

A performance-based taxonomy of entrepreneurial universities

Abstract

The European higher education landscape has experienced dramatic changes in the last decades and the entrepreneurial university has turned into a potential solution to these perceived problems. Therefore, this paper proposes a taxonomy of entrepreneurial universities. Based on a cluster analysis, three distinct groups are identified, which are in different phases within the transformation into an entrepreneurial university: one group of universities is in the first phase of the path, since they are not obtaining high entrepreneurial university's results yet; other group is in the second phase of the path, obtaining good results in hard academic entrepreneurship activities; and finally, the last group is composed by the most entrepreneurial universities. Moreover, universities are not motionless within a specific group, they can improve and move from one stage to the upper one; indeed, this paper shows the main levers in order to move from one stage to the other.

Keywords

Entrepreneurial university, Performance, Taxonomy, Academic Entrepreneurship activities, Cluster analysis, Entrepreneurial university results, Academic entrepreneurship, Higher education, Internal entrepreneurship support factors, External entrepreneurship support factors

1. Introduction

Over the past two decades, the European higher education landscape has been facing a period of profound changes and unprecedented challenges (Bronstein and Reihlen, 2014; Maassen, 2009; Pinheiro and Stensaker, 2013; Vukasovi et al., 2012). Therefore, the university is becoming entrepreneurial in order to meet the needs of its environment and contribute to regional and national economic development (Peterka, 2011); transforming into an entrepreneurial university (Bronstein and Reihlen, 2014; Clark, 1998; Kirby, 2006; Sporn, 2001).

The emergence of the entrepreneurial university is the result of internal development of the university and external influences on the university (Peterka, 2011). In addition, due to differences in organisational culture and leadership capacity, the process of building the entrepreneurial capacity differs from one university to the other (Peterka, 2011). Hence, not all entrepreneurial universities are equal, neither they are in the same stage within the path towards the entrepreneurial university.

Continuing in this vein, there is compelling evidence for seeking a valid and empirically justified means for classifying entrepreneurial university types (Moroz et al., 2011). Globally, it is well observed that some universities are better at commercialising research, facilitating entrepreneurial interactions with firms and/or spinning off new ventures than others (Di Gregorio and Shane, 2003; Etzkowitz, 2002; Segal, 1986). In line with this idea, classifications of the entrepreneurial university have been sorted by Armbruster (2008) into several conceptual variations that include “self-regulative universities” (Hölttä, 1995), “adaptive universities” (Sporn, 2001), “enterprise universities” (Hay et al., 2002; Marginson and Considine, 2000), and vague references to “innovative or discovery universities” (Garnsey and Heffernan, 2005; Jian, 2005). In addition, Tijssen (2006) identified three phases for university's transformation into an entrepreneurial university; in the first phase, the university becomes more aware of the potential for

commercialisation, the second phase is characterised by identifying opportunities for commercialisation, and the third phase by developing commercialisation opportunities.

Nevertheless, yet there is little research available that attempts to classify entrepreneurial university types, specifically from a performance based perspective (Moroz et al., 2011); requiring an urgent need to develop an empirically justified entrepreneurial university taxonomy. Indeed, universities are not motionless within a specific stage; they can improve and move from one stage to the upper one; and a taxonomy would help universities to identify the main levers in order to move from one stage to the other. Therefore, the main objective of this paper is to create a taxonomy of entrepreneurial universities based on “soft academic entrepreneurship activities” (onwards Soft AEA) and “hard academic entrepreneurship activities” (onwards Hard AEA) as entrepreneurial university’s results (Philpott et al., 2011), and paying special attention to the complementarity of the external environmental and the internal organisational entrepreneurship support factors (Markuerkiaga et al., 2014).

The paper is organized as follows: in Section 2 an integrative framework is built through a review of the literature on the factors fostering entrepreneurial university’s results, distinguishing between external and internal entrepreneurship support factors. In Section 3 the research design is introduced, while Section 4 presents the empirical analysis and through Section 5 the results are discussed. Finally, Section 6 shows the main conclusions, limitations and future research.

2. Factors fostering the entrepreneurial university

2.1. Entrepreneurial university’s results

Currently, there is no consensus regarding how to measure the entrepreneurial university. Indeed, from the literature review, two different currents are detected for measuring the entrepreneurial university:

- i. Authors such as Clark (1998), Sporn (2001), Etzkowitz (2004), Hindle (2010), Peterka (2011), European Commission (2012) and Mavi (2014) measured the entrepreneurial university based on the level that it achieves developing the factors that described the entrepreneurial university. In other words, they measure the factors that make up the entrepreneurial university.
- ii. The second group of authors, such as Wong et al. (2007), Guerrero and Urbano (2010), Sooreh et al. (2011), Gibb (2012) and Walshok and Shapiro (2014), describe a set of indicators for measuring the entrepreneurial university.

Focusing on the second group, three out of these five authors base the entrepreneurial university’s results on the three missions of the university: teaching, research and entrepreneurship simultaneously. In fact, they identify different indicators for measuring the teaching outcome (i.e. it is oriented to generate graduates who should become not only job-seekers but also job-creators or entrepreneurs), the research outcome (i.e. it is based on developing research talent and academic entrepreneurs, knowledge generation and knowledge transfer) and the entrepreneurship outcome (i.e. entrepreneurial infrastructure, entrepreneurial culture, and alliances, cooperation and networks).

After analysing the previous studies, a discrepancy is detected regarding the measurement method of the newest mission of the entrepreneurial university. Certainly, the literature

review shows that this third mission is related to the economic and social development (Benneworth, 2007; Cargill, 2007; Chrisman et al., 1995; Dill, 1995; Etzkowitz et al., 2000; Guenther and Wagner, 2008; Guerrero et al., 2006; Jacob et al., 2003; Meyer, 2011; Mohar and Kamal, 2007; Mohar et al., 2010; Philpott et al., 2011; Röpke, 1998; Yokoyama, 2006), which in turn is based on academic entrepreneurship activities (Etzkowitz et al., 2000; Kim, 2008; Klofsten and Jones-Evans, 2000; Philpott et al., 2011). Therefore, as academic entrepreneurship activities are the mechanisms for promoting this economic and social development, these are the most appropriate entrepreneurial university's results.

Accordingly, a literature review of academic entrepreneurship activities (i.e. Louis et al. (1989), Klofsten and Jones-Evans (2000), Ranga et al. (2003), Lazzeroni and Piccaluga (2003), Laukkanen (2003), O'Shea et al. (2004), Brennan et al. (2005), Brennan et al. (2005), Brennan and McGowan (2006), Mohar and Kamal (2007), Wong et al. (2007), Siegel et al. (2007), Kim (2008), Wright et al. (2008), Mohar et al. (2010), Philpott et al. (2011), Grimaldi et al. (2011) and Davey et al. (2011)) is made in order to identify the main entrepreneurial university's results (see Table 1).

Table 1 Main entrepreneurial university's results

2.2. Internal entrepreneurship support factors

The present section describes the eight internal entrepreneurship support factors that are included in the study: mission & strategy, management support, policies, support through whole entrepreneurship process, funds for entrepreneurship, entrepreneurship education, staff development in entrepreneurship and active teaching methodologies.

2.2.1. Mission & Strategy

Mission and strategy represents university's overall strategic philosophy or orientation concerning the likely trade-offs between market share growth and short term profits (Covin and Slevin, 1991). Clark (1998) state that one of the key elements of the entrepreneurial university is pursuing a clearly defined strategy. This includes that any university mission statement and published strategies should embrace the word "enterprise" or "entrepreneurship" (Etzkowitz, 2004; Gibb, 2012; Kirby, 2006); thus, the notion of "enterprise" or "entrepreneurship" is accepted as part of the "sense" of the university and each of its employees share a common vision for the creation of an entrepreneurial university (Peterka, 2011).

2.2.2. Management Support

The increase of entrepreneurial university's results imply a review and/or reinforcement of some organisational level factors, such as institutional strategies, market oriented institutional policy, links with the industrial sector, strong leadership of the top management team, among others (Yokoyama, 2006).

In fact, organisational behaviours and performances are a reflection of the traits of the members of the top management team, which influence university strategy, through the impact on group decision making processes (Gibb, 2012; Miller and Katz, 2004; Visintin and Pittino, 2010). Furthermore, according to Todorovic et al. (2005) the nature and strength of leadership in supporting an entrepreneurial culture in the university is essential, empowering the strength, compactness and credibility of the management team

(Ackroyd and Ackroyd, 1999; Bleiklie and Kogan, 2007; Gibb, 2012). Thus, the understanding of, and support from, the management team for the entrepreneurship concept is necessary for an entrepreneurial university (Gibb, 2012).

2.2.3. Organisational Design

An university's organisation can be designed to constrain entrepreneurial behaviour or to facilitate it (Gibb and Hannon, 2005). Based on this affirmation, Gibb (2012) identified some key factors related to the organisational design of a university which foster the entrepreneurial behaviour within it, such as the levels of decentralisation of decision making and the responsibility for strategies as well as operations, the associated flexibility in integrating strategies and action and the degree to which individuals, bottom-up, are empowered to innovate, among others. Indeed, all these characteristics lessen the traditional pyramid structure, facilitates the flow of information to all parts of the organisation and reduces response time to external and internal demands (Orlikowski, 2009); transforming the traditional organisational design into a contemporary organisational design. Besides, as Bratianu and Stanciu (2010) stated, universities' institutional transformation towards the entrepreneurial university cannot be forced top-down, it can only be the result of an internal movement of those living the university reality on a daily basis.

2.2.4. Policies

Literature assesses the influence of university policies, procedures and practices on entrepreneurial university's results (O'Shea et al., 2005). According to Rothaermel et al. (2007)'s review, university policies on intellectual property strategy, networking activities and resource endowments play as key factors into the success of spin-off firms. Di Gregorio and Shane (2003) also agree with the previous statement, since they confirmed that universities which adopt certain policies (e.g. incentives for entrepreneurship activity) could generate more spin-off firms.

2.2.5. Internationalisation

Internationalisation and the entrepreneurial university are two concepts that have received considerable attention as separate and distinct phenomena; however, the interface of these two concepts has seen limited analysis, despite the fact that there is much to suggest important synergies between them (Larionova, 2012).

An entrepreneurial university views internationalisation as a key tool, and is able to plan and strategically manage its internationalisation, effectively assessing the environment and its own strengths and weaknesses. Specifically, the internationalisation of higher education is a key part of the scenario in the entrepreneurial university (Gibb, 2012). Indeed, the recognition of the value of mobility (beyond the local level to the international plane) of students, academics and industrial collaborators in developing and enhancing entrepreneurial universities is essential (Allinson et al., 2012; Gibb, 2012).

2.2.6. Support through whole entrepreneurship process

The academic entrepreneurship process is essential for an entrepreneurial university, however little attention is directed to the nature of this process (Prodan and Drnovsek, 2010). Academic entrepreneurship is not a single event, but rather a continuous process comprised of a series of events (Friedman and Silberman, 2003). As a deeper

understanding of academic entrepreneurship may be achieved through the development of a multi-stage process model that identifies the key actors, activities, potential stakeholders and key success drivers associated with each stage of the innovation commercialization process (Salamzadeh et al., 2011; Wood, 2011).

2.2.7. Funds for Entrepreneurship

Another mechanism that has received much attention is the creation of university venture funds, fully or partly funded with university resources (Grimaldi et al., 2011). These are meant to provide seed funds for new firms, because it is the major source of funds for new firms in fields in which universities are a major source of new technology.

In fact, according to Fini et al. (2009) university venture funds that generally act at the seed spin-off stages should promote the spin-off firm formation. In contrast, Di Gregorio and Shane (2003) through their study showed that university venture capital funds have an insignificant effect on academic spin-off rates. This could be due to the adequate ties that the university entrepreneurs develop with external venture investors.

2.2.8. Entrepreneurship Education

In the European Union countries, governmental interest in entrepreneurship education began to be explicit in the Lisbon European Council (Lanero et al., 2011). Indeed, in March 2000, the objective of developing a dynamic enterprising culture and fostering spin-off firm formation as source of sustainable competitiveness in Europe was set (Rey, 2001). Thus, entrepreneurship education is defined as developing specific attitudes, behaviours and abilities on an individual level, which can have different expressions in an individual's career and also creating long term benefits for the society and economy (Bratianu and Stanciu, 2010).

Since then, entrepreneurship education is becoming an important entrepreneurship support factor, due to its potential for promoting the entrepreneurial innovative culture by changing values and basic conceptions (Bratianu and Stanciu, 2010). In addition, experts indicate that entrepreneurship is teachable (Kuratko, 2005; van der Heide and van der Sijde, 2008), integrative (Hindle, 2007) and needed on all levels of education (Gibb, 2006). Besides, entrepreneurship education is essential not only to shape the mindsets of young people but also to provide the skills and knowledge that are central to develop an entrepreneurial culture (Bourgeois, 2011).

2.2.9. Staff Development in Entrepreneurship

Despite the rapid growth of interest in entrepreneurship education, there is still a lack of critical mass of entrepreneurship educators in schools and universities across the world; the current pool of entrepreneurship teachers should be expanded (Volkman et al., 2009). Growing the base of experienced educators not only means providing the necessary training and education, but also requires expanding the definition of educators beyond professors to include entrepreneurs, alumni, business professionals and even students. Thereby, entrepreneurs and others with entrepreneurial experience should be allowed, encouraged and trained to teach (Wilson, 2008).

Reinforcing the previous idea, Hindle (2001) state that academics who teach entrepreneurship must have a combination of practical and academic skills. Too often, academics from other fields of business management are recruited to coordinate and work

on entrepreneurial education, instead of recruit scholars that have been trained specifically or by academics who have researched and practiced entrepreneurship (Moroz et al., 2010).

2.2.10. Active Teaching Methodologies

Traditionally, schools and universities were focused on ensuring that students can achieve a secure future employment. Nowadays, however, any education system must prepare students to work in a dynamic, rapidly changing entrepreneurial and global environment (Volkman et al., 2009); developing students' skills, attributes and behaviour to improve both creative and critical thinking (Guerrero and Urbano, 2010). This new scenario requires a complete paradigm change for academia, changing the fundamentals of how schools and universities operate and how they teach; investing in research and new pedagogies (Moroz et al., 2010).

Regarding new teaching methodologies, active learning methods are a good example. Active learning methods require engaging students' feelings and emotions in the learning process and developing the creativity, innovation and critical thinking skills of individuals. Educators therefore must be able to create an open environment of trust in which students develop the necessary confidence to take risks by learning from trial experiences with both successes and failures (Volkman et al., 2009). In addition, this pedagogy should be interactive, encouraging students to experiment and experience entrepreneurship through working on case studies, games, projects, simulations, real-life actions, internships with start-ups and more activities which involve interaction with entrepreneurs. Moreover, active and learning-by-doing methods integrate elements of practice into the learning process.

2.3. External entrepreneurship support factors

The external environment is identified as a component of the proposed model because of its seminal role in entrepreneurship theory and research (Covin and Slevin, 1991). The concept of external environment is intended to include those forces and elements external to universities' boundaries that affect the organisation. However, there are few studies that have looked at how specific environments may influence entrepreneurship (Rasmussen et al., 2012).

For the present study, the external entrepreneurship support factors are related to several basic dimensions of universities' external environment. These dimensions include institutional and industrial context. Besides, as in the previous two sections, the entrepreneurial universities are geographically dependent (Bratianu and Stanciu, 2010) and universities developed differently in different countries. Furthermore, the external environment itself is completely different from one country to another. Thus, this leads to propose the following:

2.3.1. Institutional context

Universities nowadays are operating within an Innovation System, interacting with firms and governmental institutions in order to become an entrepreneurial university (Etzkowitz, 2004). Dealing with this issue, there are consistent studies which suggest that university entrepreneurship policies, along with government commitment, were the

leading drivers affecting a university's innovation performance where University – Industry – Government linkages are involved (Hu, 2009).

One of the most important milestones for this progress was the Bayh-Dole-Act, which provided a mechanism by which the intellectual property generated under federal research grants could become universities' property. The core logic behind transferring these rights was that it would facilitate the dissemination of knowledge by allowing universities to transfer intellectual property quickly to the larger community (Wood, 2011). Besides, at early 1990s, structural changes in the external environment of European universities (e.g. legislative changes) pushed them to a more proactive role in technology transfer (Baldini et al., 2007; Fini et al., 2009).

Another diffused form of government intervention is the provision of financial incentive; both for entrepreneurship education (in order to foster the establishment of new ventures and the knowledge and technology transfer from university to market) (Guenther and Wagner, 2008) and for spin-off firm formation (Fini et al., 2009). Governments could play a vital role in creating funding mechanisms for programs, activities and initiatives associated with entrepreneurial education (Volkmann et al., 2009).

2.3.2. Industrial context

A supportive local-context seems to be really necessary for the path towards the entrepreneurial university. The local context in which a new venture decides to operate may be seen as a set of skills and resources that are both tangible (e.g. physical infrastructure, corporate physical assets, R&D laboratories, etc.) and intangible (e.g. human capital, routines, etc.), thus the external factors related to an entrepreneurial university are important for its promotion. However, there are few studies which have looked at how specific environments may influence entrepreneurship (Rasmussen et al., 2012).

Besides, mention that, arising from the agglomeration of companies in the same territory appears the so-called “role model” or “contagion effect” (Shane, 2004). A role model is a common reference to individuals who set examples to be emulated by others and who may stimulate or inspire other individuals to make certain decisions and achieve certain goals (Bosma et al., 2012); which also could occur at the institutional level.

Finally, the industrial composition of a specific territory could determine significant business opportunities. The availability of companies operating in the same or related sectors promotes the natural exchange of ideas through formal and informal networks. This closer interaction between companies helps to create a social environment that supports and encourages individuals to share knowledge and ideas (Fini et al., 2009). From the point of view of the university, it is really favourable to do research on the same industrial sector of its most nearby companies.

3. Methodology

3.1. Unit of analysis

The unit of analysis is the major entity that the researcher is analysing in his/her study. It is the “what” or “who” that is being studied. Units of analysis are essentially the things

that the researcher examines in order to create summary descriptions of them and explain differences among them.

Relating to entrepreneurial universities literature and the usual units of analysis, Brennan and McGowan (2006) identified the following five levels of analysis:

- Individual: an academic recognised by the university as an entrepreneur.
- Community of practice: an informal social network.
- The academic school: the most basic unit of academic staff for the purpose of university administration.
- University: a grouping of academic schools coordinated through a central faculty structure.
- The entrepreneurship system: the individual and corporate actors who interact in a recognisable context to form the infrastructure for entrepreneurship.

Based on this classification and in order to achieve the main objective of the research, the unit of analyses is the institution, in this case the university. For understanding the effect that certain institutional-level factors could have over the results, the analysis is made also at the institutional-level (Wright et al., 2009). Therefore, the university is the unit of analysis of the present research and the TTO Director the person to interact.

3.2. Research instrument

Given the nature of the research objectives, the quantitative approach was followed using the survey as the research strategy; due to the association of this research strategy with the deductive method (Lewis et al., 2009). The deductive method was usually used in business and management studies, since it allowed collecting a large amount of data from a population sample where data were obtained through a questionnaire. Therefore a questionnaire was constructed to collect data directly from universities involved within the entrepreneurial university path.

In order to encourage people to read and answer the questionnaire, the layout of the questionnaire was taken into consideration. It was configured a set of questions about the variables to be measured, grouped into related blocks, considering the easiest way for the respondent for concept association. Besides, this questionnaire consisted of closed questions, dichotomous (true/false) and polytomous (a five-point Likert scale, with five being the most important and one the less important rating); and was taken into account the profile of the person who should answer it, in this case the TTO Directors.

Once the questionnaire was finished, it was subject to translation and pretesting. In international research, translation is extremely important, especially if the questions are to have the identical meaning to all participants (Saunders et al., 2011). Back translation is the most commonly used method in multi-country research. Indeed, this technique was applied through the present research; developing the first version of the questionnaire in English, then translating it into Spanish and finally, translating it again into English.

The next step was the pre-testing, the administration of the questionnaire to a small but representative sample of potential respondents under conditions that were identical in all respects to those under which the final questionnaire was administered (Chapman and Singh, 2011). This pre-testing was done by getting the initial response and a subsequent interview with 6 experts from different positions and profiles, such as deans, TTO Directors, academic coordinators and entrepreneurship teachers, in order to identify areas where the questionnaire could needed corrections (Fatoki and Asah, 2011). This decision

was made since there are some questions regarding specific topics (e.g. entrepreneurship education or teaching methodologies) that could be better formulated by experts on the topic. In consequence, various suggestions were incorporated to make the final questionnaire for the study.

3.3. Sampling design, selection and size

Antonius (2002) describes the sampling design as the procedure for selecting a sample that specifies the type of sample to be used, the number of units to be selected in the sample as a whole and the method for choosing the units.

Furthermore, Saunders et al. (2011) state that sampling techniques provided a range of methods that enabled a researcher to reduce the amount of data needed to be collected by considering data from the elements in the population frame. Indeed, according to Saunders et al. (2011), sampling techniques that are available could be divided into two types namely probability (or representative sampling) and non-probability (or judgmental sampling). Probability sampling is based on the concept of random selection thereby affording the sample a random and equal chance of being selected. Non probability sampling, however, draws its sample arbitrarily thereby depriving the sample from a random selection.

This study is concerned with the precision of the element selection and therefore adopts the probability sampling as its representation basis. The reason for doing so is because probability sampling methods require the use of sampling frames and statistical analysis which can be done to estimate population parameters from sample statistics. They also allow for tests of significance to be done on the results.

Once the unit of analysis and the sampling design are established, the selection of a fraction of the total number of units of interest is made (Limpanitgul and Robson, 2009), since it is uncommon for a research to survey the entire population due to time and financial constraints, specially, when the population is very large.

The sample frame is drawn from the total number of European universities. A sample frame is a complete list in which each of the unit of analysis is mentioned only once. In fact, the sample size is chosen correctly by ensuring that is large enough, representative and randomly selected to allow a generalisation of the results of the population as a whole. As it is explained in previous paragraphs, the sampling is composed by European universities that are promoting entrepreneurship within their institutions and therefore, due to the novelty of this subject, they are participating in international conferences in order to disseminate their learning and best practices. Thereby, the universities and their respective respondents are selected due to their participation in international conferences related to entrepreneurial universities and entrepreneurial education (such as FINPIN Conference, UIIN Conference, BCERC Conference, ECSB Entrepreneurship Education Conference and Global Entrepreneurship Monitor - GEM). In total, 361 European universities were contacted.

3.4. Data collection procedure

Online data collection methods have become increasingly attractive to researchers (Asaad, 2011), thanks to its several advantages: (i) unrestricted compass: wide geographical coverage, (ii) low cost of sending out e-mails and faster responses, (iii)

higher response rates over postal surveys and (iv) convenience for the respondent. The present research used a self-administered e-mail questionnaire to collect data for the survey from TTO Directors of the targeted universities. E-mail surveys are a practical, cost-free and suitable data collection method as this study involves a probable wide geographical dispersion of respondents.

Regarding the present research, the process of collecting questionnaires online lasted five months, with a monthly reminder during the first three months. In fact, out of the 361 surveys mailed sixty-nine were returned (19,11%).

3.5. Measures and descriptive statistics

After data was collection, the data analysing and interpreting stage started (Robson, 1993). For the correct development of the research, a quantitative research methodology is established. Thus, in the present section the data analysis techniques used are explained.

Prior to assessing the measurement scales, validity and reliability of the instrument are explored; incorporating an exploratory factors analysis in order to improve the validity and reliability (Cronbach's alpha) (Parsian, 2009). Indeed, the analysis shows that the validity and reliability of the instrument is accepted. Besides, Skewness and Kurtosis are tested for normal data distribution. All the values of Kurtosis and Skewness statistics are within the conventional range of $\pm 1,96$ (Ghasemi and Zahediasl, 2012); thus, all manifest variables are reasonably normally distributed. Then, descriptive statistics are conducted with the assistance of SPSS Version 20.0 for Windows (Statistical Package for Social Science), developed by the University of Chicago and one of the most widespread. In order to reveal the central tendency and dispersions of the variables, the mean and the standard deviation are initially calculated.

Regarding the variables that composed the research, every variable of the study is constructed based on a 5-point Likert scale; in order to simplify the statistical analysis (see Table 2).

Table 2 Measurement scales

In Table 3 the main characteristics of the sample universities are shown. In fact, there is shown that almost all surveyed universities are public (81%) and possess an engineering faculty (87%); besides, a high percentage is engaged with an entrepreneurship centre (55%), an incubator (43%) and/or a technology park (45%).

Table 3 Sample universities characteristics

In addition, Table 4 shows the external and internal entrepreneurship support factors and the entrepreneurial universities results put in place by the fifty-nine European universities.

Table 4 Descriptive statistics of all sample universities

3.6. Cluster analysis

Cluster analysis is used to explore the evolution patterns of European entrepreneurial universities, based on both soft and hard academic entrepreneurship activities. Indeed, information dissemination, networking, industry mobility, consulting, contract research, patent and license, and spin-off firm formation were the clustering variables.

The primary purpose of cluster analysis is to group objects based on the characteristics they possess (Hair et al., 2009; Ketchen and Shook, 1996). Cluster analysis is a useful tool for data reduction. Data reduction can be achieved by objectively reducing the information from an entire population to the information about specific smaller subgroups (Romesburg, 2004).

In addition, cluster analysis encompasses a number of different classification algorithms, which can be classified into two broad families: hierarchical and non-hierarchical clustering. Ketchen and Shook (1996) suggest using both procedures as complements to each other: first a hierarchical procedure can be used as an exploratory methodology to determine the desired number of clusters and as input to the non-hierarchical step. Following in this line, diverse research projects on academic entrepreneurship (e.g. Clarysse et al. (2005); Heirman et al. (2003)) use this double approach for the statistical analysis; therefore, for the present research the same analysis was used.

Hierarchical method (Ward method): The first step in the cluster analysis is the application of a hierarchical cluster analysis in SPSS to find the agglomerative schedule and proximity matrix for the data obtained on each of the variables (entrepreneurial university's results) for all the cases. After doing so, the SPSS output provided a proximity matrix which showed the distances (similarity) between all the cases/objects and agglomerative schedule which was used to find the number of clusters present in the data on the basis of fusion coefficients. Furthermore, a dendrogram was obtained (see **¡Error! No se encuentra el origen de la referencia.**).

Figure 1 Dendrogram using the Ward method

The horizontal axis of the dendrogram represented the distance or dissimilarity between clusters and the vertical axis represented the objects and clusters. Each joining of two clusters was represented on the graph by the splitting of a horizontal line into two horizontal lines. The horizontal position of the split, shown by the short vertical bar, gave the distance (dissimilarity) between the two clusters. Looking at the previous dendrogram (**¡Error! No se encuentra el origen de la referencia.**), the three clusters or branches that occur at about the same horizontal distance are shown; therefore the most appropriate number for clustering the sample is three.

Non-hierarchical method (k-means method): The second step in the cluster analysis is the application of the *k*-means cluster analysis in SPSS. The process was not stopped with the Ward method because of the fact that *k*-means analysis provided much stable clusters due to interactive procedure involved in it, in comparison to the single-pass hierarchical methods. Then, the case listing of cluster membership was used to describe which case belonged to which cluster. Finally, the ANOVA table described which of the variables were significantly different across all the identified clusters in the problem.

As a result, the sixty-nine universities are clustered, regarding entrepreneurial university's results, into three different groups: Cluster 1 composed by fourteen universities (high values in Soft AEA and on the mean in Hard AEA), Cluster 2 composed by ten universities (low values in all entrepreneurial university's results) and Cluster 3 composed by forty-five universities (on the mean in all entrepreneurial university's results) (see Figure 2).

Figure 2 Entrepreneurial university's results of the three clusters

Afterwards, an ANOVA analysis was developed in order to confirm the difference between the three clusters regarding entrepreneurial university's results. Thus, through a comparison of means (see Table 5) the rejection of the null hypothesis of equal means is shown.

Table 5 ANOVA analysis of entrepreneurial university's results for the three clusters

Once the differences between groups' means are demonstrated, the means of the entrepreneurial university's results for each cluster are analysed. Cluster 2 obtains the worst values on all entrepreneurial university's results, except for PR_RESEARCH, variable that is in the same level of Cluster 3. Regarding Cluster 1, these are the universities that obtain the highest values on Soft AEA and are in the same level of Cluster 3 regarding Hard AEA. Finally, Cluster 3 is on the mean on all entrepreneurial university's results.

Based on these three clusters it was interesting to analyse their differences regarding external and internal entrepreneurship support factors in order to identify the main mechanisms that leading universities had for entrepreneurial university's results promotion. To achieve this objective, an ANOVA was performed for both groups (see Table 6 and Table 7); which shown all p-values under the threshold 0,005, falling to reject the null hypothesis.

Table 6 ANOVA analysis of external entrepreneurship support factors for the three clusters

Table 7 ANOVA analysis of internal entrepreneurship support factors for the three clusters

Once the differences between groups' means were demonstrated, the means of the external and internal entrepreneurship support factors for each cluster were analysed (see Figure 3). As it is shown in the figure below, Cluster 2 obtained the worst values on all external and internal entrepreneurship support factors which agreed with the results on entrepreneurial university's results, considering that this group of universities had the lower values on entrepreneurial university's results. Regarding Cluster 1, the best universities as to Soft AEA, obtained the highest results on all external entrepreneurship support factors and the highest results on almost all internal entrepreneurship support factors, except for E_CURRI_ACTIVITIES & E_STAFF. Finally, Cluster 3 showed better results on E_CURRI_ACTIVITIES & E_STAFF than Cluster 1 although their results on Soft AEA were worst.

Figure 3 Entrepreneurship support mechanisms level of the three clusters

4. Results

In order to develop a universities' taxonomy depending on entrepreneurial university's results, the combination of two statistical techniques for clustering (specifically, the hierarchical and the non-hierarchical processes) was used. The sixty-nine universities were clustered, regarding entrepreneurial university's results, into three different groups: Cluster 1 composed by fourteen universities, Cluster 2 composed by ten universities and Cluster 3 composed by forty-five universities. Afterwards, an ANOVA analysis was developed in order to confirm the difference between the three clusters regarding the entrepreneurial university's results and both external and internal entrepreneurship support factors. In the following lines there are further details regarding the three clusters.

4.1. Advanced Entrepreneurial Universities (Cluster 1)

Universities from Cluster 1 (composed by fourteen universities) are the ones which obtained the best entrepreneurial university's results; therefore they are the Advanced Entrepreneurial Universities. Indeed, these universities stand out for their exceptional results on I_TRAINING, CONSULTING and PR_RESEARCH. These three results suggest a higher university business collaboration, since the three are directly related to knowledge transfer between the two organisations. This fact could be due to the high support they have from industry (i.e. high values on INDUS_CONTEXT). Besides, regarding internal organisational factors, the universities from this first cluster also obtain high values as to their organisational design, since they have a contemporary organisational design which promotes the decentralisation of decision making and empowered their employees to innovate (through a bottom-up flow). This fact could also reinforce the promotion of I_TRAINING, CONSULTING and PR_RESEARCH, seeing that the decentralisation of decision making push academic and researcher into knowledge transfer activities. Continuing with the entrepreneurial university's results, although universities from this cluster also obtained good results in INFO_DISSEMINATION, NETWORKING and IND_MOBILITY, they are not too far from Cluster 3. Furthermore, regarding PATENT_LICENSES, SSO and ASO (or Hard AEA), these universities are in the same level as Cluster 3. Moving on to the entrepreneurship support mechanisms, these universities obtained high values on almost all entrepreneurship support mechanisms except on E_CURRI_ACTIVITIES and E_STAFF. This fact reiterates previous results, ratifying that the support of E_CURRI_ACTIVITIES and E_STAFF is unnecessary for improving on soft entrepreneurial university's results if there is a supportive industrial context (INDUS_CONTEXT).

4.2. Emerging Entrepreneurial Universities (Cluster 2)

Universities from Cluster 2 (composed by ten universities) are the ones that obtained the worst values on all entrepreneurial university's results, except for PR_RESEARCH, result that was in the same level of Cluster 3. Furthermore, these universities have neither a supportive external environment nor a supportive internal organisation; since all the values obtained within these factors are really low. These facts could be because these universities are still at the beginning of the entrepreneurial universities' path; therefore, they could be labelled as Emerging Entrepreneurial Universities.

4.3. En route Entrepreneurial Universities (Cluster 3)

Universities from Cluster 3 (composed by forty-five universities) are the ones that obtain average scores on almost all entrepreneurial university's results, except on PATENT_LICENSES, SSO and ASO; which are on the same level as Cluster 1. Thus, universities from this cluster are good on Hard AEA development and the group could be labelled as En route Entrepreneurial Universities. Furthermore, it should be highlighted that this group of universities obtained the worst values on PR_RESEARCH; fact that could be related to the high level of Hard AEA, since fostering direct mechanisms of knowledge transfer could reduce PR_RESEARCH. Besides, another reason for the low values on PR_RESEARCH could be the low INDUS_CONTEXT that this group of universities have. In this vein, another characteristic of these universities is the low presence on INDUS_CURRI, which could be also due to the low INDUS_CONTEXT.

Regarding the internal entrepreneurship support factors, E_CURRI_ACTIVITIES and E_STAFF stand out because of their high values; which could be directly related with the good values on Hard AEA.

5. Discussion

From this taxonomy, it is clearly showed that these universities are in different stages within the path of the entrepreneurial university. There is a first stage (the Emerging Entrepreneurial University) where universities are not inside a supportive external environment and internally they are still backward regarding the internal entrepreneurship support factors. Therefore, they are not obtaining high entrepreneurial university's results yet. In the second stage (the En route Entrepreneurial University), universities start promoting entrepreneurship (through E_CURRI_ACTIVITIES and E_STAFF) within its collective and although they do not have a really supportive INDUS_CONTEXT, they are obtaining good results in Hard AEA. And finally, the third stage (the Advanced Entrepreneurial University) is composed by the most entrepreneurial universities, which thanks to a supportive INDUS_CONTEXT obtain really good values on Soft AEA; maintaining the same level as the second stage on Hard AEA. Besides, this cluster promotes less E_CURRI_ACTIVITIES and E_STAFF and obtains the same results on Hard AEA as Emerging Entrepreneurial Universities, reinforcing the importance that a supportive industrial context has.

In addition, the cluster analysis showed that not all universities are in the same level regarding entrepreneurial university's results. The analysis clearly proved that universities are in different stages within the entrepreneurial university path; indeed, they could be classified into three stages:

- First stage, the Emerging Entrepreneurial Universities: Universities from this stage are not inside a supportive external environment and internally are still backward regarding the internal entrepreneurship support factors. Therefore, they are not obtaining high entrepreneurial university's results.
- Second stage, the En route Entrepreneurial Universities: These universities start promoting entrepreneurship and obtaining good results on Hard AEA through two main activities: on the one hand, providing support within the whole entrepreneurship process and on the other hand, training its staff on entrepreneurship. Besides, these universities do not have a really supportive industrial context.
- Third stage, the Advanced Entrepreneurial Universities: Universities from this stage, thanks to a supportive industrial context obtain really good values on Soft AEA; maintaining the same level as the second stage on Hard AEA. Moreover, these universities promote less internal entrepreneurship support factors, concretely the support within the whole entrepreneurship process and the training in entrepreneurship for its staff. In fact, the core factor for staying in this stage is to have a supportive industrial context.

Continuing in this vein, universities are not motionless within a specific stage; they can improve and move from one stage to the upper one. In fact, an entrepreneurial university has to work on specific factors depending on its objective. If the university wants to

improve on Hard AEA it has to provide support within the whole entrepreneurship process and promote its internationalisation activity, and do not care about industries' presence on curriculum development and delivery. Therefore, with respect to the promotion of these two internal entrepreneurship support factors, universities should implement the following activities:

- Regarding university's support within the whole entrepreneurship process, academic entrepreneurship is not a single event, it is a multi-stage process model that identifies the key actors, activities, potential stakeholders and key success drivers associated with each stage of the innovation commercialisation process (Salamzadeh et al., 2011; Wood, 2011). Therefore, the university should provide supportive activities within each phase of the entrepreneurship process; such as: talks with entrepreneurs in order to make aware of the entrepreneurship importance, innovation and creativity workshops in order to generate new possible business ideas, business model and business plan courses in order to become this business ideas into business project and finally, courses on new business venture launching.
- Internationalisation is a key tool for an entrepreneurial university, since mobility (beyond the local level to the international plane) of students, academics and industrial collaborators in developing and enhancing entrepreneurial universities is essential (Bramwell et al., 2012; Gibb, 2012). Therefore universities have to increase their international activities and collaborations.

On the contrary, if university's objective is to increase Soft AEA, it has to work on promoting industries' presence on curriculum development and delivery and developing policies and laws regarding entrepreneurial issues. Besides, they do not have to make any effort on training its staff in entrepreneurship. In this vein, so as to boost these two entrepreneurship support mechanisms universities should work on the following activities:

- The industry presence in curriculum D&D is the process of creating a learning environment and the development of human resources relevant to modern society. In fact, universities have to include the following mechanisms: university business collaboration in the development of a fixed programme of courses, modules, planned experiences as well as guest lectures by delegates from private and public organisations within undergraduate, graduate, PhD programmes or through further professional education (Davey et al., 2011).
- Regarding policies on both UBC (between universities and enterprises) and entrepreneurship (between the university and the researcher/ worker/ student), universities should develop some policies in order to establish a working framework. On the one hand, regarding UBC policies, universities should clarify students' internships, knowledge transfer activities and the promotion of R&D, among other activities. And on the other hand, regarding entrepreneurship universities should establish the distribution of royalty rates between inventors and the university, since it could influence the propensity of entrepreneurs to found firms to exploit university inventions, the university's choice to take an equity stake in the spin-off firm in exchange for paying patenting, marketing, or other up-front costs and the use of internal venture capital funds has to be regulated.

6. Conclusions, limitation sand future research

As the cluster analysis showed, not all universities are in the same level regarding entrepreneurial university's results. The analysis clearly showed that universities are in different stages within the entrepreneurial university path; indeed, they could be classified into three stages.

In addition, universities are not motionless within a specific stage; they can improve and move from one stage to the upper one; and the performance-based taxonomy of entrepreneurial universities showed within this paper would help universities to identify the main levers in order to move from one stage to the other.

However, the study also presents some limitations. Firstly, the sample size used, which do not allow a more rigorous statistical analysis. Indeed, sixty-nine European universities answered the whole questionnaire out of the 361 surveys mailed. Likewise, the results' generalizability is unreal; since, although normality was achieved for all variables, the sample was not significant enough to extrapolate the results to the whole population. This makes that the findings of the previous section were applicable only to the sample tested. Secondly, another limitation dealt with the measures used in the research; since data was gathered throughout scales getting TTO Directors' self-perceptions on her/his university, and therefore these variables have a degree of subjectivity.

An interesting extension of the paper would be the analysis of more European universities, in order to increase the size and the homogeneity of the sample; and then, analyse the real differences between universities from different countries; since there are specific cultural, political... determinants that may affect the results. In this vein, and in order to get a global vision of the entrepreneurial university, it could be interesting to survey different people within the university. Indeed, they could be classified into two groups: on the one hand, the management team, the TTO Director, etc. and on the other hand, the researchers, professors, etc. This large number of questionnaires could allow developing more complex models that include latent (unobserved) variables, formative variables, chains of effects (mediation), and multiple group comparisons (e.g. multilevel analysis) of these more complex relationships.

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Table 8 Main entrepreneurial university's results

<i>Entrepreneurial university's results</i>	<i>Description</i>
Academic spin-off firm formation	Academic spin-offs are new companies that evolve out from universities as a result of the process of technology transfer from research to commercialization of new products or services (Iacobucci et al., 2011).
Student spin-off firm formation	Student spin-offs are usually launched to exploit a business opportunity that is rarely grounded on extensive research activities (Pirnay et al., 2003).
Patenting and Licensing	The securing of intellectual property rights on discoveries and know-how developed within the university (Philpott et al., 2011).
Collaborative research	A collaborative research agreement involves multiple partners, often a mixture of private and public sector actors, working together on a particular research project. Each partner contribute an amount of money, skilled talent, and technology to a central pot that they then harness to conduct research (Gold et al., 2007).
Industry Training Courses	Teaching students from industry, including executive education (Philpott et al., 2011).
Consulting	Directly selling academic expertise to external organizations to solve practical problems (Philpott et al., 2011).
Industry mobility	Mobility of students, academics and industrial collaborators between university and industry (Davey et al., 2011; Gibb, 2012).
Networking	Interpersonal contacts, learning through experience or imitation, face to face exchanges, personnel mobility (Lazzeroni and Piccaluga, 2003).
Information dissemination	Publishing books, chapters and articles and developing doctoral dissertations in collaboration with industry (Philpott et al., 2011).

Table 9 Measurement scales

First ord.	Second ord.	Abbreviation	N° Items	Scale type
External Entrepreneurship Support factors	Institutional Context	INST_CONTEXT	5	5-point Likert
	Industrial Context	INDUS_CONTEXT	4	5-point Likert
Internal Entrepreneurship Support factors	Mission & Strategy	STRATEGY	4	5-point Likert
	Management Support	MANAG_SUPPORT	4	5-point Likert
	Organisational Design	ORGANI_DESIGN	4	5-point Likert
	Policies	POLICIES	3	5-point Likert
	Industry in curriculum D&D	INDUS_CURRI	5	5-point Likert
	Support through whole entrepreneurship process	E_CURRI_ACTIVITIES	4	5-point Likert
	Internationalisation	INTERNATIONALISATION	4	5-point Likert
	Funds for Entrepreneurship	E_FUNDS	6	5-point Likert
	Entrepreneurship Education	E_EDUCATION	3	5-point Likert
	Staff Development in Entrepreneurship	E_STAFF	3	5-point Likert
Active Teaching Methodologies	METHODS	3	5-point Likert	
Entrepreneurial university's results	Information Dissemination	INFO_DISSEMINATION	3	5-point Likert
	Networking	NETWORKING	3	5-point Likert
	Mobility with Industry	IND_MOBILITY	4	5-point Likert
	Consulting	CONSULTING	1	5-point Likert
	Industry Training Courses	I_TRAINING	1	5-point Likert
	Collaborative research	PR_RESEARCH	3	5-point Likert
	Patents & Licenses	PATENT_LICENSE	3	5-point Likert
	Students Spin-offs	ASO	4	5-point Likert
	Academics Spin-offs	SSO	5	5-point Likert

Table 10 Sample universities characteristics

	<i>Public</i>	<i>Private</i>
OWNERSHIP STATUS [%]	81	19
	<i>Yes</i>	<i>No</i>
ENTREPRENEURSHIP CENTER [%]	55	14
INCUBATOR [%]	43	26
TECHNOLOGY PARK [%]	45	24
ENGINEERING FACULTY [%]	87	13

Table 11 Descriptive statistics of all sample universities

	<i>N</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Mean</i>	<i>Std. Deviation</i>
INST_CONTEXT	69	1,50	4,80	3,1072	,73491
INDUS_CONTEXT	69	1,40	4,80	3,0797	,78151
STRATEGY	69	1,30	5,00	3,3826	,88649
MANAG_SUPPORT	69	1,00	5,00	3,1883	,79326
ORGANI_DESIGN	69	1,00	4,75	3,0430	,75977
POLICIES	69	1,00	5,00	3,4616	,96867
INDUS_CURRI	69	1,40	4,80	2,9968	,75443
E_CURRI_ACTIVITIES	69	1,00	5,00	3,3387	,92678
INTERNATIONALISATION	69	1,25	5,00	3,2843	,83722
E_FUNDS	69	1,00	5,00	2,4254	,89540
E_EDUCATION	69	1,00	5,00	3,0149	,90754
E_STAFF	69	1,00	5,00	2,4248	1,00179
METHODS	69	1,00	5,00	3,0361	,82034
INFO_DISSEMINATION	69	1,00	4,33	2,8761	,62047
NETWORKING	69	1,33	4,33	3,2532	,62159
I_TRAINING	69	1,00	5,00	3,0435	,86492
IND_MOBILITY	69	1,00	4,33	2,5343	,62410
CONSULTING	69	1,00	5,00	3,2319	,80704
PR_RESEARCH	69	1,67	5,00	3,0530	,72748
PATENT_LICENSE	69	1,00	4,00	2,5707	,59232
ASO	69	1,40	4,20	2,5478	,56532
SSO	69	1,25	4,25	2,7283	,61198

Table 12 ANOVA analysis of entrepreneurial university's results for the three clusters

		<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
INFO_DISSEMINATION	Between Groups	10,525	2	5,262	22,187	,000
	Within Groups	15,654	66	,237		
	Total	26,178	68			
NETWORKING	Between Groups	9,421	2	4,710	18,447	,000
	Within Groups	16,853	66	,255		
	Total	26,273	68			
I_TRAINING	Between Groups	28,063	2	14,032	40,607	,000
	Within Groups	22,806	66	,346		
	Total	50,870	68			
IND_MOBILITY	Between Groups	10,691	2	5,345	22,335	,000
	Within Groups	15,795	66	,239		
	Total	26,486	68			
CONSULTING	Between Groups	23,388	2	11,694	36,926	,000
	Within Groups	20,902	66	,317		
	Total	44,290	68			
PR_RESEARCH	Between Groups	12,263	2	6,131	17,057	,000
	Within Groups	23,725	66	,359		
	Total	35,987	68			
PATENT_LICENSE	Between Groups	11,066	2	5,533	28,547	,000
	Within Groups	12,792	66	,194		
	Total	23,857	68			
ASO	Between Groups	3,268	2	1,634	5,841	,005
	Within Groups	18,464	66	,280		
	Total	21,732	68			
SSO	Between Groups	7,547	2	3,773	13,897	,000
	Within Groups	17,921	66	,272		
	Total	25,467	68			

Table 13 ANOVA analysis of external entrepreneurship support factors for the three clusters

		Sum of Squares	df	Mean Square	F	Sig.
INDUS_CONTEXT	Between Groups	9,388	2	4,694	11,332	,000
	Within Groups	27,338	66	,414		
	Total	36,726	68			
INST_CONTEXT	Between Groups	7,565	2	3,783	7,350	,001
	Within Groups	33,966	66	,515		
	Total	41,532	68			
STRATEGY	Between Groups	10,723	2	5,361	8,284	,001
	Within Groups	42,717	66	,647		
	Total	53,439	68			
MANAG_SUPPORT	Between Groups	10,497	2	5,249	10,727	,000
	Within Groups	32,292	66	,489		
	Total	42,790	68			
ORGANI_DESIGN	Between Groups	7,530	2	3,765	7,834	,001
	Within Groups	31,722	66	,481		
	Total	39,253	68			
POLICIES	Between Groups	23,753	2	11,876	19,570	,000
	Within Groups	40,053	66	,607		
	Total	63,806	68			
INDUS_CURRI	Between Groups	9,998	2	4,999	11,493	,000
	Within Groups	28,706	66	,435		
	Total	38,704	68			

Table 14 ANOVA analysis of external entrepreneurship support factors for the three clusters

		Sum of Squares	df	Mean Square	F	Sig.
INTERNATIONAL.	Between Groups	13,128	2	6,564	12,545	,000
	Within Groups	34,535	66	,523		
	Total	47,663	68			
E_FUNDS	Between Groups	5,213	2	2,607	3,489	,036
	Within Groups	49,305	66	,747		
	Total	54,518	68			
E_EDUCATION	Between Groups	7,058	2	3,529	4,758	,012
	Within Groups	48,950	66	,742		
	Total	56,007	68			
METHODS	Between Groups	5,848	2	2,924	4,835	,011
	Within Groups	39,913	66	,605		
	Total	45,761	68			
E_CURRI_ACTIVITIES	Between Groups	15,155	2	7,578	11,563	,000
	Within Groups	43,251	66	,655		
	Total	58,407	68			
E_STAFF	Between Groups	12,013	2	6,007	7,050	,002
	Within Groups	56,230	66	,852		
	Total	68,243	68			

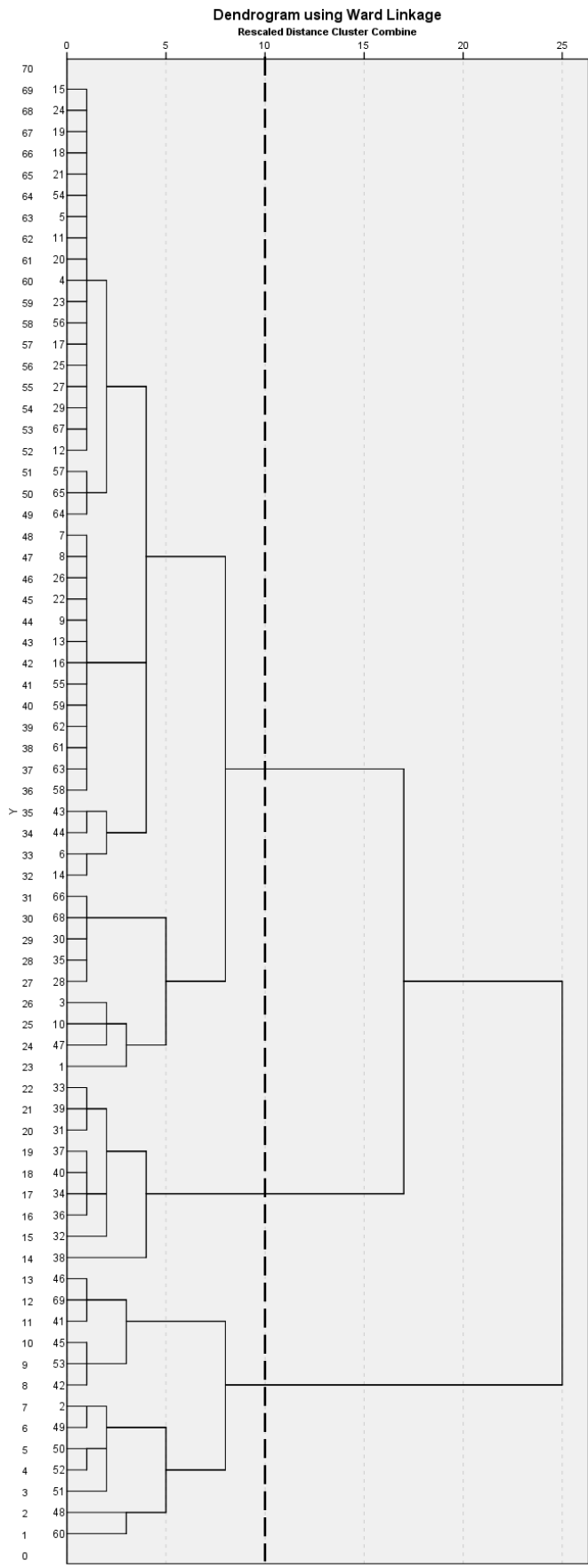


Figure 4 Dendrogram using the Ward method

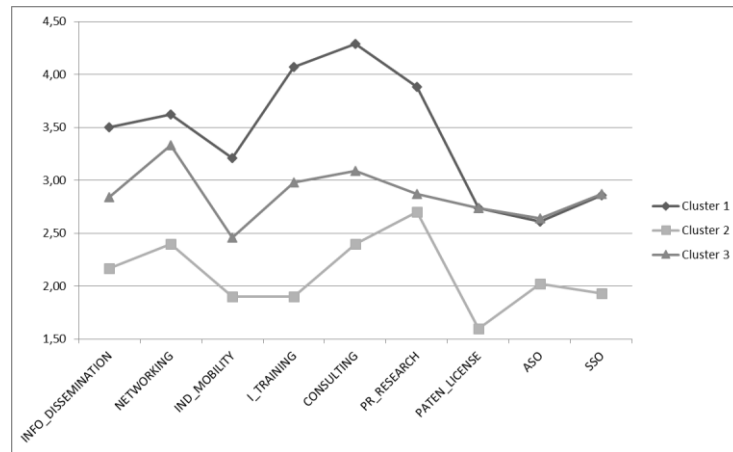


Figure 5 Entrepreneurial university's results of the three clusters

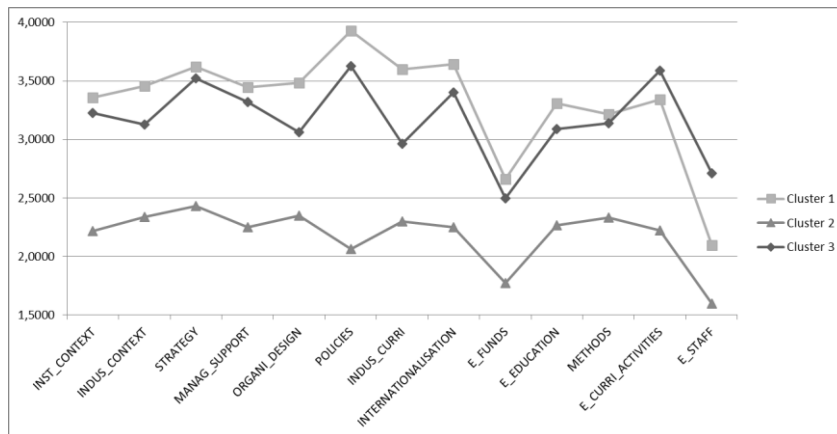


Figure 6 Entrepreneurship support mechanisms level of the three clusters