range test were used to differentiate means.

Table 6. Incubator typology's characterization according to quantitative variables.

Variable	Clúster			p-Value [1]
	1	2	3	
37.Grd com Iv	2.67 [a]	3.30 [b]	3.46 [b]	*
40.Grd com fd pr	1.75 [ab]	2.30 [b]	1.54 [a]	*
47.Expenses	25,056 [a]	865,224 [b]	156,342 [a]	*
48.Revenue	36,700 [a]	801,381 [b]	168,867 [ab]	*

[1]p-Value: *$p < 0.05$

The variable 37.Grd_com_Iv was linked to the monitoring of the venture once it leaves the incubator. In 76% of the cases, the startups maintained contact with the incubator, while 24% did not. The results showed significant differences between clusters ($p < 0.01$) (Table 6). The business incubators of Cluster 2 showed greater monitoring of the startups, on the contrary those of Cluster 1 showed the lowest monitoring rates. Pattanasak et al [73] reported the great value involved in keeping contact between business incubators and startups alive and dynamic startups.

Subsequently, the clusters were characterized according to the specific activities developed with the graduates (42.Grd_mon_act). Significant difference between clusters were obtained ($p < 0.001$). In Cluster 2, incubators predominate with regular meetings and networking events between graduates and residents. Hosted Enterprises training is also frequent. On the contrary, in Cluster 1 and 3 there is a frequent absence of specific meetings between graduates and hosts and an absence of improvement in the training of the activity. This *inter pares* training is basic for solving problems in better response times and more effectively [74].

Regards to the viability or survival rate of the companies, once they leave the incubator (37.Grd_com_Iv) by cluster, significant differences were founded ($p < 0.05$). 62% of companies continued their activity and were viable, with a range of values between 3.30 and 3.46 in clusters 2 and 3. This percentage decreases sharply to 40% in the incubators of cluster 1. The variable 40. Grd_com_fd_pr. represented the percentage of startups that have been financed with private funds, both for investment and Venture Capital. Although the percentage is very low (less than 40%), we found in cluster 2 values much higher than the remaining clusters ($p < 0.05$).

Regarding the budget of income and expenses (Table 6) of the business incubators (47.Expenses), significant differences were observed in cluster 2, with very high values and marking the existence of a scale effect. Thus, the average annual budget in cluster 2 was 856,224 euros, a value much higher than that of the other groups ($p < 0.05$). Likewise, the annual operating income budget in the incubators (48.Revenue) showed significant differences between clusters ($p < 0.05$). The incubators Cluster 2 have a higher level of income (scale effect) than the remaining groups and those in group three showed intermediate values between Cluster 1 and 2. In cluster 3 we found business incubators with a low level of expenses and an intermediate level of income. It could indicate the existence of a group of small size but economically efficient business incubators. Results were similar to founded by Funcas´s ranking 2022/2023 [60].

4. Discussion

The progress of startups in business incubators was segregated into four phases: Spreading, Pre-Incubation; Basic Incubation and Advanced incubation [12]. In this research, 33 variables were used that have different effect on the incubators' success; Spreading (9), Pre-Incubation (9); Basic Incubation (9); and Advanced incubation (6). In addition, a group of response variables were selected, related to the survival rate of the startups (9 variables) and 20 general or operational variables were considered for characterization.

33 initial variables were analyzed on the partial correlation matrix and the preliminary models, in order to reduce the number of variables. The principal components analysis verified, on the one hand, the goodness of each of the proposed variables and secondly, its reduction to eight factors or latent variables that explained 73.47% of the existing variability. The first factor was strongly linked to Phase 2 of Pre-Incubation, the second factor was associated with the variables of Phase 1 of incubation (Spreading) and the third factor was related to Phase 3 of incubation (Basic Incubation).

These three factors explained 41.91% of the variance. The remaining factors were mainly linked to phase 1 of Spreading. Three groups or clusters made up the population of Spanish business incubators , which were subsequently characterized with the output variables; both general and graduation. Group 1 (16% of business incubators) was the smallest and had markedly negative values in the centroids with respect to the first three factors. This group represents those nurseries with more structural deficits and lower graduation rates. Group 2 (30% of the sample) constitutes the leading group with positive values in all factors and strongly positive in factors 1 and 2. It brings together the largest business incubators and highest graduation rates. The analysis also showed factors where it is necessary to focus improvements. Group 3 (54%) is an intermediate group with positive values in its factors, although low and close to zero. This group is clearly the recipient of improvement policies and within it different strategies are developed.

Business incubators with better graduation results (Group 2 and 3) showed a higher level of network use, marking significant differences with those of Group 1. On the other hand, those incubators located in industrial and technological parks improve the results, and therefore On the contrary, those in the rural world or located in cities decrease their results. The determining factors of success in the startups hosted in the business incubators were linked to the success of the pre-Incubation phase, secondly, the dissemination of the entrepreneurial spirit (Spreading) and the third factor was related to the basic Incubation (Phase 3).

First factor obtained, was linked to preincubation variables and was focused on an incubation's short phase with a duration between 4 and 6 months. However, this factor strongly explained the high variability between business incubators in Spain. On the other hand, it was associated with the graduation rate and survival of startups. In this phase the entrepreneur is carrying out his Business Plan with the support and advice of the business incubator technicians. Entrepreneurs in this phase were also offered expert advice and information on financing sources [60].

The appropriate building of the Business plan was positively associated with the survival of the startups and their viability in the market [75]. The business plan is a tool that makes it easier for organizations to chart a route to achieve objectives, consider obstacles and propose solutions for the development of activities in the future [76]. Likewise, the Business plan helps to forecast a contingency plan in the event of possible disturbances [77, 78]. Also, the results indicated the importance of a competitive operative staff in this first phase of preincubation of startups.

The second factor obtained in the analysis of principal components was the diffusion of the entrepreneurial spirit (Spreading). According to Funcas [60], incubators in this phase constitute a reference for startups, offering expert support, training sessions, social networks, training in tools, among others [52]. Although it is a priority for entrepreneurs to discover the link between the startup and the incubator and how this alliance contributes to graduation [60], it is a phase of information gathering, where the entrepreneur has not started the execution of his project, but has gone to the business incubator to resolve doubts, advice and obtain guidance regarding his business idea [79]. At this initial moment, the entrepreneur consults with different advisory services and goes to different incubators, so the appropriate approach to the project and his trust in the know-how of the staff constitutes an element of competitiveness compared to other incubators. Quality of the mentoring provided within these incubators depends on the incubator staff, emphasizing their fundamental role in guiding entrepreneurs in business development and strategy formulation [80].

Regarding the third factor, basic incubation, according to the Funcas ranking, in this phase, entrepreneurs have already matured their business ideas, studied their viability and, therefore, converted their idea into a business project. It is the go to market phase in which the planned project is carried out [33]. It is the most critical stage of an entrepreneur in which entrepreneurs must be provided with an especially favourable growth environment, and a series of specific resources and services must be made available to them, which allows them to successfully reach the maturity of the project. This factor is a priority according to the study by Funcas [60], however the results of the research relegated it to third place and it only explained 6.86% of the variability.

The variables that made up advanced incubation did not appear to be very relevant in the study of the phases of startups in the incubator. According to [81-84] in the advanced incubation phase,

companies develop internationalization strategies, seek new financing, scale up production and enter a growth phase. During the previous phases, pre-incubation and basic incubation, startups face the "valley of death", a stage in which companies are developing their business project and are not yet solvent, they do not generate enough profits to cover all their costs and that lasts until sales stabilize.

Once this period has passed, around two to three years of life (depending on the economic sector in which the startup operates), the companies begin to scale, so the support of the Business incubators favours the projects, but it is not as definitive for their survival as in the previous stages [85, 86]. At this stage, companies normally need capital to finance their growth or to make the leap into international markets. This capital is not always provided by business incubators, so the importance of the incubator for the survival of the company is not so relevant.

When face up the clusters obtained with the operative variables and those related to the success rate, differences between clusters were found. Communication variable determined significant differences between clusters and the results. Communication is appropriate in Cluster 2 and Cluster 3, and poor in Cluster 1. Communication was related to the graduation rate. So, an improvement in communication has an impact on improving results and contributes to avoiding business failure [87].

These results are in accordance with analysis of relational coordination [59] and Tailored Capabilities [68]. In this sense, this analysis is aligned to the study by [88] who related internal and external networks to the incubator and business growth. It has been reported a positive correlation between networks, performance, facilities offered by the incubator and link with the university [89].

The dimension showed significant differences between clusters, so that the small incubators are located in Group 1, the medium ones in Group 3 and the large ones in Group 2. Likewise, the dimension was linked to the graduation rates. That is, the larger the dimension, the structure of the business incubators was modified, and the graduation rate was improved [68, 69]. Normally, a larger business incubator will have more capital, more staff and possibilities to support a greater number of entrepreneurs, as pointed out by several authors [90].

The business incubators of Group 2 and some of Group 3 showed high success rates, and were significantly linked to positive values in: a) the existence of agreements for the installation of the company outside the incubator [31]; b) after-sales service or the regular maintenance of contact between the incubator and the enterprise, once it leaves the incubator [73]; c) the existence of training and monitoring actions for graduates [18, 52]; d) the percentage of ventures financed with private funds [90]; e) high rates of continuity of activity once the incubators were abandoned [19, 21, 59, 75].

5. Conclusions

The application of multivariate analysis (Principal components and cluster) in the four startup incubation phases (Spreading, Pre-incubation, Basic incubation and Advanced incubation) was shown to be a useful tool to create a typology of business incubators in Spain. Main components analysis reduced the dimensionality and grouped 74% of the variance into 8 factors. Factor 1 was positively related to Pre-incubation variables, factor 2 was linked to training and collaboration variables within the Spreading phase. Factor 3 was called monitoring and control of activity and was related to variables from phase 3 or basic incubation.

The typology favoured the grouping of the business incubators in Spain into three clusters. Cluster 1 (16% of the total) collected incubators with great deficit in phase 2, phase 1 and phase 3. Furthermore, they are small size incubators, frequently located in rural areas or cities, and have a low graduation rate. Cluster 2 (30%) incubators with a very high graduation rate, and strongly positive values in factor 1 and 2. In this group factor 3 was positive although susceptible to improvement. They are the largest size incubators and were usually located in industrial and technological parks. Cluster 3 (54%) is the majority, with intermediate values. They showed intermediate size and their begins with factors 1 and 2. In this group there are some very efficient incubators, with medium size and high graduation rate.

This work will serve to provide incubators of companies with elements of analysis to improve their activities and allocate their resources to those phases and activities that have a greater

contribution to the successful development of the entrepreneurs advised and the companies incubated or hosted therein optimizing the resources used and max-imitating their profitability.

Knowing which group each business incubators is located favours the development of specific policies according to their problems. Simple factors were also identified that could be modified and lead to an improvement in the graduation rate. In subsequent studies, it is recommended to deepen the quantitative knowledge of the relationship between incubation phases and graduation rates with other statistical techniques such as Structural equation modeling by the partial least squares method (PLS-SEM).

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