CONSTRUCTION OF A MASTER SCIENCE AND TECHNOLOGY PARKS OPERATIONS MODEL FOR THE STATE OF MINAS GERAIS – BRAZIL

1.Executive Summary

In Brazil the Science and technology parks movement is still under construction. The State of Minas Gerais, through its Science and Technology State Secretary, is conducting a great effort to build an effective articulation of the triple helix and bring significant social and economic accomplishments with measurable results. The State of Minas Gerais in partnership with DM&P[1], constructed a Master model of operation for the emerging parks, using the QFD methodology, linking market demands to the possible technical features involved in the design of the science and technology parks. This work aims to discuss the deployment and implementation process of the generated model, presenting its characteristics, results and lessons learned.

2. Science Parks and QFD

There are several definitions of science parks. Despite their variations, in general, most of them imply a strong connection between the technological and scientific environment and the generation of wealth and development.

For IASP[2], a science park is an organization whose primary goal is to increase the wealth of the community in which it is inserted in, promoting a culture of innovation and competitiveness, among enterprises and institutions that generate knowledge. A Science Park, then, stimulates and manages the flow of knowledge and technology among universities, research institutions, companies and markets.

For ANPROTEC[3], technology parks can be defined as "an industrial complex with scientific and technological basis of planned, formal character, concentrated and cooperative, which aggregates companies whose production is based on research developed in technological R & D centres linked to the park." It is possible to point three different generations of technology parks (ANPROTEC & ABDI, 2008, p. 12)[4]: 1st generation parks - pioneers parks: were raised to support the creation of NTBFs (new technology-based firms) and interaction with universities. A classic case of Pioneer Park is the Stanford Research Park, which originated in the innovative region known as Silicon Valley. 2nd generation parks - followers: created in a planned and formal structure, aiming to follow the footsteps of the established pioneers. They were focused largely in the process of promoting university-industry interactions over the decades from 70 to 90, in Europe and USA. 3rd generation parks: this type of park is strongly associated with the economic and technological development process of emerging countries (Korea, Taiwan, Singapore, among others). Created as a result of regional or national policies and designed to promote a process of socio-economic development. These Parks had strong governmental support and investment.

The same authors define some aspects that must be considered in an ideal development of a park (ANPROTEC & ABDI, 2008, p. 19): (a) have a clear value proposition and really be different from the others, (b) be a promoter of scientific and technological development in key economic sectors for the country, (c) define clearly what efforts are essential to the park growth and sustainability , (d) be connected to universities and entrepreneurial excellence; (e) have a deployment plan and a efficient management system (f) Have a set of backbone enterprises that contribute to the consolidation, (g) have a feasibility model based heavily on planned investments. The dynamics of technology parks in Brazil has been intensified in the last decade

1 DM&P is a private Brazilian company focused on new business opportunities, innovation and organizations restructuring from the perspective of customer needs and management tools.

2 International Association of Science Parks - http://www.iasp.ws/

3 Associação Nacional de Entidades Promotoras de Empreendimentos Inovadores - http://www.anprotec.org.br/

4 ABDI; ANPROTEC. Parques Tecnológicos no Brasil – Estudo, Análises e Proposições. Brasília, 2008. 561p

and more recently, after the 2008[5] crisis, has strengthened its relevance, since the global strategies and positions have been systematically reviewed and restructured. Brazil is expected to play an important role in the coming decades and need robust mechanisms for promoting innovation, education and development.

This relevance is reflected in the State of Minas Gerais[6] which had, since 2007, inserted among its structuring projects for innovation the development of five technology parks. There are some key characteristics that must be considered in the task of implementing and operating a park. Dimensions such as compliance rules; management structure, services, innovation incentives, infrastructure, etc. These dimensions are considered and discussed in Science parks worldwide[7].

A question always remains during the Science parks operational model development: how to define the ideal model? QFD (Quality Function Deployment) is a useful tool to help answer that question[8].The QFD method contributes to understand the priority needs and desires of organizations and stakeholders, registering and transmitting information to the development team. Within this context QFD supports the operations structure action planning[9].

QFD ensures, then, that the determined demands are incorporated into the project development. The method can be applied in various industries for different kinds of services or products, no matter they are tangible or intangible. It can also be used for different degrees of innovation, starting from simple adjustment, with minor changes, to more complex projects[10].

One of the most important benefits of QFD is often associated with the increase of communication between development project team. The information is grouped by affinity tables which are used throughout the project development process, gathering information about customer and stakeholders needs, driving the deployment of service quality characteristics. It is important to highlight the direct correlation between the needs and what is build to meet these referred needs.

Some other tools, such as Marketing research and statistics, are very important to facilitate the use of QFD[11]. In this content is possible to maximize the customer and Stakeholders satisfaction, by developing a service or product that meets their expectation, and accelerate the implantation process. The exhibit bellow illustrates this information.

---

5 Depois do Bric, o N11. Em: O Mundo dos emergentes. Revista Exame CEO. Dezembro de 2008

6 Plano Mineiro De Desenvolvimento Integrado
http://www.planejamento.mg.gov.br/governo/publicacoes/plano_mineiro_des_integrado.asp

7 SPOLIDORO, R.; AUDY, J. Parque Científico e Tecnológico da Pontifícia Universidade Católica do Rio Grande do Sul – TECNOPUC. Porto Alegre: Editora PUCRS, 2008.

8 GARGIONE, L. A.; PLONSKI, G. A.; LOURENÇÃO, P.T. M. Fatores Críticos de Sucesso para Modelagem de Parques Tecnológicos Privados no Brasil. In: XI Seminário Latino-Iberoamericano de Gestión Tecnológica. ALTEC: Salvador, 2005. 16p

9 CHENG, et Al. QFD: Planejamento da Qualidade. Belo Horizonte: Fundação Christiano Ottoni, 1995.

10 CHENG, L. C. ; FILHO, L.D.R. QFD: Desdobramento da Função Qualidade na gestão de desenvolvimento de produtos – São Paulo: Ed. Blücher, 2007.

11 DRUMOND, F.B; POLIGNANO, L.C. The role of market research during product development - http://pmd.hostcentral.com.br/search.php?busca=vol_01/nr_1#revista

.

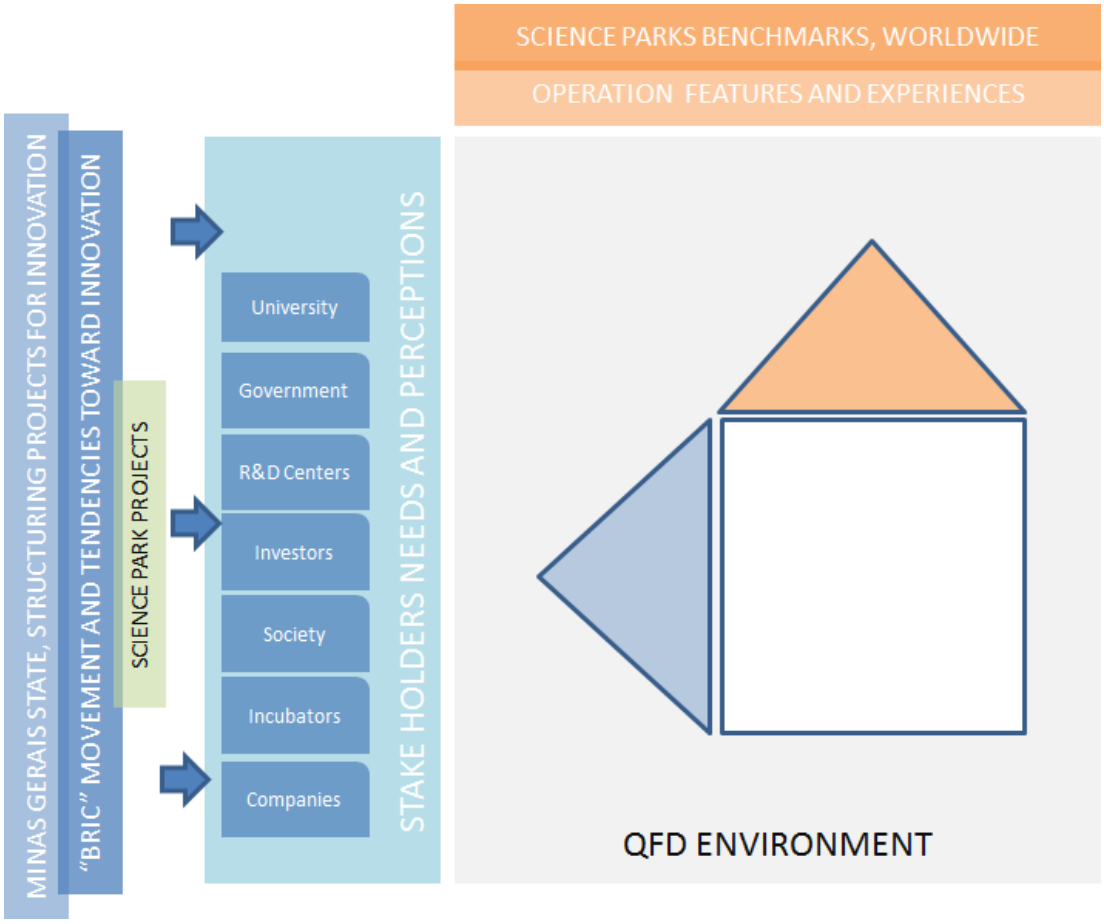


Exhibit 1 – The QFD environment and Science Parks

3. The Master Science and Technology Parks Operation Model

The Master Science and Technology Parks Operation Model represents the result of efforts undertaken to develop a simple and easy to use solution for the State of Minas Gerais. Now it can be used to plan and implement a Science and Technology park.

It was built from a methodology that seeks to encompass different perspectives on the subject, and an understanding of expectations and visions of various stakeholders in the project. Several lines of research were developed to elicit information necessary for the construction of the General Model. Some of these research findings will be incorporated throughout this article, in order to highlight the time and manner of use thereof.

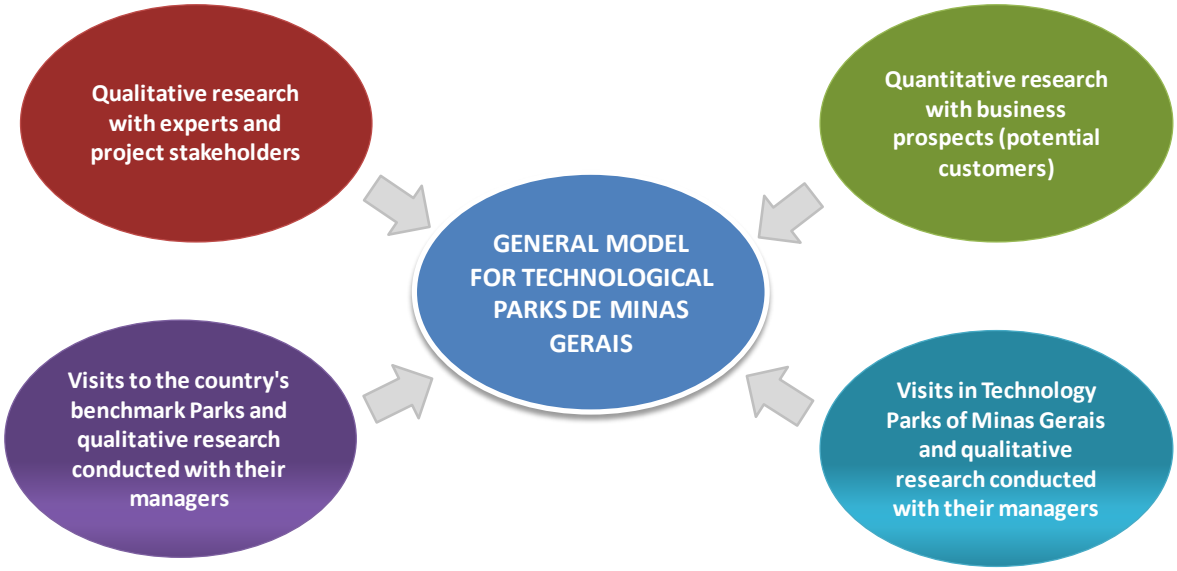


Exhibit 2 – Researches developed for the construction of the General Model

For differentiated Parks is necessary, essential and indispensable that three main goals are met throughout its planning on the construction process of Innovation Habitats: Strong concept, Good structure and a effective operation, Sustainability.

- CONCEPT. Initially, we must have a high concept for our Technology Park. That means we need to understand what is expected of our technology park, it is necessary to understand what our technology park should contain, offer and promote, in order to be seen as an attractive habitat for Innovation, from the look of different agents, local and global.

- STRUCTURE AND OPERATION. From the moment we have a strong concept for Technology Park, we must specify the Technology Park in terms of structure and operation, to meet the strong concepts with an efficient perspective.

- SUSTAINABILITY. Finally, we must have control over how to assess the sustainability of the Technology Park, not just in the financial aspect but also in relation to broader dimensions, as described later.

It is believed that these three great pillars bring differentiated Parks in Minas Gerais. In this sense, the model appears as a general base of information that defines and guides the decision making process of designing a technology park, providing the answers and following three main issues.

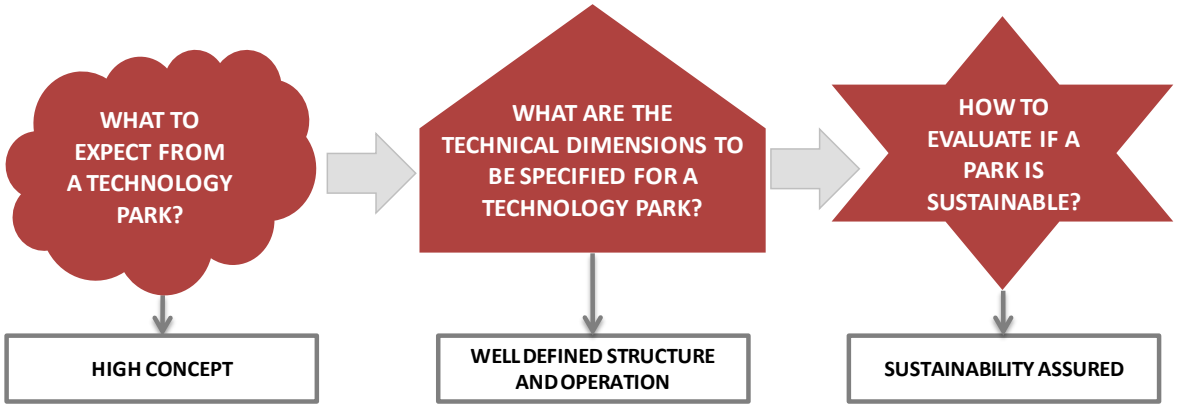


Exhibit 3 – The decision making process of the General Model

3.1. HIGH CONCEPT: What to expect from a Technology Park?

In order to identify strong concepts for Parks, consultations were held with experts in this issue of Science Parks, executives of Technology Parks in the country, potential customers of Science Parks (here referred to as business prospects) and others project stakeholders. For this, we had used techniques of quantitative and qualitative research.

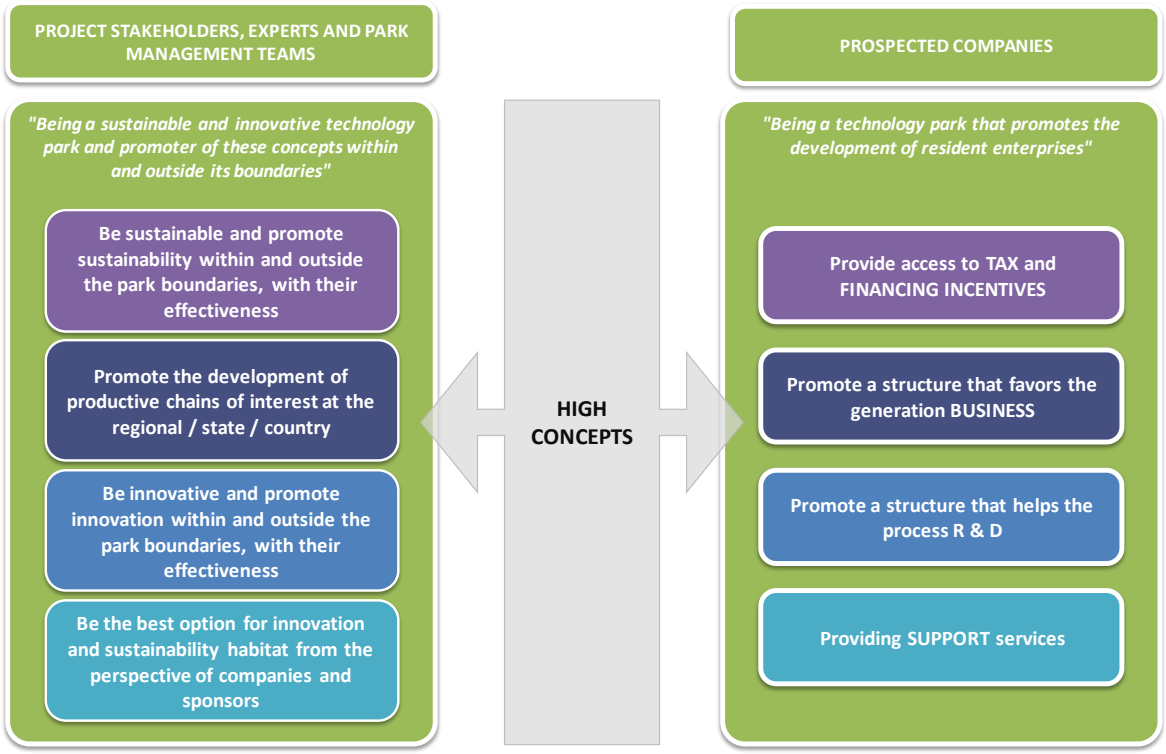


Exhibit 4 – The expectations from two different groups of customers

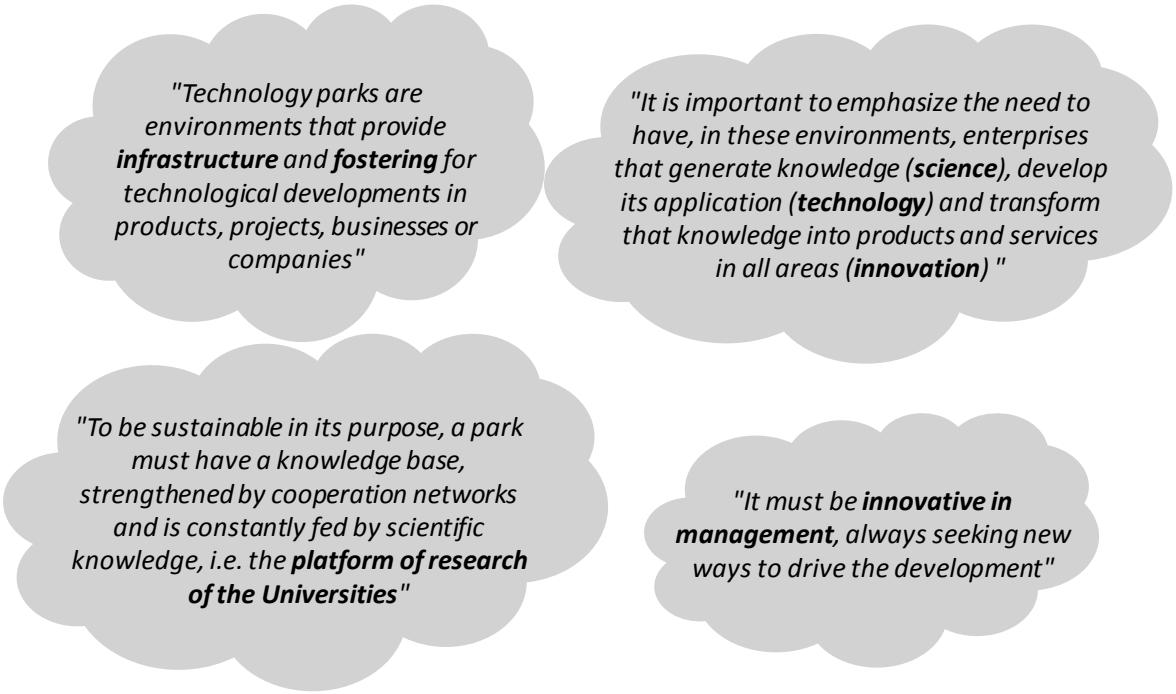
As we can see, different agents may have different views on Technology Parks, especially in terms of "what a technology park should contain, offer or promote". Upon hearing the voice of (1) the project stakeholders, subject matter experts and management teams of Parks and hear the voice of (2) business prospects, it is observed that the group of companies understands that a park should be an environment that promotes development, especially their own organizations residing in the Parks. On the other hand, the first group of interviewees goes a step further, emphasizing the need to increase the performance of the Parks as agents of socio-economic development of regions - the figure presented above bears the name of some interviewees to design concepts for Technology Parks. Importantly, these two views are parallel and there are, however, inconsistencies between them.

- **The view of specialists, managers of Parks and stakeholders of the project - interviewed:**

The project stakeholders, experts and management teams of Parks believe that four major dimensions summarize the general set of expectations related to addressing the broad concept of a Technology Park. These dimensions are not independent but interrelated and complementary.

Two main themes are part of the root of the concept of a Technology Park: park must be sustainable, innovative and promote sustainability and innovation within and outside the Park boundaries. In the dimension of sustainability, it can be detailed expectations related to the dimensions (A) economic and financial, (B) environmental and (C) social. The characterization of the dimension of innovation, in turn, passes through (A) the existence of skilled human resource, (B) the existence of networks of knowledge, technologies and business between agents and trainers involved with the Park and (C) offer support to companies in innovative processes.

Results of qualitative market research[12] from experts, managers and Technology Parks in the country project stakeholders:



Two other dimensions were substantiated by these respondents as complementary dimensions to the concepts of innovation and sustainability, and also essential for a park to be differentiated. Firstly, this habitat has to be attractive to its customers in order to attract quality companies and to convince the sponsors about this project. Therefore, it is necessary that the Park (A) provide basic infrastructure for installation of agents and (B) has a model of governance and management satisfactory.

Moreover, it is understood that a venture such as this should have the task of promoting the development of productive, whether at regional, state or even national, in order to contribute to raising the degree of competitiveness of Brazilians industries and companies on the world stage.

- **The vision of business prospects of Technology Parks:**

In view of potential customers on Science Parks (business prospects), there are four major dimensions of concept required by businesses. To be a Technology Park that promotes the development of resident firms it is necessary, initially, that Park have (A) a structure that favors the generation of business, (B) a structure that helps R & D processes, (C) support services to the company's activities, and has to (D) facilitate access to tax incentives and financing.

Quantitative research conducted with companies that already are located in Science Parks and with companies that are not within these habitats yet (but has potential to be) revealed some interesting results.

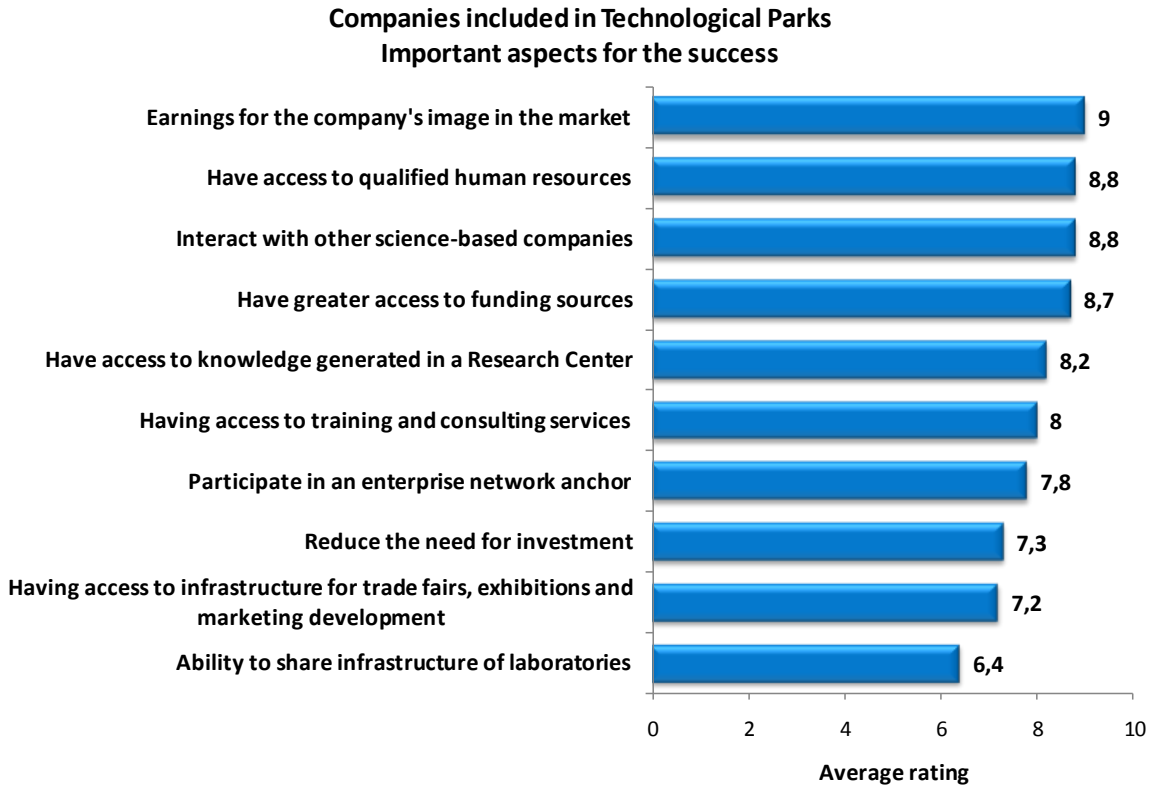
It was noted that "interact with other science-based companies" is not relevant for companies that are not in Science Parks, but is a standout in the rankings for businesses who already know the dynamics of these habitats for Innovation and already benefit from are installed there.

The item "reducing the need for investment, in turn, loses its value for companies that are already within Parks, possibly because they have already realized the value that brings to a park resident organizations goes far beyond the financial value .

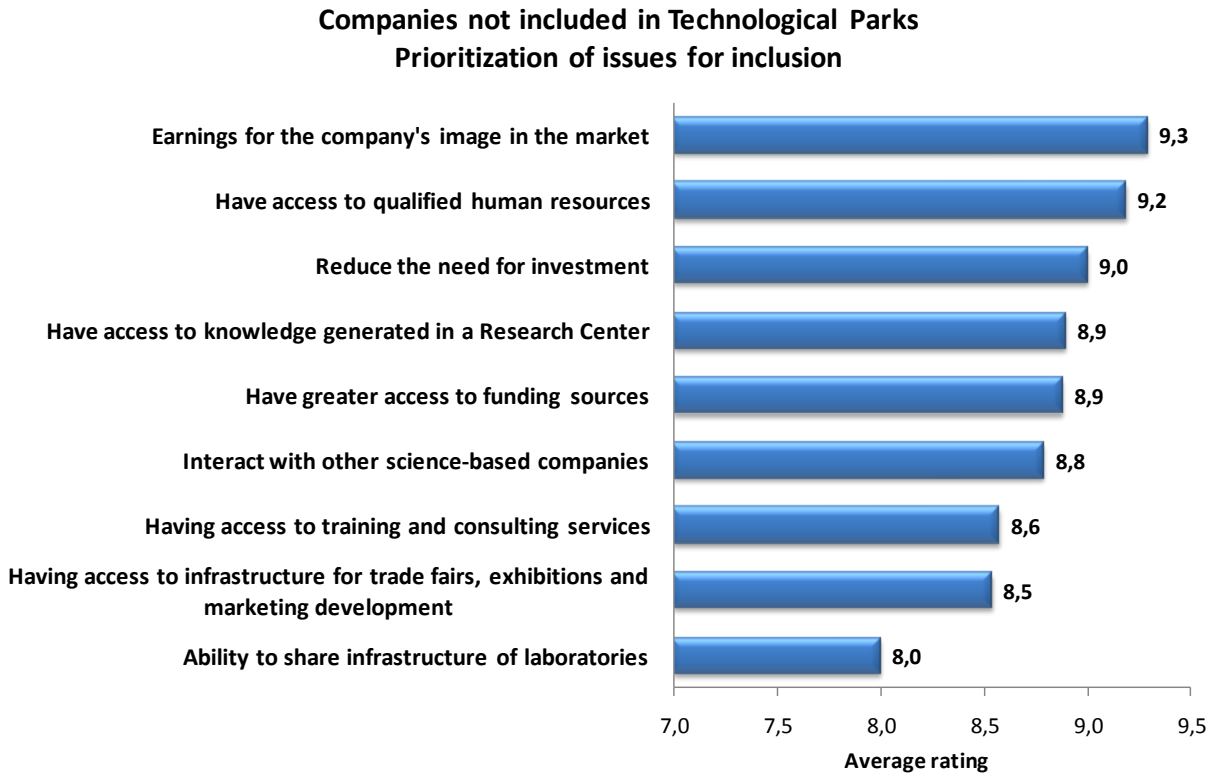
[12] Survey of 26 experts and stakeholders (DM&P / 2010)

The perception on the concept of a technology park, in some respects, are different for companies that are already in these environments and the ones that are not included. The two groups discussed agree that it is very important that a technology park would bring "gains for the company's image in the marketplace." They agree, too, which is not the function of these priority habitats of Innovation: the "guarantee of infrastructure for trade fairs, exhibitions and marketing development" and "the possibility of sharing infrastructure of laboratories."

Those are some results from the quantitative market research[13] with companies - on and off Science Parks.



[13] Survey of 178 business prospects (DM&P / 2010)



- **The high concepts of Parks built from the voice of various stakeholders in the project:**

The voice of these two groups of players approached to build strong concepts for Science Parks: (1) specialists, managers and Parks project stakeholders and (2) business prospects. Information was organized into two tables with different levels of deployment. It can be seeing below part of the deployed customer requirements tables developed in the project. The correct reading of the tables assumes that the sum of the items most deployed (right) meet the levels of grouping (or items left). Therefore, it is believed that if all the items in the table are met, we have strong concepts of Parks, given: "To be a sustainable and innovative technology park and promoter of these concepts within and outside its boundaries" and "Be a technology park that promotes the development of resident companies."

TABLE I for Customer Requirements - , experts and park management teams:
"Being innovative and sustainable and promote these concepts"

LEVEL 1	LEVEL 2	LEVEL 3
4- Be the best option for innovation and sustainability habitat from the perspective of companies and sponsors	Offer attractive INFRASTRUCTURE for installation (attraction and retention) of innovative and sustainable companies	Offer an attractive real estate model
		Offering good access
		Offer tax incentives
		To provide quality of work life
		Offer convenience services
		Provide condominium basic services
	Have models of GOVERNANCE and MANAGEMENT that promote advanced innovative processes and practice of sustainability	Have transparent governance model
		Have freedom of transit and interface with the academic and scientific community, community manager, government and society
		Have a professional management and entrepreneurial character
		Have autonomy, flexibility and efficiency in management
		Ensure continuity of projects, plans and strategies of the park over time
		Always seek new ways of conducting the enterprise

TABLE II for Prospects Companies - companies with potential for residence in a park:
"Being a technology park that promotes the development of resident enterprises"

LEVEL 1	LEVEL 2
1 - Provide access to tax and FINANCING INCENTIVES	Facilitating access to incentives
	Facilitating access to government investment
	Facilitating access to investors and lenders

Taking up what is expected of a technology park, we can show the dimensions of technical requirements related to the design of a park and bring alternative solutions to meet the demands and expectations outlined above.

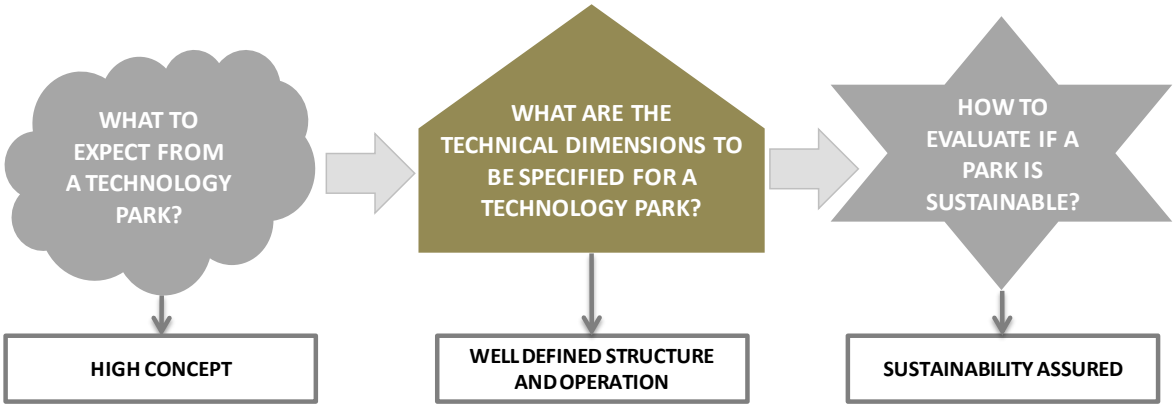


Exhibit 5 – The decision making process of the General Model, Step 2

3.2. WELL DEFINED STRUCTURE AND OPERATION: What are the technical aspects to be specified for a Technology Park?

To identify the technical dimensions of a technology park project, an experiment was conducted involving specialists and managers of Parks and benchmarks aimed at finding the "alternative solution techniques" that might somehow impact on meeting the strong concepts outlined.

This work was developed and presented to a group of people directly or indirectly involved in the project, and people involved in the design and operation of other parks already established in the country.

In a second step, the work was submitted for evaluation and validation of a set of experts in different areas of expertise: legal, government, finance and investment, real estate, urban planning and construction, among others. Of course, were part of this process of evaluating and validating that people are taken as reference in the environment of Science Parks.

The process of identifying the technical dimensions of project Park is shown below and was developed in four main steps, namely:

- Study and understand the concept of dimensions (presented in the previous section of this chapter);
- Extraction of alternative solution techniques related to the scope of the concepts outlined;
- Organization of alternative solution techniques in seven large project: governance, management, infrastructure, services, resources, incorporation and residents;
- Elaboration and refinement of each of the seven-dimensional design techniques Technology Park

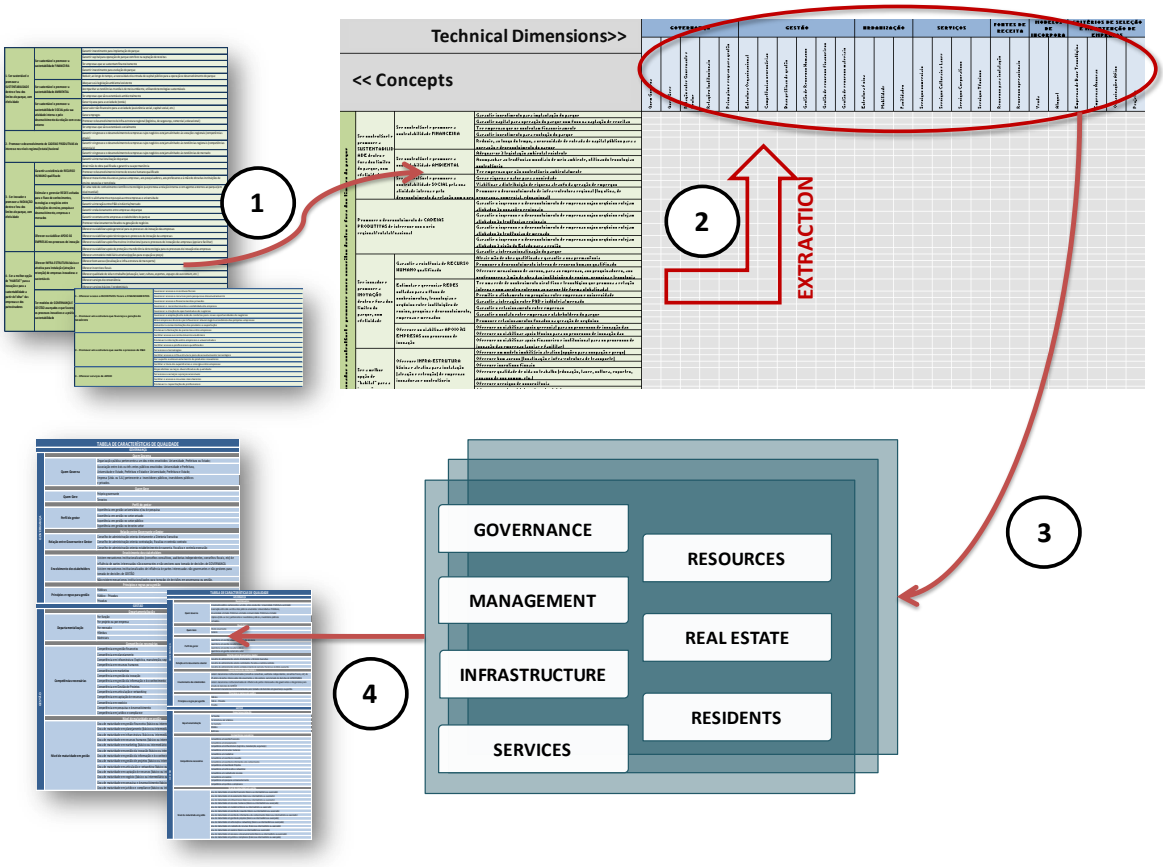


Exhibit 6 – The process of identifying the technical dimensions

The "technical requirements" drowned brings the pragmatism of forms and models of benchmark experiments to resolve the issues expected by the customers. These are the seven groups of specifications used to organize and characterize it.

• **GOVERNANCE:** Governance has emerged to resolve the conflict of interests between the owners or founders of organizations and the specialist officers assigned to their management. The main goal is to create an efficient set of incentive mechanisms for monitoring and ensuring alignment between the behavior of managers and the objective of the organization and its leaders. Good governance provides the organization's strategic management by governments, the monitoring of executives and their actions. Those who choose to practice good governance principles adopted as transparency, accountability, fairness and corporate responsibility.

• **MANAGEMENT:** The management seeks to achieve the goals through strategy development and utilization of human resources, financial and material provided by governments. A structured management is important to provide a strong performance at all levels of operation. Management should be divided into the strategic, tactical and operational levels.

• **URBAN INFRASTRUCTURE:** The Urban Infrastructure designates the action to provide an area, urban services and equipment to enable installation and proper functioning of the park and its hosted companies. This structure is an important resource for Technology Parks of Minas Gerais. Their qualitative features (modern, clean, accessible, etc...) and quantitative (size, numbers, etc...) influence the perception of people who will hire and utilize the direct and indirect services of those Parks. Also permit the provision of services and quantify the availability to host. If, in one side, the lack of space or structure can create problems to meet existing demands, loss of opportunity, too much idleness leads an increase in maintenance cost.

• **SERVICES:** As a physical structure, the services provided will directly influence the perception of benefits and quality of Parks by individuals and corporations interested or hosted. The services also provide revenue, such as real estate. The absence of some services can cause problems in meeting the existing demands and lost opportunity. Too much idleness leads, an increase in maintenance cost. Services can be outsourced, or in the condominium are available free or paid for use.

• **FINANCIAL RESOURCES:** The sources of revenue guaranteeing the installation and operation of the park. The investment and operational costs must be identified for financial sustainability planning. For the design of parks, it is believed that values should be planned and supplies for this two moments of the development: (A) Installation and (B) Operation.

• **REAL ESTATE MODELING:** The real estate is the activity performed by total or partial disposal of buildings, which may be composed of autonomous units in a condominium regime, in order to promote the construction. The owner may also choose or be required to maintain the property under his ownership, so he only gives its use in a lease basis. Thus, it is believed that the design specification of a technology park should specify the park's real estate agent, the business model used, the objects delivered, the ways of marketing, the average price in relation to local landmarks and forms of payment.

• **RESIDENTS:** The existing selection rules for entry into Parks and maintenance organizations point to different solutions. They range from the absence of formal rules, to the structuring of rules defined for different forms of entry and types of organizations. In the context of the State of Minas Gerais, the basic concern is to generate a structure based on the attendance of the sustainability. Variables must be inserted to define the rules for selection and maintenance of candidate firms and determine the types of organizations residing in the park, the space available for each type of organization, areas of knowledge that will be used to assess.

Each one of these groups of specifications was deployed in levels of specifications. This will detail the alternative for the decision making and specification during the park planning. As an example we bring a detailed group.

TABLE III - Real State Models deployed

REAL STATE MODELS		
	Real State Agent	
	Real State Agent	Own Technology Park
		Expert partner - Merging
	Marketing Forms	
	Marketing Forms	Construction itself - Land is delivered to the end user / investor to construct the building.
		Tailored or "Built to suit" - A bulding is made for a plaintiff
		Speculative - Land is handed over to build a standard and offer to the market without having a prior applicant
	Object	
	Object	Lands
		Buildings
		Rooms and assembly rooms
		Flats and houses
		Urbanized areas
	Business Model	
	Business Model	Sale
		Rent
		Grant
	Price	
	Price	Above average of the regional market
		On the averave or the regional market
		Bellow the average of the regional market
	Forms of Payment	
	Forms of Payment	Cash
		Financing
		Exchange

Back to the questions being answered by the general model under different parks in Minas Gerais State, we can proceed to the third and final question.

3.3.SUSTAINABILITY: How to evaluate a technology park is sustainable?

After bringing an understanding of what is expected of a Technology Park ("concept") and about what should be designed to develop a technology park ("structure and operation"), the next lines of this document brings a vision of how to analyze Sustainability of this project. As previously mentioned, analysis of ability implies the study of other dimensions beyond the financial. At this point they are the social and governance sustainability, as evidenced in the following figure.

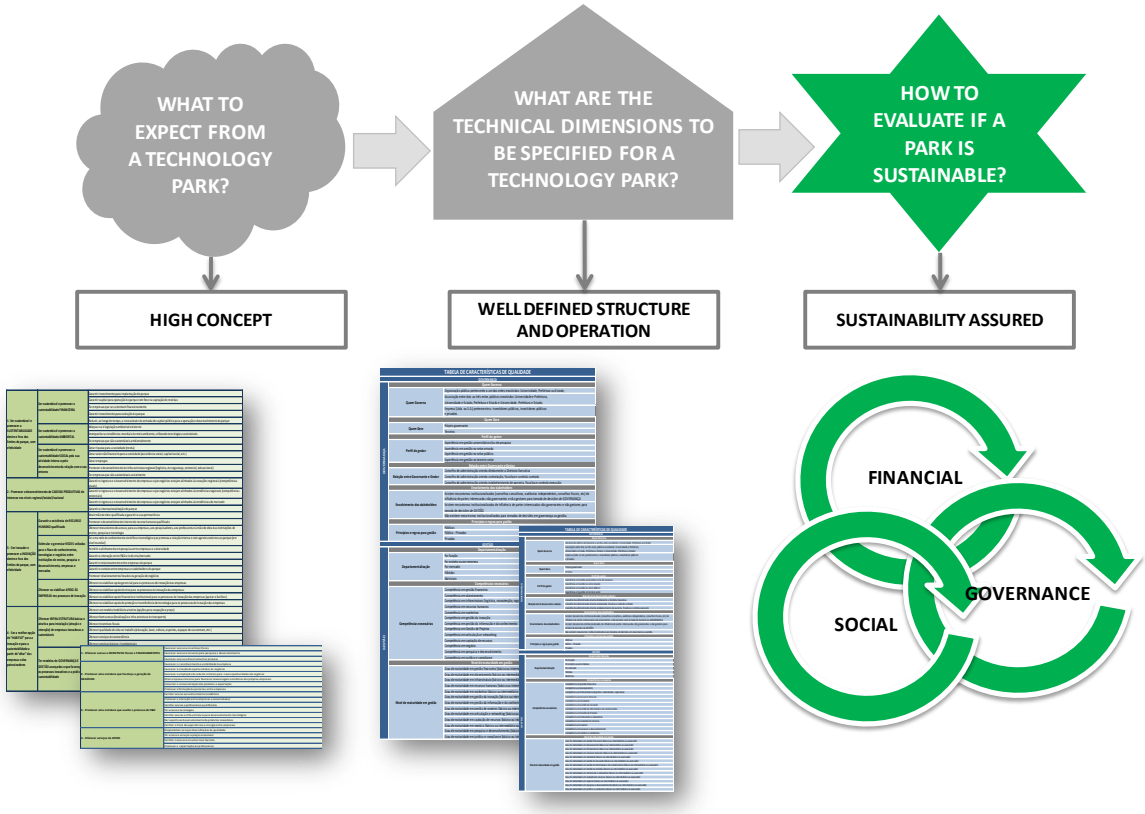


Exhibit 7 – The decision making process of the General Model, Step 3

It is considered in this work that: (A) a technology park will be financially sustainable when its operating cash flow is in equilibrium, (B) is socially sustainable when it is able to return to society, local and regional results Socioeconomic satisfactory (C) and will be sustainable from the aspect of its governance from the moment you've structured instruments of transparency and adequate for its proper functioning.

It's expected that environmental perspective will be evaluate over the services, architecture and engineering designs, so it will not be excluded from the Park or from this model.

3.3.1. FINANCIAL SUSTAINABILITY

From the financial point of view, the Sustainability Review aims to present what is the financial result of the project (cash flow, ROI) and what conditions guarantee Financial Sustainability (established premises). In this sense, some questions answered are: From what year the Technology Park will be able to function without the input of external resources? How will the fundraising to cover operating expenses (condo, rental, services, etc.)? How will the tax collection?

Therefore, it is necessary to devote efforts in collecting market information and to establish some assumptions, among which we can mention:

- Values rent rooms and offices of the Technology Park;
- Values rent lots of land on the Technology Park;
- Technical services, management and sources of incentive for innovation to be considered;
- Booking Fees / rental auditorium and training rooms to be charged;
- Operating Expenses condominium;

- Apportionment of the condominium;
- Other Operating Expenses, not condominium;
- Investments;
- Taxes;
- Scenarios for growth and occupation of the Park.

3.3.2. SOCIAL SUSTAINABILITY

With respect to the axis of Social Sustainability, the analysis aims to measure the result of the implementation of the Park in a socioeconomic perspective. In this sense, the model brought answers to such questions as: What is the expected job creation in the Park? What is the expectation of generating revenue in the Park? What is the potential to generate socio-economic outcomes for the region from the Technology Park?

Within the scope of the Analysis of Social Sustainability, you should gather information and establish premises such as:

- Rate of growth in the number of jobs in the municipality or region;
- Growth rate of GDP of the municipality or region;
- Occupancy rate for rooms in the Technological Park, by type of organizations;
- Jobs generated in the Technology Park;
- Annual turnover for medium sized organization resident;
- Average annual tax for possession of a resident organization;
- Occupancy rate of the area in the Technological Park.

3.3.3. GOVERNANCE SUSTAINABILITY

Within the last axle of Sustainability the study aimed at identifying conditions that ensure sustainability of governance. Thus, we seek to find answers to questions such as: What transparency instruments das Park should have? What is the maturity degree of the instruments used? What is the degree of difficulty to deploy missing instruments?

It is important to highlight how important is to the Park the formal documents that will bring transparency to the activities and for the business. The set of documents listed passes through the seven areas of Technical Requirements (presented in the previously).

The documents listed may have different levels of formality or completeness in a Park that has been developed. This model established degrees of maturity that can be used for each instrument of transparency and will identify gaps that should be filled in order to increase the sustainability of governance. These levels and their details are described in the next table.

TABLE III - Maturity levels for governance instruments

Maturity Level		Description
LEVEL 0	No existing	There are still having discussions among some policy makers
LEVEL 1	Informality	It is informal, but has its guidelines agreed between the leaders
LEVEL 2	Deployment	Instrument is in the process of formalization, with all its guidelines agreed upon by those responsible and set to their executioners
LEVEL 3	Reasonable	Instrument is finalized, but needs fixing to meet all standards and rules imposed on him or yet to be applied throughout the organization.
LEVEL 4	Good	Instrument is formalized according to all standards and rules imposed and fully implemented

The documents with short maturity levels need to be evaluated about the risk of lack of sustainability management in its area. These documents, by their maturity, are at levels 0, 1, 2 or 3 and need to reach level 3 or 4, what is considered sustainable.

The degree of difficulty of deployment can be seen as the difference between the current level of implementation and the reasonable level. After calculating these degrees for transparency instruments in the Technological Park it is possible to trace its profile of sustainability in governance.

4. Benefits from the master Model

The use of the master Model and its Business Plans customization developed for the Science parks in Minas Gerais, brings several benefits for the executives who manage these innovation habitats:

• Relates some experts opinions about the definitions and roles of a Science Park, regarding issues such as technological innovation and development;

• Brings the opinion of innovative companies, which may probable be candidates to be installed in the Park, expressing what is expected of a technology park;

• Points the view of stakeholders by outlining the guidelines that define the concepts of Minas Gerais parks;

• Points the requirements of each of these different clients, what helps to define the Park´s concept;

• Defines the dimensions and sub-dimensions, and their featured alternatives for structuring and operating the parks, aligned to the concept previously defined;

• Provides the evaluation of financial, social and governance sustainability, generated by the adopted model.

The Master model can also be used as an instrument for Park Management, as:

• Leads to a continuous collection of the customer needs, in order to measure and evaluate innovation levels compared to other habitats;

• Prioritizes dimensions and subdimensions pointing out which structure and operation improvements are necessary for the ongoing attraction and retention of businesses, projects, organizations and partners;

• Prioritizes the use of resources for infrastructure and new services implementation.

The Master Model also generates benefits for the different institutions involved in the Park value chain. These benefits are:

For the sponsors, stake holders, board and directors:

- Professionalism in the allocation and reallocation of resources;
- Greater involvement of people;
- Greater capacity for counseling and decision-making
- Transparency and compliance.

For the Anchor companies, TBF, partners, real state investors, Venture capitalists:

- The investments can be better planned, driving to a more secure decision making

For the other involded:

- Opportunity to participate in the construction of relevant public policies aiming to strengthen economic and social development in the region;
- Greater effectiveness in attracting and retaining key people (staff, partners and suppliers)
- More jobs opportunities.

The following exhibit illustrates these relations

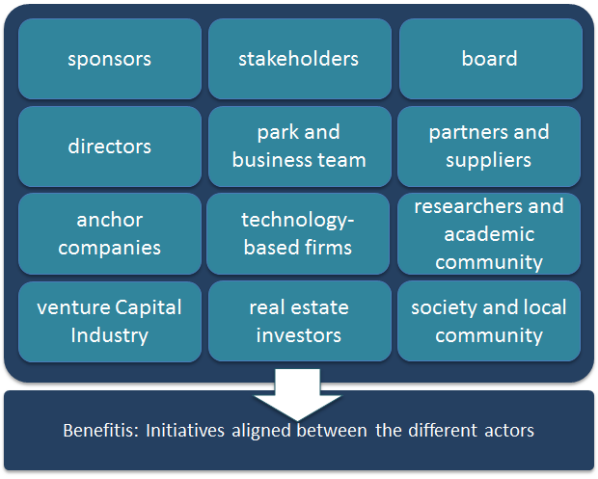


Exhibit 8 - Benefits for the involved institutions