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Benchmarking in the incubation process of business incubators of public higher education institutions in Hidalgo state: a multi-case study

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Abstract. The economic situation and dynamics has led countries to develop policies and strategies to promote their respective developments. Part of them is composed by the creation of Employment Sources through entrepreneurship. The formation of new entrepreneurs in Mexico can begin or be strengthened through higher education institutions. University incubators provide tools to those people, generally students who wish to create their own business, which help them to make business decisions that contribute to the development of their environment.

In this qualitative and multi-case phenomenological study, the best practices in the incubation process in the Business Incubators of Public Educational Institutions of Higher Education in Hidalgo state (BIPEI) were identified, the most important item in classifying whether or not the incubators have good practices was also identified, and through a hierarchical grouping algorithm, three groups of incubators with similarities between them were identified as well.

Keywords: Benchmarking, University, Incubators, Clustering,

1 Introduction

Business incubators, also known as *catalytic incubators* (Chinsomboon, 2000) or *germinators* or *accelerators* (Hannon, 2003) accelerate and systematize the successful process of business creation by providing them with various elements such as support, a physical space and networking (Lalkaka, 1997), which house entrepreneurial or industrial activities in the design, prototype and formal start-up stages of products or services that provide advice in the preparation of business plans or in intellectual property (IME, n.d.). A university incubator is defined as an institution that provides support to the creation of young enterprises through tangible and intangible services. It has an incubation system that is provided in a space within the university to promote the creation of university enterprises and are an effective way to seek cooperation and create networks that generate added value. Universities have been considered as part of an innovation ecosystem and as key players for the creation and processing of knowledge and information, which can be "exploited" and commercialized in the marketplace (Carmen, 2017).

2 Benchmarking in the business incubation process

2.1 Business incubators

There are several types of incubators which seek to achieve different objectives, but most tend to guide early-stage enterprises. Private, for-profit incubators tend to focus on developing marketable intellectual property, transferring new technologies and investing. The public-sector, non-profit ones, on the other hand, focus on creating jobs and diversifying local economies. On the other hand, we also find those that are generated in the context of universities or research centers (Middleton et al., 2012).

There are also other classifications of incubators, such as the classification made by Holger and Sowah (2020) shown in Figure 1:
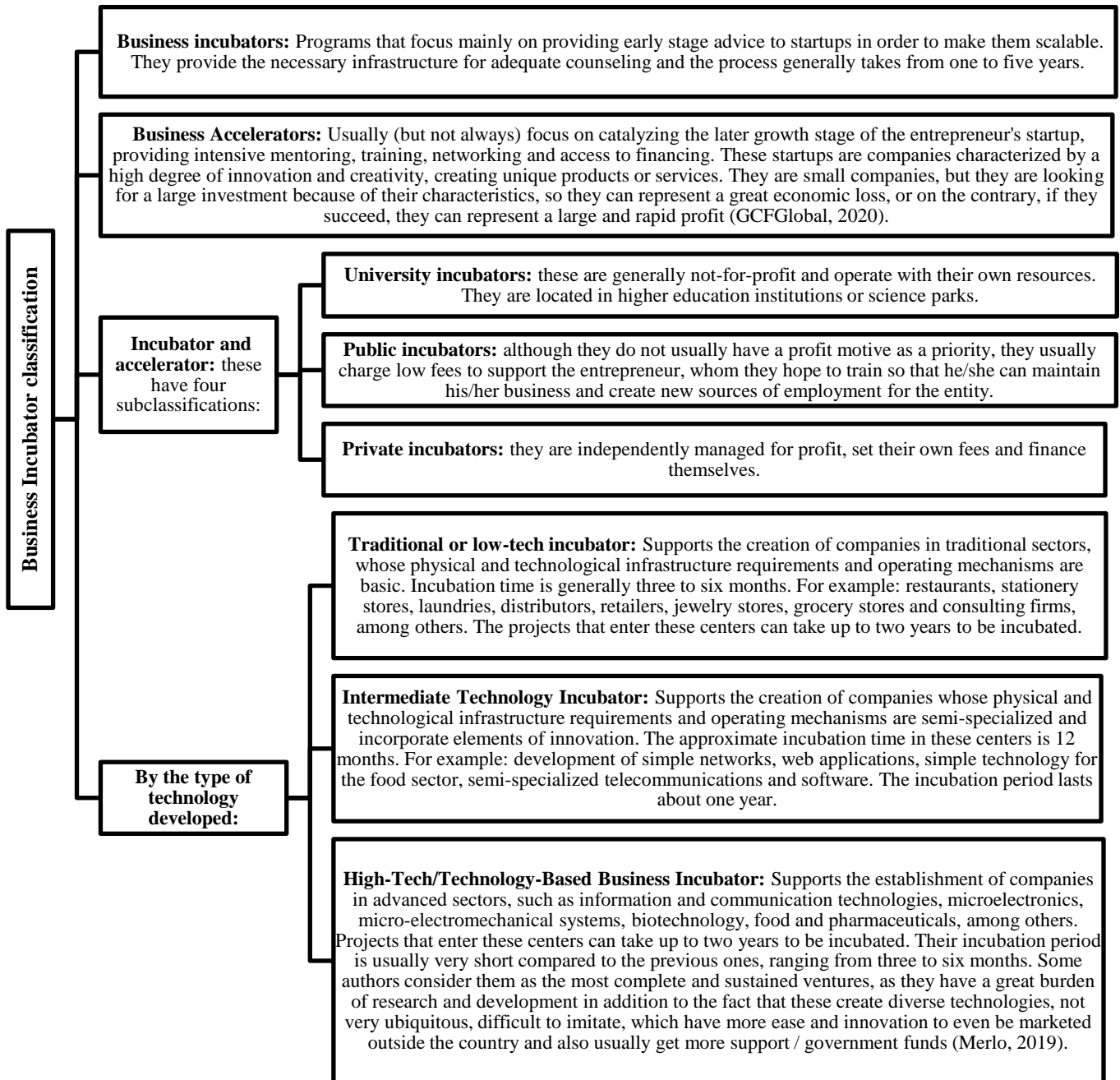
Business Incubator classification

Business incubators: Programs that focus mainly on providing early stage advice to startups in order to make them scalable. They provide the necessary infrastructure for adequate counseling and the process generally takes from one to five years.

Business Accelerators: Usually (but not always) focus on catalyzing the later growth stage of the entrepreneur's startup, providing intensive mentoring, training, networking and access to financing. These startups are companies characterized by a high degree of innovation and creativity, creating unique products or services. They are small companies, but they are looking for a large investment because of their characteristics, so they can represent a great economic loss, or on the contrary, if they succeed, they can represent a large and rapid profit (GCFGlobal, 2020).

Incubator and accelerator: these have four subclassifications:

University incubators: these are generally not-for-profit and operate with their own resources. They are located in higher education institutions or science parks.

Public incubators: although they do not usually have a profit motive as a priority, they usually charge low fees to support the entrepreneur, whom they hope to train so that he/she can maintain his/her business and create new sources of employment for the entity.

Private incubators: they are independently managed for profit, set their own fees and finance themselves.

By the type of technology developed:

Traditional or low-tech incubator: Supports the creation of companies in traditional sectors, whose physical and technological infrastructure requirements and operating mechanisms are basic. Incubation time is generally three to six months. For example: restaurants, stationery stores, laundries, distributors, retailers, jewelry stores, grocery stores and consulting firms, among others. The projects that enter these centers can take up to two years to be incubated.

Intermediate Technology Incubator: Supports the creation of companies whose physical and technological infrastructure requirements and operating mechanisms are semi-specialized and incorporate elements of innovation. The approximate incubation time in these centers is 12 months. For example: development of simple networks, web applications, simple technology for the food sector, semi-specialized telecommunications and software. The incubation period lasts about one year.

High-Tech/Technology-Based Business Incubator: Supports the establishment of companies in advanced sectors, such as information and communication technologies, microelectronics, micro-electromechanical systems, biotechnology, food and pharmaceuticals, among others. Projects that enter these centers can take up to two years to be incubated. Their incubation period is usually very short compared to the previous ones, ranging from three to six months. Some authors consider them as the most complete and sustained ventures, as they have a great burden of research and development in addition to the fact that these create diverse technologies, not very ubiquitous, difficult to imitate, which have more ease and innovation to even be marketed outside the country and also usually get more support / government funds (Merlo, 2019).

Fig. 1. Business incubators classification. Adapted from *UBI Global World Rankings of Business Incubators and Accelerators 2019-2020*, by Holger & Sowah, 2020.

2.1.1 University Incubators

Ventures developed in university incubators are considered to have a higher prestige than one that are not developed in an academic context, as they have undergone a dynamic exchange of ideas and the rigor of academic and even scientific analysis. University incubators can benefit from synergies through the use of computer systems, libraries, databases, special scientific

equipment, and faculty expertise. (Lalkaka, 2006). Universities can enhance their role through an incubation system that promotes and creates a culture of entrepreneurship in society (Ahmed, 2020).

2.7 University Incubators in the State of Hidalgo

Out of 40 public universities identified in the state, 42.5% have at least one business incubator within their facilities. It is observed that some municipalities host up to two university incubators, as shown in Figure 2:
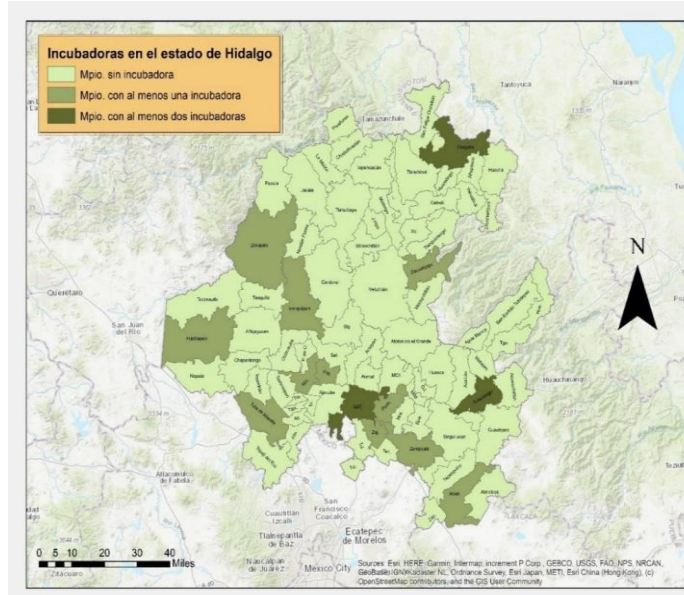

Fig. 2. Incubators in public universities in the state of Hidalgo. Note: This figure shows the location by municipality of university incubators in Hidalgo as of May 2022. Adapted from *Biblioteca Digital de Mapas*, by Instituto Nacional de Estadística, Geografía e Informática, 2022 (https://www.inegi.org.mx/app/mapas/).

The typology of these incubators is varied, although most of them are low-tech. The following table shows the universities that house the incubators located in Hidalgo, as well as the municipality where they are located:

Table 1. University Incubators in Hidalgo state

No.	ID	Municipality	Type of incubator by Technology developed
1	Incubator 1	Apan	Low Technology
2	Incubator 2	Atitalaquia	Low Technology
3	Incubator 3	Francisco I. Madero	Low Technology
4	Incubator 4	Huejutla	Low Technology
5	Incubator 5	Huejutla	Low Technology
6	Incubator 6	Huichapan	Low Technology
7	Incubator 7	Ixmiquilpan	Intermediate Technology
8	Incubator 8	Mixquiahuala	Intermediate Technology
9	Incubator 9	Pachuca de Soto	Low Technology
10	Incubator 10	San Agustin Tlaxiaca	High Technology
11	Incubator 11	Tula de Allende	Low Technology
12	Incubator 12	Tulancingo	Intermediate Technology
13	Incubator 13	Tulancingo	Intermediate Technology

14	Incubator 14	Zacualtipán	Low Technology
15	Incubator 15	Zapotlan	Intermediate Technology
16	Incubator 16	Zempoala	Intermediate Technology
17	Incubator 17	Zimapán	Intermediate Technology

2.2 Benchmarking

Benchmarking (BM) is defined as a theoretical and systematic approach for the improvement of a company or institution, where best practices are identified and implemented with the purpose of improving some aspect or aspects of these practices (Sourching, 1997). This is one of the most widely used methods to assess performance and helps institutions to better understand best practices and makes them think differently by exposing them to new models and processes that fit their organizational objectives (Miller and Dalziel, 2018). The BM compares methods and processes to improve them.

This can be conceived as an external look at internal activities, functions or operations in order to achieve continuous improvement. Its essence lies in identifying the highest standards of excellence for products, services or processes, and then making the necessary improvements to achieve those standards (and to emulate them), also known as best practices (Rostek, 2015). These are compared within the same organization or with other external organizations, but with similar characteristics.

In a philosophical sense, BM can be defined as a sense of humility enough to admit that someone else is better at something and of wisdom to learn to match, or even surpass the competition (APQC, 1993). Another definition of BM indicates that it is the process of constantly measuring and comparing a company's processes with those of its direct competitors to obtain information that will help the company identify and implement improvements. (Andersen & Petterson, 1996).

2.2.1 Types of Benchmarking

There are several classifications in the BM. These help to give an approach based on the needs of the institution or company, (Rostek, 2015; Andersen & Petterson, 1996). Some of them are as follows:

1. **Performance Benchmarking:** relates comparisons of performance and processes. It is the comparison of performance measures in order to determine how good an organization is compared to others.
2. **Strategic Benchmarking:** Is the comparison of an organization's strategy with successful strategies of other organizations to help improve the ability to cope with a changing external environment. Strategic BM seeks to help improve the ability to cope with change.
3. **Internal Benchmarking:** performance comparisons made between departments/divisions of the same organization solely to find and apply best information practices.
4. **Generic Benchmarking:** It is the comparison of the levels of achievement of an organization with the best that exists anywhere in the world, no matter what industry or market it is in. It consists of the comparison of related functions or processes regardless of the sector to which their companies belong. (Camp, 1989).

2.2.2 Phases of Benchmarking

Camp (1993) identifies 4 phases:

a) **Planning phase:** here we propose what we want to investigate. This must be feasible and viable, as well as focused on a specific process or area. Likewise, it must be established with which competitors the BM is to be carried out, for which the following must be considered:
   i. The competition provides useful information for the study
   ii. Information is within reach
   iii. That the structure between the chosen competency is similar to the others to be studied.
   It should also be established what type of BM will be carried out, based on the purpose and objectives of the application of this tool. Data collection strategies should also be established.
b) **Analysis phase:** this phase seeks to understand how the identified best practices can be applied. To do this, it is first necessary to identify the best practices of the competition (the number of competitors can be any) that can benefit another, and this can be known by determining positive or negative gaps or pairs; the former indicate better performance compared to the rest of the competition, while the latter indicate poor performance and the third, that the performance is very similar.
c) **Integration Phase:** once the findings are available, future strategies are proposed that indicate the expected

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performance when the identified best practices have been emulated. The identified practices are converted into operating principles that achieve a change in methods and actions that cause a closing of the performance gaps with the competition, achieving parity or even superior positive performance.

d) **Action Phase:** this phase means monitoring progress after applying the new operating principles. It is necessary to have spent some time to carry out this phase, which will depend on the time it takes in each case to apply each action. It is a stage of continuity and maturity will be considered to have been reached when best practices are found in all competitive processes, thus ensuring leadership in the sector.

Camp's process is possibly the clearest and most adaptable to the different contexts where the BM is to be applied, so for the purposes of this research it has been decided to use this model.

2.2.3 Strategic Benchmarking in Business Incubators

The BM is a dynamic process of identifying good results in organizations that could be attributable to their successful practices and adapting them to the operations of another group. It is a continuous learning and self-correcting process with quantitative comparisons of performance in participating organizations. It is best undertaken within a region, preferably one that has an association or focal body to help mobilize consensus among participating incubators, implement programming, compile and disseminate relevant statistics, anonymously if necessary. This refers to an organization's "best practices".

According to Caiazza (2016), applying the BM in incubators can be very useful to identify practices that can be easily replicated or emulated by others, but it will be useless if this is done between incubators of different types, so he recommends that they be analyzed when they are all of the same type as they may not only not be on an equal footing.

For Porter (2008) strategy is the creation of a unique and valuable position; if there were only an ideal position, there would be no need for a strategy. The essence of strategic positioning is to choose activities that are different from the competition. A competitor can reposition itself to match a rival that has superior performance. A sound strategy can be weakened by an uninformed view of the competition, organizational mistakes and especially the desire to grow.

Strategy makes decisions about what not to do as important as decisions about what to do. To establish it, it is necessary to identify the target market, its needs and expectations, but it is also necessary to know which is not. In order to strengthen strategies, efforts should be concentrated on deepening a position that leverages the existing system of activities by offering benefits or services that would be impossible for rivals to match, i.e. which activities or forms of competition are feasible to replicate as a complementary activity to those already being carried out.

Strategic Benchmarking (SB) focuses on comparing and improving your overall business strategy, vision, mission, goals and objectives. It evaluates strategic best practices to assess strengths, weaknesses, opportunities and threats, as well as to evaluate your competitive position. The SB identifies and emulates successful strategies, business models or innovations of competitors or industry leaders, and adapts them to its own context and needs. (Wudhikarn et al., 2020).

SB focuses on how companies compete. This form of benchmarking examines what strategies organizations use to succeed. This is the type of benchmarking technique used by most Japanese firms (Lankford, 2002). It is used to compare organizational structures, management practices, and business strategies (Drew, 1997).

2.8 Incubation process

Business incubators, as part of their activities, carry out an incubation process. This is different in each incubator, however, in most cases, three general stages can be distinguished: pre-incubation, incubation and post-incubation as shown in Figure 3.
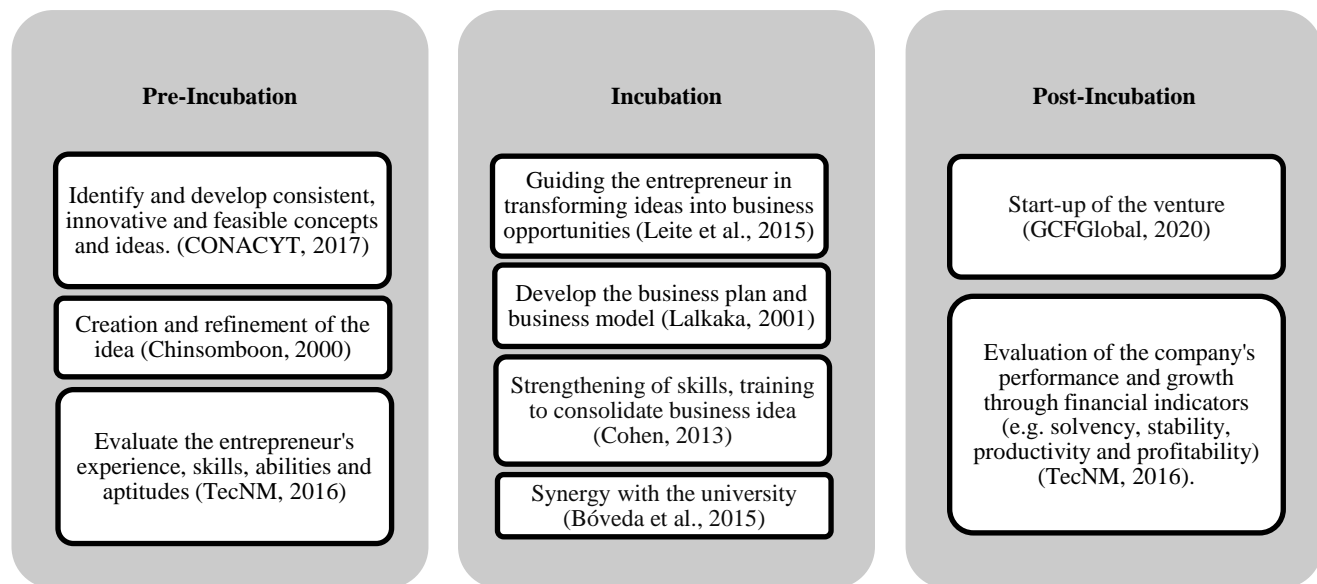
Pre-Incubation	Incubation	Post-Incubation
Identify and develop consistent, innovative and feasible concepts and ideas. (CONACYT, 2017)	Guiding the entrepreneur in transforming ideas into business opportunities (Leite et al., 2015)	Start-up of the venture (GCFGlobal, 2020)
Creation and refinement of the idea (Chinsomboon, 2000)	Develop the business plan and business model (Lalkaka, 2001)	Evaluation of the company's performance and growth through financial indicators (e.g. solvency, stability, productivity and profitability) (TecNM, 2016).
Evaluate the entrepreneur's experience, skills, abilities and aptitudes (TecNM, 2016)	Strengthening of skills, training to consolidate business idea (Cohen, 2013)	
	Synergy with the university (Bóveda et al., 2015)	

Fig. 3. Objectives in the stages of the incubation process.

a) Pre-Incubation Stage

Here, the entrepreneur makes an initial contact with the incubator. Its main task is to motivate and encourage entrepreneurs, but also researchers/teachers and specialists to put the ideas into practice. (Bajmócy, 2006) The entrepreneur presents his/her business idea, the incubator analyzes it, evaluates whether it is viable or not, and determines the incubation work plan to be followed according to the needs of the project, the incubator's capabilities or the entrepreneur's expectations. The entrepreneur's skills, attitudes and aptitudes are also evaluated in order to identify strengths and areas of opportunity. The most appropriate business model will be determined. The approximate duration is 1 to 6 months. (TecNM, 2016) (Bóveda et al., 2015). approximately. At this stage, innovative projects with growth potential that must solve real problems by offering viable and effective solutions are usually sought.

At this stage, the incubator's collaboration with the entrepreneur is usually formalized with the signing of an agreement. This agreement stipulates the obligations and rights of both parties, and also protects the entrepreneur in case of misuse of the information provided to the incubator. It may also include the participation of the academy. This stage culminates once agreements and expectations have been established to give way to the post-incubation stage.

b) Incubation Stage

At this stage, the plan and/or business model is developed, and new strategies and action plans can be adjusted and defined. Entrepreneurs' skills are developed and strengthened. These are in constant training by the incubator to achieve the consolidation of the business idea. Incubation lasts approximately 1 to 2 years, although this period may vary, as the characteristics and needs of each of the companies will influence the duration, depending on the type of enterprise. Technical support and infrastructure are provided, for example (Bóveda et al., 2015):

- Tutoring to develop the business plan
- Specialized tutors
- Personalized consulting
- Access to business networks
- Intellectual property management
- Technological support to develop prototypes, if applicable.
- Use of hatchery infrastructure

This stage seeks to generate synergy between the university, the incubator, financial institutions, public and private entities. The aim is to reduce the mortality rate of the companies thanks to the training obtained by the entrepreneur during his stay in the incubator. This stage culminates with the "graduation" of the entrepreneur from the incubator, or his rejection.

c) Post-Incubation Stage

Passing from the incubation stage to this one can be considered a successful outcome. Similarly, not all entrepreneurs reach this stage, and the reasons are diverse: lack of time, lack of interest, lack of resources, unmet expectations, among others. If the established incubation period has been completed and the incubation has not yet been completed, the end date can be postponed to give the opportunity to make the necessary adjustments. In the post-incubation stage, the business idea has already been consolidated and materialized, has become independent from the incubator and is already in function (Bóveda et al., 2015). This monitors the progress or maturity that the company has reached after incubation. Certain indicators can be applied to determine their performance since they "graduated" from the incubator, for example, to determine the number of jobs created, sales volume, financial analysis, degree of satisfaction of the entrepreneur, among others. This stage usually begins one year after the start of operations of the company. (TecNM, 2016).

3 Methodology and design

In this qualitative and multi-case study of a phenomenological, non-experimental and cross-sectional nature, the best practices in the incubation process in the BIPEI were identified. This is limited to the units of analysis, which will be the heads or managers of these. Emphasis is also placed on the entrepreneurial students of their respective educational institutions.

 Identifying the incubator population and their location were the prerequisites for building an overview of the incubators in the state. In an initial contact, a population of 17 BIPEI was identified; however, in a second contact, after approximately 12 months, incubators 2, 3, 10, 16 and 17 disappeared, while 6 and 5 did not wish to participate in the present study, thus obtaining a convenience sample of 10 BIPEI. Only one participant was identified in each of them.

A data collection instrument was developed and named *"Scale of Best Practices in the Business Incubation Process"*. This was carried out based on the *Global Entrepreneurship Index 2019*, *Benchmarking of Business Incubators Final Report 2002* and *Guidelines Metrics & Milestones for Successful Incubator Development 2013*, on the literature review, as well as with the advice of incubator managers of the Tecnológico Nacional de México (2016). This identifies whether there are best practices in the strategies in the incubation process mentioned above, and how well they are geared towards achieving successful incubation, the contents of which are summarized in Table 2.

Table 2. Summary content of the stages of the Incubation Process of the developed scale.

Pre Incubation	Pre-selection of projects, evaluation of skills, established goals/objectives, knowledge and experience of student entrepreneurs, promotion of entrepreneurship, development of diversified activities related to entrepreneurship, completion time and percentage.
Incubation	Impact of the incubation model on students, organization of the model, incubator support, specialists, impact of the model on students' entrepreneurial skills, start-up of the entrepreneurship project, time to completion and percentage.
Post-Incubation	Follow-up of incubated projects, visits and reviews, suggestions for improvement, level of entrepreneur satisfaction, achievement of established goals, relationship with public and private sectors, financing, "Valley of Death", completion time and percentage.

This scale was applied by means of an interview (face-to-face and remote). It consisted of 5 parts: 1) Profile of the incubator manager 2) Profile of the incubator 3) Pre-incubation stage 4) Incubation and 5) Post-incubation. This consisted of 45 items/strategic statements, with response options consisting of a Likert scale from 1 to 5 (Strongly disagree 1, Partially disagree 2, Neither agree nor disagree 3, Partially agree 4, Strongly agree 5), as well as open and multiple-choice questions. For this research, parts 3, 4 and 5 were considered, whose answers were scaled.

4 Results

Regarding the profile of the incubator manager, it was found that they are 90% women and 10% men, with an average age of 36 years, most of whom have postgraduate studies, who are not only dedicated to coordinating the incubator's activities, but are also involved in teaching, and 90% consider that they do not receive support from management for the achievement of the incubator's objectives.

From the incubator profile, it was found that all of them have at least one office to carry out their activities, but very few have

more infrastructure, in addition, it was found that all of them have a minimum age of 3 years, that 80% incubate from 0 to 5 companies per year and 20% between 6 and 15, that all offer the service of creating a model and/or business plan, 50% patenting, 50% financing, and that they have unclear performance indicators, The strengths considered to be the existence of innovative and technological projects, the existence of productive links with the public and private sector, as well as the existence of subjects related to entrepreneurship, and, on the other hand, the lack of budget to operate, lack of infrastructure, lack of entrepreneurial culture, lack of personnel are considered to be the weaknesses. 90% of the participants consider that there is a great lack of interest on the part of the students in entrepreneurship and there is an approximate participation of between 30 and 40% of their student staff. Regarding the type of incubator, 80% are traditional or low-tech businesses, 10% are medium-tech and 10% are high-tech. All share the objective of contributing to the social and economic development of the region.

According to the interpretation of the results in Table 4, it can be seen that Incubator 1 has the Best Practices Achieved in the state (score of 203), but it was also observed that it is also the one that incubates the most companies (between 6 and 12 per year), is the most recently created and has a high percentage of completion of the three incubation stages, followed by Incubator 15 and 13, whose results were almost similar. Incubator 11 has insufficient Best Practices.

Table 4. Interpretation of the *Best Practices Scale in the Business Incubation Process*

Interpretation of results (score)		
181 - 225	**Best practices achieved:** Best practices are identified to achieve the greatest use of resources necessary to carry out a successful incubation process.	
136-180	**Good practices:** Good practices are identified to achieve the best use of the resources needed to carry out an incubation process, which can be improved.	
91-135	**Moderately sufficient practices:** practices that are at a decisive point, as they can reach the best practices or reach the point of not applying any of them.	
46-90	**Nearly insufficient:** practices that have not benefited an efficient hatchery process	
0 - 45	**Poor practices:** insufficient practices. The incubator will have to decide whether to continue to operate by completely restructuring its incubation process or to disappear.	

An algorithm was developed to determine whether the BIPEI are similar to each other by means of a *hierarchical clustering algorithm* (the top-down approach, in which all the data points are treated as a large cluster and the clustering process consists of dividing the large cluster into several small clusters) with the help of the *Orange* data mining *software. In addition* to this hierarchization, an algorithm capable of creating an alternative classification - to the one obtained by scores - was also created by applying the scale by means of the Predictions function.

Table 3. Results of the scale applied to BIPEI

Incubator	Pre-Incubation	Incubation	Post-Incubation	Score
Incubator 1	71	73	59	**203**
Incubator 15	69	62	65	**196**
Incubator 13	72	63	58	**193**
Incubator 12	57	62	56	**175**
Incubator 4	62	50	54	**166**
Incubator 14	64	56	41	**161**
Incubator 8	66	42	50	**158**
Incubator 7	60	46	48	**154**
Incubator 9	53	49	48	**155**
Incubator 11	27	24	20	**71**

Scale reliability was measured through Cronbach's alpha, obtaining a value of $\alpha = .902$, considered a high level of consistency

(Cronbach, 1951). (Cronbach, 1951).

A divisive *hierarchical clustering algorithm* was developed with the help of *Orange.* Hierarchical *clustering* is a type of unsupervised machine learning algorithm used to cluster unlabeled data points. Hierarchical Clustering computes hierarchical clustering of arbitrary types of objects from a distance matrix. The result is an inverted tree structure, called a dendrogram. For this study, the algorithm yielded 8 levels as seen in the dendrogram in Figure 4, with a Ward link, which calculates the increase in the sum of squares of the error. In other words, Ward's minimum variance criterion minimizes the total variance within the group. It creates logical groups, grouping data points with similar characteristics together (Wuntkal, 2020). In addition, he identified 3 clusters (C1, C2 and C3).

Fig. 4. Dendrogram of BIPEI

An algorithm capable of creating an alternative classification - to the one obtained by scores - by applying the scale through the *Predictions* function in *Orange* was also created. The widget receives a data set and one or more predictors (predictive models, not learning algorithms). It outputs the data and the predictions; it displays the probabilities and final decisions of the predictive models. The output of the widget is another dataset, where the predictions are added as new meta-attributes.

The training data of 8 incubators (Incubators 1, 4, 7, 8, 9, 13, 14 and 15) were entered first, i.e. the answers given by these incubators for the three stages of the incubation process, to later check that the algorithm classified correctly with the remaining 2 incubators (Incubators 11 and 12). For this part, the median ($\tilde{x}$) of the total scores of the 10 incubators was calculated, being $\tilde{x} = 163$, with which the following criterion was established to train the algorithm: scores $\geq 163 =$ Incubators with good practices and scores $<163 =$ Incubators without good practices. This is shown in Figure 5.
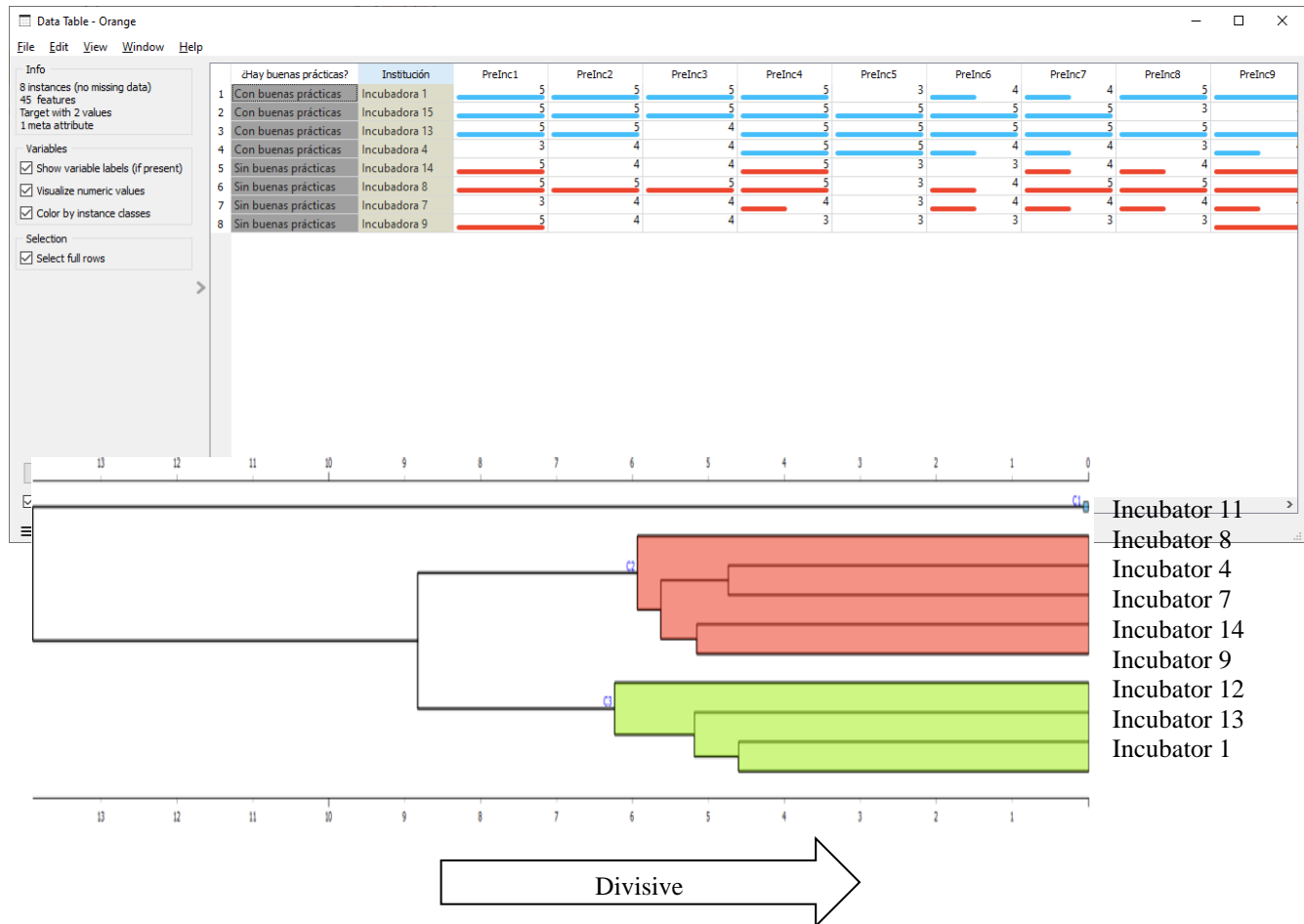

Fig. 5 Data table of 8 hatcheries classified as "With good practices" (*Con buenas prácticas*) or "Without good practices" *(Sin*

buenas prácticas).

A Prediction Tree was created, shown in Figure 6, which identified the most decisive scale item or the one that most indicates whether or not a hatchery has best practices, which was item 13, from the Incubation stage.
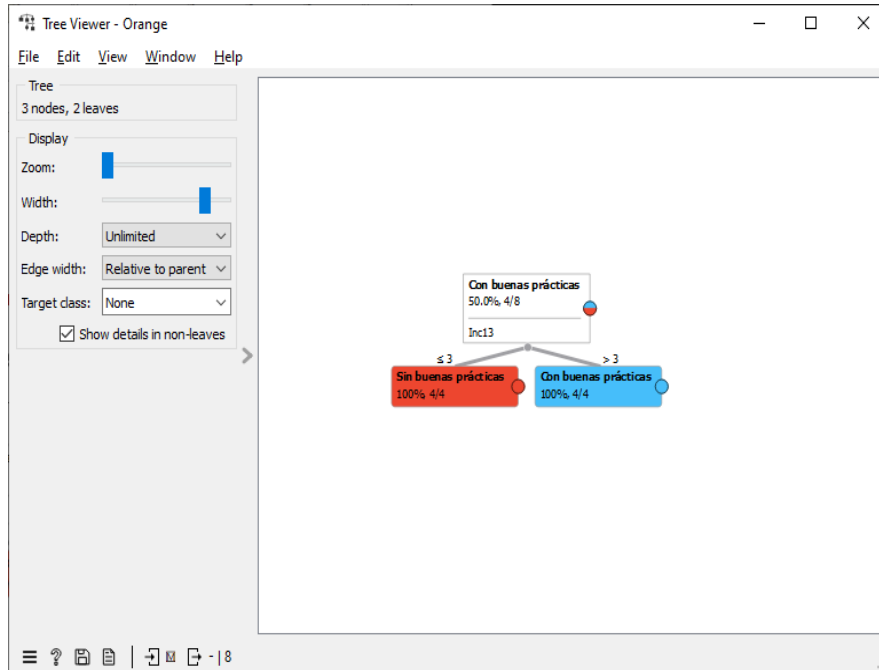

Fig. 6 Decision Tree view of responses from 8 hatcheries

Subsequently, the correct functioning of the trained algorithm was checked by entering the data of the two remaining incubators -11 and 12- as shown in Figure 6, using the Predictions function again, the algorithm was asked to classify these incubators, for which it showed that Incubator 12 had good practices (score ≥ 163) while Incubator 11 did not have good practices (score <163), this being correct, thus proving the reliability of the algorithm.
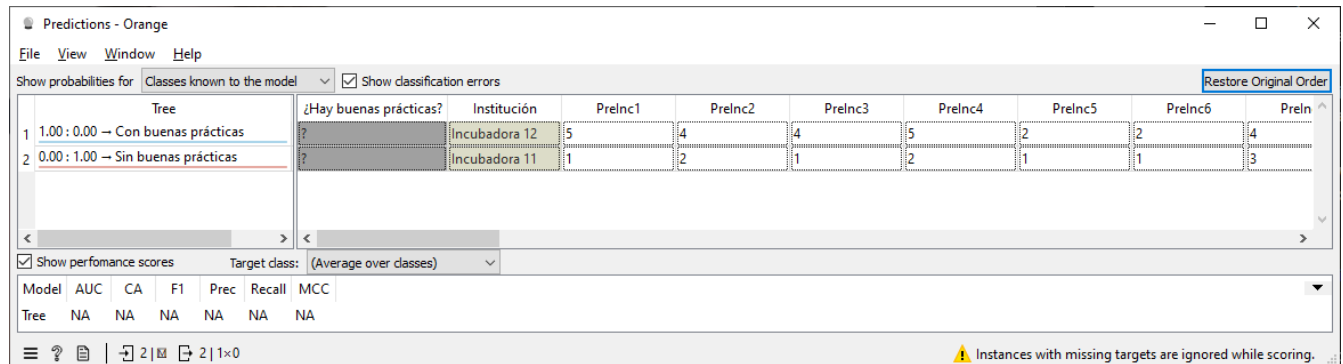
Fig. 7 Predictions with two incubators

5 Conclusions

In the present research, the 1st and 2nd phases of the WB were followed: a) it was planned what was to be studied - which was the best practices in the BIPEI - where and with whom the WB was to be carried out, and the way to obtain the information and findings was established, b) the best practices were identified, as well as the existing gaps between the BIPEI. As part of the conclusions, the following proposal of actions and strategies is made, which corresponds to the 3rd phase of the MF, with the purpose of reducing the gap between the levels of best practices in the BIPEI:

- To have a multidisciplinary team of advisors in the incubator.
- Provide entrepreneurship-related training to all members of the incubator, regardless of their profile.
- To have staff dedicated exclusively to the support of entrepreneurs.
- The BIPEI should focus their efforts on contributing to the social and economic development of their respective regions, for which they need to generate synergies with public and private institutions.
- Designate clear performance metrics to be tracked and monitored
- An office alone is not enough: it is necessary to manage the necessary actions for the establishment of laboratories, simulators, meeting rooms, and internet service.
- Emphasize the intellectual property protection and legal aspect; almost no one offers it.
- Create alliances to gain access to external expertise

- The most effective awareness-raising strategies were the dissemination of the incubator's activities.
- Lack of budget has limited the diversification of its services; there should be a budget earmarked exclusively for the incubator.
- Having subjects on entrepreneurship has allowed more students to approach the incubator.
- The incubator can be in charge of fostering the entrepreneurial spirit (which was high) in order to eradicate the existing high level of disinterest.
- A pre-selection (1st stage) is necessary to determine the feasibility and viability of the project and minimize the risk of abandonment.
- Selectivity: Incubate projects that solve a real problem with a viable and effective solution.

The 4th phase is planned for a second phase in a later study to find out how the emulation of good practices in the incubators turned out according to their skills and capabilities.

According to the interpretation of the scale created, it was possible to identify that there are mostly good practices in 9 out of 10 BIPEI, although these are developed at different levels. There is a large gap between Incubator 1 and 11.

In turn, developing the hierarchical *clustering* we found a contrast in the good practices in the BIPEI; here three clusters were generated, where C1, formed by Incubator 11, the one with the lowest score, does not share many characteristics with the rest of the incubators. C2, on the other hand, grouped incubators whose scores are closer to the median ($\tilde{x} = 163$) except for Incubator 4, while C3, grouped those incubators whose scores were farther away from the $\tilde{x}$. It is observed that the C2 incubators share the following characteristics: they have high good practices mostly in the Pre-Incubation stage, they are mostly of the traditional business type, they all share as their main objective to contribute to the social and economic development of the region. They offer the services of creating business models and/or plans, patenting and financing advice. They consider that making a pre-selection of possible entrepreneurial projects for incubation allows to know the feasibility and viability of the project, and also that the incubator has an important role in challenging the business models of its entrepreneurs and contributing to make them innovative. If a project is not viable for incubation, the entrepreneurial student is informed of the areas of improvement that must be strengthened in order to make the project feasible. The incubated entrepreneurship projects are evaluated by a group of experts in the field who provide feedback to the entrepreneurs in order to make improvements to the project. Any student regardless of their area of study may be able to develop a business idea, as the incubation model is adaptive and also helps to awaken creativity and innovation. The incubator has been able to adapt to the needs of the entrepreneurial students that have been identified throughout the incubation process and provides the entrepreneurial student with tools that not only allow him/her to start his/her business, but also to consolidate it. Very little budget is allocated to carry out its functions.

Regarding the C3 incubators, the following common characteristics were identified: all are of the traditional business type, have at least 3 years in function, seek to support the emergence of new companies, have at least one office for the development of their activities, all offer support for the creation of models and/or business plans, all consider that there is a lack of interest on the part of students to undertake, no exclusive budget is allocated for their operation, they partially consider that making a pre-selection of possible entrepreneurial projects for their incubation, allows to know the degree of innovation of the same, they do not consider totally certain that if the entrepreneurial student has previous experience in entrepreneurship, he/she has greater probabilities of success in the incubation process, if some project turns out not to be viable to be incubated, less than 10% of student entrepreneurs complete the Pre-Incubation stage, they consider that the incubation model manages to sensitize and inspire students partially about the importance of entrepreneurship, that the incubation model does not respond to the

current needs and trends in the market, since it is not constantly updated, and that there is insufficient follow-up of the companies once they have completed the incubation process. They do not consider that from its beginnings to the present, the incubator has had an annual increase in the number of incubated companies.

It was possible to identify that a decisive item to know if an incubator has good practices or not, is item 13, of the Incubation Stage, which indicates the following: *"The incubator has professionals specialized in different areas of entrepreneurship, which allows the idea of entrepreneurship to have a better support when making key decisions for the creation of an attractive business plan".* A multidisciplinary team allows individuals to interact in a relative and direct way for the achievement of objectives or goals, where each member is responsible for a part of the work assigned to them according to their skills, and require the contribution of each of them to achieve the established goals. It is a sum of juxtaposed disciplines (Valverde et al., 2021). These allow support to see ventures from a holistic point of view, encompassing different areas of knowledge so that they can be incubated in a more complete way.

Finally, with the help of the *Predictions* widget in Orange, a more drastic classification of BIPEI could be made, since with this tool there are or there are not good practices and they do not exist at different levels of development. This is a more drastic prediction, but perhaps more accurate if a general restructuring of BIPEI is to be made.

The BM in the BIPEI helped to understand the current situation faced by them in their respective incubation processes, to identify the best practices that have been useful to develop more productive processes that have helped them to take advantage of all their resources and capabilities, and to propose some strategies to emulate some of them.

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