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# Strategic Management Method for the Incubation Process of Industrial Companies: Case Study of the Tooling Industry in Brazil

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**Abstract**

Industrial competitiveness has required from companies elevated quality standards, cost reduction and a high capacity of delivery. Within this scenario, an important industrial segment has a fundamental role: the tool and die industry. Tools and dies are resources that are fit to a specific task and are either produced as a single-unit batch or intermittently according to demand. Generally, this industrial segment has demonstrated low competitiveness, which in turn affects the performance of other production chains that rely on it. This is the case of the plastic transformation and metalworking industry, especially when forged and stamped parts are considered. This low competitiveness is a consequence of the deficient corporate structure found in these companies, which results in lack of compliance to quality standards, high costs and long delivery times. Besides the support given to current tool-and-die making clusters, a decentralization structuring project of this industry to other regions of Brazil is necessary. This need is illustrated by new automotive and other consumer goods production plants that have recently started operating in the northeast and central regions of Brazil. In order to contribute to this issue, this article proposes a strategic management model for the incubation process of industrial companies that comply with competitiveness standards required by current market demands. Besides the usual difficulties related to incubation and the creation of any enterprise, the tooling industry faces an additional obstacle related to investment in assets (buildings, machinery, and software). Therefore, a nucleation process based on an existing structure that will be shared by several companies is proposed (IDS – Industrial Development Structure). This structure shall be preferably established on an ICT (Brazilian denomination for Science and Technology Institutes) that shall contribute with professional training (tool and die making) and specialized services (e.g. metrology and tool tryouts).



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*Keywords:* strategic management; incubator; incubation model; industrial cluster; tooling industry.

## 1. Introduction

In a productive chain, a company from the tooling metal-mechanical sector supplies production resources to consumer goods producers. A mold or die, the product of a tooling shop, is a resource that is always adapted to a specific task, and its production is either single or intermittent. Due to this and to the intrinsic complexity of these products, it becomes hard for a tooling shop to remain in the market. When an agglomeration of tooling shops becomes significant (cluster), the growth potential and competitiveness are levered.

Aiming at proposing a specific model for a company cluster to act in the tooling area, taking the characteristics and peculiarities of the activities into consideration a sectoral structuring project was developed [1,2,3]. Under this project, the goal of this article is to propose a strategic management model for the industrial incubator process, considering the industry competitiveness required by the market. Besides the difficulties in the incubation and creation of any company, the tooling segment faces a huge additional obstacle – high investment in assets (buildings, machines and software). A structured nucleation process is proposed based on an already-


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existent structure to be shared by several companies (Business Incubation Lab), preferably in an Institution that also offers professional education (toolmakers) and specialized services (measurement by coordinates, mold tryout etc.).

## 2. Proposed structures to form a cluster

Altenburg & Meyer-Stamer [4] and Suzigan et al. [5] define a cluster as a sizeable agglomeration of firms in a spatially delimited area which has a distinctive specialization profile and in which interfirm specialization and trade is substantial. Besides the presence of local external economies related to the size of the market, the concentration of specialized labor, technological spillover and other factors that favor local specialization, cluster companies usually interact through production, trade and distribution linkages. They also cooperate in marketing, promotion of exports, supply of essential input, P&D activities among others. However, despite joint actions and cooperation, local companies try to keep a healthy balance between competition and cooperation. Local companies also benefit from the support of local institutions. Local leadership usually coordinates private and public actions. The existence of some forms of political, social or cultural identity constitutes the base for the existence of reliability and information sharing. The importance of business clusters therefore resides in characteristics that ensure success for companies in terms of international competitiveness and exports, longevity, as well as job generation and income for the regions where they are located.

Based on Altenburg & Meyer-Stamer [4] and Suzigan et al. [5] work on clusters, and considering the national global business development scenario, three models of industrial incubators are proposed: i) Model 1: Shared Industrial Incubator; ii) Model 2: Semi-shared Industrial Incubator; iii) Model 3: Non-shared Industrial Incubator.

Each of these models will be described below and a comparative analysis will be made to assess their strengths, weaknesses, opportunities and threats.

### *2.1. Model 1: Shared Industrial Incubator*

In the model shown in Fig. 1, the incubated firms share the physical and virtual infrastructure resources of the mother institution. As in other models, incubated firms have “business offices” in the Incubator structure.

The physical structure of the business incubation lab is comprised of machines and equipment dimensioned to promote the manufacturing of products foreseen for the cluster. In the case of tooling, these pieces of equipment are, for example, conventional machining centers, HSC machining centers, adjustment equipment, polishing equipment, injection machine to help injection mold try-out. The virtual structure is comprised of a project lab and simulations with CAD 3D, CAE (rheological analysis, mechanical forming etc.) and CAM software.

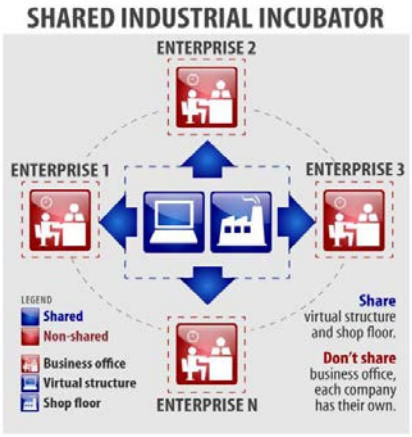


Fig. 1. Model of Shared Industrial Incubator.

### *2.2. Model 2: Semi-shared Industrial Incubator*

In the semi-shared industrial incubator model (Fig. 2), companies share physical infrastructure resources. Companies have their own virtual structure and business offices. Virtual and physical infrastructure resources are those described in the previous model. The companies that will be a part of cluster share the same physical space.

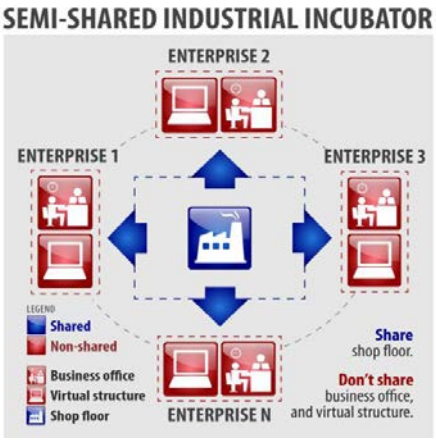


Fig. 2. Model of Semi-Shared Industrial Incubator.

### *2.3. Model 3: Non-shared Industrial Incubator*

In the non-shared industrial incubator shown in Fig. 3, companies share the physical space only, maintaining their own physical and virtual structures and “business offices”. In this model, each company has its own physical and virtual infrastructure and “business offices”. The resources of the physical and virtual infrastructure are described in the previous model.

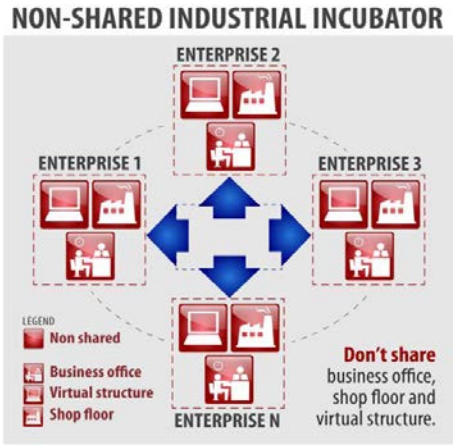


Fig.3. Model of Non-Shared Industrial Incubator.

The Fig. 4 shows the relative advantages, strengths, weaknesses, opportunities and threats to each industrial incubator model).

| Strengths and Weaknesses Matrix | | | |
|---|---|---|---|
| PARAMETERS COMPARISON | Shared Industrial Incubator | Semi-shared Industrial Incubator | Non-shared Industrial Incubator |
| Acquisition cost of machinery and equipment | Low | Low | High |
| Cost of acquisition and maintenance of software | Low | High | High |
| HR cost | Low | Medium | High |
| Initial Investment | Low | Medium | High |
| Production Capacity | Medium | Medium | Low |
| Competition from companies for the use of shared equipment | High | Medium | Low |
| Ease in finding highly specialized HR | Alto | Medium | Low |
| Knowledge sharing | Alto | Medium | Low |
| Ease of technical troubleshooting | Alto | Medium | Low |
| Dynamism and flexibility | Low | Medium | High |
| Ease of acquisition financing and government support | High | Medium | Low |
| Potential conflicts between companies | High | Medium | Low |

| Opportunities and Threats Matrix | | | |
|---|---|---|---|
| PARAMETERS COMPARISON | Shared Industrial Incubator | Semi-shared Industrial Incubator | Non-shared Industrial Incubator |
| Creation of direct jobs | Low | Medium | High |
| Creation of indirect jobs | High | Medium | Low |
| Creation of new businesses | Low | Medium | High |
| Tax collection | Low | Low | Medium |
| Increase export | Low | Low | Medium |

| Legend | |
|---|---|
| | Largest relative advantage |
| | Medium relative advantage |
| | Lower relative advantage |

Fig.4. Comparison between strengths, weaknesses, opportunities and threats of tooling industrial incubator models.

## 3. General model suggested for nucleation of companies that focus on new markets

To illustrate the application of this model in a market segment, a case study has been carried out in the state of Bahia, Brazil, for the tooling sector. The state of Bahia has a petrochemical pole that supplies raw material to the plastic transformation industry. It is an emerging industry as well as the computer and automotive chain industries, among others. In this context, the nucleation of the tooling sector in the state is an urgent need to consolidate the plastic transformation chain.

Considering a product development process, companies from the tooling segment could be inserted in distinct stages of the product life cycle. In the initial development stage, as a technology supplier; in the production preparation stage, as a tool supplier; or in the production stage, it could supply tools and commodities.

When a big company develops a new product, as in the automotive segment, a great number of tools of various complexity levels and sizes is usually necessary. To meet this demand, the market must be able to supply them. Therefore, the development of companies focusing on meeting these demands is essential. An example of this are the companies in the region of São José dos Campos that support EMBRAER.

Brazilian companies that produce molds for the transformation of resins into plastic, also called tooling shops, are technologically and organizationally behind the main international producers. In the last couple of years, the national manufacturing park was updated through the acquisition of CNC machines/tools and of computer systems to help projects and manufacturing (CAE/CAD/CAM). Brazilian tooling shops make molds of different types and sizes, but they are not specialized in a given sector. Their low competitive and technological capacity is reflected in high prices and long delivery times when compared to those in the international market, and the trade balance systematically shows a deficit.

Considering the technical characteristics of the mold and die industry, there is a natural trend to form clusters in this industry due to its atomized structure – even in the main manufacturing countries, small and medium-sized companies prevail, that is, few companies have more than 99 employees – and there is a need to form consortiums to buy the necessary machines to make a return on investment possible. Moreover, specialization has a great effect on the reduction of production costs. Finally, skilled labor in the Brazilian mold industry, considered an essential element to achieve competitiveness differentials, has yet to be developed.

The industrial incubator model suggested is comprised of a set of elements that must act as a facilitator for company entrepreneurship processes and technological innovation, providing:

- Physical space constructed or adapted to temporarily house micro and small companies or service providers;
- Flexible environment to provide companies of different branches involved in the development of molds with distinct human resources and technical structures;
- Technical and business management support;
- Shared infrastructure and services: meeting rooms, telephone, access to Internet, data processing support;
- Access to financing mechanisms;
- Access to markets and relationship networks;
- Follow-up, evaluation and guidance process.

Considering a time scale required to support the tooling business, the proposed model simultaneously comprises characteristics of shared, semi-shared and non-shared structure

incubators. At an early phase, the implantation stage, the model will assume the characteristics of a shared industrial incubator. After that, in the mature stage semi-shared characteristics will be assumed. In a third phase, the consolidation phase, the model will have non-shared industrial incubator characteristics. This proposal is represented in a schematic form in Figure 4.

In the model proposed, the implantation, maturing and consolidation stages can take place simultaneously, depending on the degree of development of the company to be implemented. In other words, at a single moment you may have companies in a higher development level (Phase 2 and Phase 3) coexisting with companies in Phase 1. The former will assume incubator roles (resources, benefits, obligations and duties) of semi and non-shared type while the latter will be managed by shared incubator guidelines. It is important to mention that even companies that are in an advanced phase of development (consolidated companies), when part of an industrial incubator, will share information and knowledge with other companies.

Due to the development of the company business itself, the proposed model considers a change in phases (Fig. 5). In this model, a Business Management Committee will be responsible for evaluating the business of a company, that is, it will analyze the company business aiming at consolidating its development.

In the Implantation Stage companies, state and city secretariats, support foundations, technological centers, vocational school, universities among others must be informed about the importance of the process. The purpose is to define and detail a Work Plan to create a solid platform for the development of an arrangement within the model suggested.


Fig.5. Business incubation model suggested for tooling APL.

Companies that wish to start in the business (such as tooling shops) will be given the resources of a Shared Structure. These companies will be technically qualified in the business segment they act in (for example, mold design, electrode manufacturing, polishing, specialized thermal treatment among others) as well as in business management. These companies will get considerable support from Business Support Institutions, and will simultaneously learn and share knowledge and experiences with the remaining companies involved in the businesses, whether acting in the same phase or in more advanced phases of development. The companies in this phase will be intensively monitored by audits to make the business effective. The companies in this phase may be nucleated with potential human resources, universities and research centers through articulated actions among the entrepreneurship partners.

In the Maturing Stage, companies will be given semi-shared structure resources. In this phase, two types of companies can be present. The first type is comprised of companies that have achieved the degree of maturity required for Phase 1 and advanced to Phase 2. The second, by companies entering the business, partially developed, with a certain degree of experience in the business that require specialized technical support and business management. Companies in this phase will be able to enjoy the benefits of Shared Incubators and the obligations of Non-Shared ones. Likewise, these companies will be technically qualified in the business segment they act in as well as in business management. They will share their “learned lessons” with companies in the implantation stage and will learn from companies in the consolidation stage, in a more advanced development level.

Companies in the Consolidation Stage are in the final business maturing stage and are practically ready to “live by themselves”, that is, to manage their own tooling business in the local productive arrangement. They will then be given the resources of a Non-Shared Structure. In this phase, two groups of companies may be present. The first one is comprised of companies that achieved the maturity level required for the maturing stage and that advanced to the consolidation stage. The second, by companies entering the business practically developed, experienced in the business, but that require some specialized technical support and business management. These companies are seen as companies that can potentially attract new businesses to the local productive arrangement. The companies in this phase will have to share experience with the remaining companies involved in the business, and are seen as an example to be followed.

It is important to mention that companies that are in this level, that is, at a greater development level, can “physically” install themselves outside the incubator as spin offs, and can benefit from the incubator; they will have to carry out the “duties” and “obligations” of that incubator. In other words, although they are outside the incubator, they are virtually participating in the incubator.

The final purpose of the industrial incubator is the development of companies of enhanced capacity to deliver services, technological development, and to manage business processes. For example, companies must have technological support in essential areas regarding the tooling shop business, especially in:

- Mold design and product development regarding the following areas: aesthetic and functional drawings, material selection, rheological and structural analysis, construction of models and machined prototypes or fast prototyping in the engineering area;
- Scanning services of parts and changing of logic formats (IGES, STEP, VDA, DXF, SET, SPAC);
- State-of-the-art equipment to manufacture complex cavities (of high added value), such as high-speed CNC

machining centers, wire electrical discharge machines and CNC penetration electrical discharging machines.

To do this, the proposed industrial incubator model consider information that are part of the business management model, as described below.

## 4. Business management model

The proposed management model can be considered the core of the industrial incubator model. This management model is centered on complementary competencies, business self-sustainability, business collaborative development, qualification of human resources and focus on innovation.

The industrial incubator management model assumes managing dimensions such as human resources, finance, physical, business process and innovation management. These dimensions are detailed below:

- Human Resources Management – Human resources management comprises the definition of qualification models that consider distinct competences and improvement levels to keep professionals permanently trained and updated in terms of technique application and effective innovations, considered the unique reality of each product. The model must foresee learning between a support institution and a company (explicit knowledge) as well as learning among companies (tacit knowledge). In the case of tool shops, resources must be developed to make tacit knowledge learning feasible among companies.
- Financial Resources Management – The vision of the business must be based on the broadest financial sustainability reach possible, investing business resources in the development of new strategic actions. A financial resources policy, prioritizing self-sustainability of the business must be developed. For the industrial incubator this policy must foresee fixed investment as well as investment regarding trips by professionals to collect data and exchange information, organize and analyze the collected data and to guide actions.
- Physical Resources Management – Responsible for the management of incubator's physical resources, including, equipment acquisition, installation and maintenance processes. Therefore, the equipment acquisition process by the companies participating in the incubator must be assessed with the purpose of making the company business feasible as well as the self-sustainability of the undertaking. This need arises from the high cost of the equipment necessary to make the business feasible.
- Business Process Management - Within the industrial incubator management model, business process management assumes the main role as it comprises the basic mechanisms of a business: institutional support mechanisms for companies, mechanisms to attract companies to the business, mechanisms to change company's phase in the business, mechanisms to adapt companies to the specificities of the industrial incubator implantation place, commercial mechanisms, legal mechanisms, and mechanisms that define company roles.
- Business Innovation Management – A company innovation management process must be structured bearing in mind performance indicators that consider technical, financial, human, structural and relational aspects; indicators that evaluate the degree of interaction and effective integration among companies so as to maintain the cluster of incubated and formerly incubated businesses alive and active; and indicators that follow up and promote continuous optimization of processes and products in order to create an environment or ecosystem that increasingly favors innovation. This dimension will be dealt with in greater detail in the next section.

### *4.1. Business Innovation Management Dimension*

For this dimension, the key variables that contribute to the innovation process of the incubator and of incubated companies must be firstly defined and then they must be assessed and managed with a view to continuous improvement of the innovation environment in mind. These key variables can be represented as tangible and intangible capital, in a general level, which are unfolded into factors and then into indicators. Fig. 6 shows examples of tangible and intangible capital and their respective factors that could be considered in the evaluation of the incubated companies.

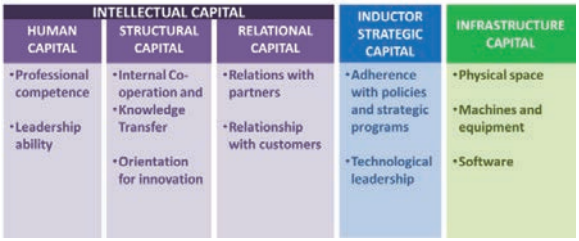


Fig.6. Example of tangible and intangible capital and factors that could be considered in the evaluation of incubated companies.

The factors can be qualitatively evaluated by an institution's employees in workshops using the QQS (Quantity, Quality and Systematic Management) method developed by the Fraunhofer Institute [6]. With this structured method suggests that factors be evaluated according to a defined scale (Fig. 7) in terms of the current amount, quality and systematic management regarding the incubator's strategic goals. Each of the workshop participants grades the factor being evaluated with color cards as per scale in Fig. 7, and the performance of each factor is the mean value calculated from participants' grades. Besides grading, the participants must also evaluate the relative importance of each of the factors for the industrial incubator strategy, ranking them.

At the end of the QQS evaluations, a matrix is obtained as shown in Fig. 8, where each of the factors evaluated is placed in terms of their performance and relative importance. A strategy (stabilize, develop, analyze and no need for action) must be defined for each quadrant. Factors located in the quadrant whose strategy is "develop" must get special attention as their performance is low, but their relative

importance is high to the business. The end product of this evaluation is an action plan comprised of the measurements to be implemented to develop the factors necessary for the success of the business.

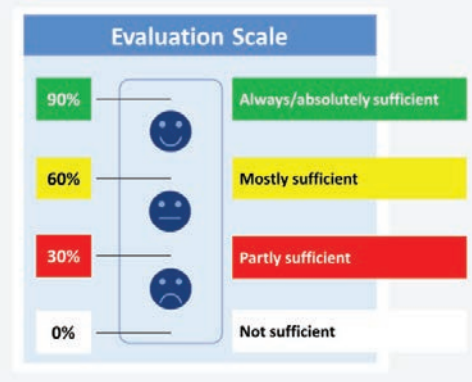


Fig. 7. QQS method evaluation scale. Source: Adapted from [6].


Fig. 8. Example of factors portfolio matrix. Source: Adapted from [6].

When the tangible and intangible capital and their respective factors are defined, it is important to define the appropriate indicators for each factor. The indicators measure factors and monitor their development over time on a quantitative basis besides validating the qualitative evaluation of the QQS methods., As well as the tangible and intangible capital and factors, the indicators must reflect the degree of incubated companies innovative magnitude in terms of product development and innovative processes, technological leadership, diversity and degree of added (depth) knowledge of their competencies as well as the existence of a collaborative and synergetic ecosystem to support and encourage innovation.

In this context, it is also suggested that the degree of integration for innovation of the companies involved in the incubation process be measured. This degree indicates how deeply each company is integrated with others and with partner institutions in terms of cooperation for innovation, that is, active participation in joint innovation projects; offer of innovation and technology solutions, and hiring of technology and innovation solutions. The more integrated the companies are, the more they share information and knowledge, and consequently, the greater the probability of offering services and solutions of high added value to their customers.

## 5. Conclusion

The practice of structured development of local productive arrangements with institutional support of all actors of the business chain is the only way to regionally react to global competition.

Unlike the necessary actions for traditional arrangements, this article has dealt with the application of a method to incubate, manage and support industry development actions.

To do this, a method like the one proposed was simulated in a tooling shop environment in the state of Bahia, Brazil, where an emerging automotive industry and a petrochemical pole have generated a natural need for this chain.

In this initiative, the need for a guide to implement an “industrial incubator” is observed. However, the development of a cluster in a non-developed region will only take place with government support.

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