RESEARCH PAPER

A model for measuring the quality of public policies in innovation

Paulo Renato Pakes[1] Ana Lúcia Vitale Torkomian[1] Brena Bezerra Silva[2] Miguel Ángel Aires Borrás[3] Vívian Karina Bianchini[3]
Carlos do Amaral Razzino[3]

[1]Federal University of São Carlos (UFSCar), São Carlos, SP, Brazil.
[2]Federal University of Bahia (UFBA), Salvador, BA, Brazil.
[3]São Paulo State University (UNESP), São Paulo, SP, Brazil.

ABSTRACT

Goal : This article presents a model for measuring the quality of public policies on innovation and its validation in a public policy on technology parks (SPTec)

Design/methodology/approach: A survey on the quality of public policy SPTec was carried out. Through descriptive analysis, it was possible to verify the quality of public policy in five determinants of quality. Factor analysis allowed the regrouping of quality attributes into new determinants for SPTec public policy. Finally, the multiple regression analysis allowed us to analyze the dependence relationship between the variables.

Results: The public policy SPTec is immature in terms of process quality, quality of the relation, and quality of the result. In addition, we identified the determinants that should be prioritized in the implementation of SPTec public policy in a possible reformulation. Finally, the attributes of quality that generate the greatest effect in terms of an increase in user satisfaction are shown, as well as those that generate a decrease in satisfaction if they have an increase in their performance.

Limitations of the investigation: Because of the chosen research approach, the research results may lack generalizability. Therefore, researchers are encouraged to test the proposed propositions further.

Practical implications: As a limitation, there is the fact that the factor analysis of public policy SPTec can only be generalized at the level of the same. Likewise, the presented model for measuring quality in the public sector requires adaptation for each public policy analyzed.

Originality/value: This article fills a gap regarding the lack of instruments for measuring the quality of public policies in innovation systems.

Keywords: Public Policies; Innovation System; Quality in the Public Sector.

INTRODUCTION

Saisse and Lima (2019) argue that leveraging technological capabilities for innovation is crucial for sustained economic growth and prosperity and, in this sense, to increase relations between companies and other organizations in the innovation system (IS), the Government of the State of São Paulo (GESP) instituted the São Paulo System of Technological Parks (SPTec) in 2006. The SPTec aims to give specific support to technology parks, attract investments, and generate new

knowledge-intensive or technology-based companies that promote the economic development of the State (ALESP, 2008).

The maturity of an IS depends on the synergy caused by the interaction between the different actors and institutions. Maturity can assume three different levels: mature, fast follower, or immature (WIPO, 2022; Figueiredo, 2011). Besides that, innovation is crucial to increasing productivity in emerging economies with recent growth-related difficulties, such as Brazil (WIPO, 2022). Governments at national, state, and regional levels carried out various initiatives to mature their Innovation Systems via the promotion of public policies.

Given this context, seeking to contribute to the theory of IS in local and regional governments in Brazil, the central question that guided the research is: Considering the existence of public policies aimed at the consolidation of the IS of the State of São Paulo like SPTec, how do users perceive the quality of these policies?

Therefore, the study is justified considering that several public policies have been implemented to strengthen the IS, however, studies on user satisfaction regarding their execution have not yet been carried out. Furthermore, it is important to look at the IS from the state perspective to analyze its components and their relationships and elaborate recommendations for improvements to the SPTec policy. This could have the effect of increasing the relationship between companies and other organizations of the IS.

Thus, to generate orientations to improve the quality of an innovative public policy, this paper proposes an original model for measuring the perceived quality of the IS based on the user's view. Specifically, it is expected to contribute to the analysis of the quality of public policies aimed at consolidating innovation systems.

It should be noted that this research will provide researchers and public managers in innovation with a basis for systematic investigation and implementation of the perceived quality of public policies as well as the quality determinants appropriate to their evaluation. The proposal of a model for the quality of public services in innovation systems can assist in understanding the bottlenecks of the innovation system.

Specific objectives include:

a) Analyze the performance of SPTec public policy and make inferences about the maturity of the IS;

b) Find the factors to identify the determinants of quality for SPTec public policy;

c) Verify the dependency relationships between the attributes of quality and the general level of satisfaction of users of the public policy SPTec.

To achieve these objectives, the survey method was used. The survey method contributes to the discovery of relationships between variables within a population (Hoss and Ten Caten, 2010).

Immaturity of innovations systems and SPTEC

Based on WIPO (2022) and Figueiredo (2011) we can state that immature innovation systems:

a) lack a legal framework in innovation and/or have ineffective legal frameworks that do not provide the appropriate incentives for innovation. It is proposed that in immature innovation systems, there is no participation of stakeholders in the development of innovation public policy.

b) face an environment that needs organizations to support their production activities, technical schools, and universities to provide them with the resources for innovation and usually present a precarious technological infrastructure.

c) the coordination between national, regional, and local levels is generally more precarious.

d) have ineffective regulatory frameworks, that is, they do not achieve results.

e) the definition of a robust and long-term set of priorities is difficult and - for purely budgetary reasons - the ability to finance, coordinate, and evaluate the large package of innovation is restricted, which would affect the reliability of public innovation policy.

It is worth stating that the opposite of these characteristics might be the reality for innovation systems that are mature or fast-followers.

To develop the IS of the State of São Paulo, SPTec was created. SPTec is a public policy whose objective is to promote technological research and innovation and to support the development of knowledge-intensive business activities. It aims to increase the technological innovation capacity of the hosted companies and contribute to the development of innovations and companies.

In this context, SPTec has the role of encouraging interaction and synergy between companies and other organizations in the IS, such as universities, research institutes, and others, in addition to facilitating the performance of innovative activities - such as access to laboratories, R&D external, technology transfer offices, conducting training and offering technological services, among others - as well as facilitating access to lines of financing for innovation as well as foreign direct investment.

Quality in the public sector

Quality in the public sector has been of great complexity because it involves not only the public sphere but also the association of the third sector and the realization of public-private partnerships (Pollitt, 2000). Therefore, an analysis of the specific needs of each type of user assumes greater production for the provision of quality public services. Measuring quality in the public sector allows the assessment of citizens' perceptions and provides public managers with the information necessary to take action to better serve the public. When it comes to innovation and the creative economy, public authorities must support and embrace a variety of business models, types of companies, and economic agents. They should also consider different strategies for viability and create a space for the resolution of conflicts and interests (Lima, 2018).

Regarding the measurement of quality in the public sector, this paper did a bibliometric analysis and a systematic analysis to identify models related to the measurement of quality in the public sector. The models are shown in Table 1 with their respective approaches, objects, and quality determinants.

Table 1 - Determinants of quality in the public sector

Model	Focus	Objects	Determinants
Parasuraman et al. (1985)	Private Services - expectation and performance	Product repair and maintenance, retail banking, long-distance phone calls, stock brokerage, and credit card operation - USA	Reliability, Promptness, Guarantee, Empathy and Tangible Aspects
Cronin and Taylor (1992)	Private Services - performance	Banks, pest control, dry cleaning and cafeteria - USA	Reliability, Promptness, Guarantee, Empathy and Tangible Aspects
Fornell (1996)	Public Services - Expectation and Performance	Government Services - United States of America	Consumer Expectation, Perceived Quality, Perceived Value, Consumer Complaints, Consumer Loyalty.
Sabadie (2003)	Public services	Family Allowance and Railways Fund Program - France	Reliability, Promptness, Guarantee, Empathy, Tangible Aspects, Equal Treatment, Participation, Complaints Management, Transparency.
Bovaird and Löffler (2003)	Public Governance	Public Policies - Several countries in Europe	Citizen commitment, transparency, accountability, equality, ethical and honest behavior, equity, ability to compete, capacity for partnership, sustainability, and respect for the rule of law.
Chen *et al.* (2005)	Public services	Public agencies - Taiwan	Consumer identification, consumer needs assessment, service system planning, service delivery, and service recovery.
Rhee and Rha (2009)	Public Services - expectation and performance	Hospitals - South Korea	Reliability, Promptness, Guarantee, Empathy and Tangible Aspects, Project Quality, Process Quality, Result Quality and Relationship Quality.
Meynhardt and Bartholomes (2011)	Public Services - Performance	Federal Labor Agency - Germany	Moral Obligation, Political Stability, Institutional Performance.
Im and Lee	Public Services -	District Governments -	Quality of the Process,

(2012)	Expectation and Performance	South Korea	Quality of the Result, Quality of the Environment, and Social Quality.
Mugion and Musella (2013)	Public Services - multichannel	Health Agency - Italy	Accessibility, Tangible Aspects, Responsiveness, Adequacy of information, Employees.
Brinkerhoff and Wetterberg (2013)	Public services	National Government - Indonesia	Decentralization, Setting standards, Transparency in information flows, and citizen participation.
Guenoun *et al.* (2016)	Public Services - expectation and performance	Municipality - France	Reliability-Transparency, Tangibles, Ethics, Relationships.
Santos *et al.* (2019)	Public Services	Public Regulatory Agency - Brazil	Service delivery, service cost, schedule and safety.

Source: The authors themselves.

Like Parasuraman et al. (1985), this paper considers that users of public services use the same criteria to arrive at an evaluative judgment on the quality of the service provided. The criteria are the determinants or dimensions of quality, which are sets of attributes related to the characteristics of the service provided.

As Cronin and Taylor (1992) this paper considers that quality should not be measured through the differences between expectation and performance - as proposed by Parasuraman et al. (1985) - but rather as a perception of performance. In addition, it is highlighted that the SERVPERF instrument is more sensitive in portraying quality variations about the SERVQUAL model (Cronin and Taylor, 1992; Guimaraes Junior et al., 2024).

After the qualitative analysis of the attributes of the twelve models of determinants, it was possible to propose five quality determinants that might comprise elements present in all identified models. Therefore, this paper is based on the use of five determinants for measuring quality in the public sector, namely:
a) Quality of planning.
b) Quality of the process.
c) Quality of the relationship.
d) Quality of the result.
e) Reliability.

This reduction of the original nine determinants of Rhee and Rha (2009) to only five determinants was made considering the precedents of Parasuraman et al. (1988) regarding the refinement of the original SERVQUAL instrument of Parasuraman et al. (1985) that reduced the number of determinants from ten to five. Besides that, a wide range of determinants can make it difficult to understand the limits between the proposed factors and, consequently, the priorities to be followed by managers.

METHODOLOGY

The survey method contributes to the discovery of relationships between variables within a population (Hoss and Ten Caten, 2010). In general, surveys involve the collection of information from individuals about themselves or about the social units to which they belong, through questionnaires sent, phone calls, and personal interviews (Forza, 2002).

Through this survey, it was intended to investigate the quality of public policy SPTec from the users' point of view. Then, it was necessary to identify the determinants of quality in the public sector and the attributes of quality related to the execution of the selected public policy.

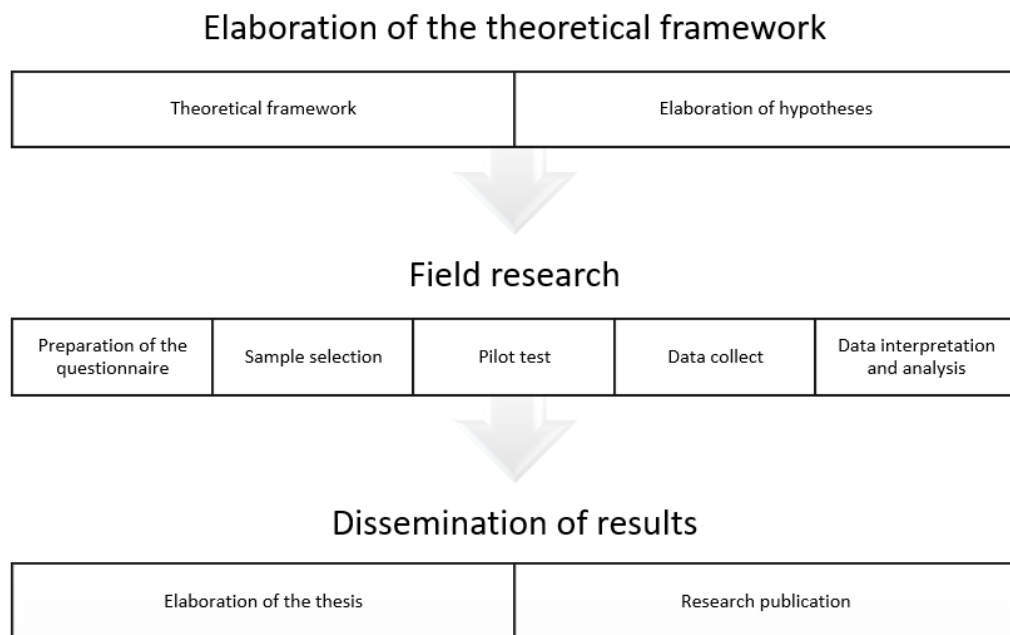This study was conducted in three major phases, as shown in Figure 1.

Elaboration of the theoretical framework

Figure 1 - Research steps
Source: The authors themselves.

Elaboration of the theoretical framework

To select the theoretical framework for IS, a bibliometric analysis was carried out. To build the theoretical framework on quality in the public sector and quality measurement models in the public sector, a bibliometric analysis and a systematic analysis were carried out, to identify the existing models and quality determinants used.

Elaboration of hypotheses

For Luna (2009) to formulate the hypotheses, based on analysis of available knowledge, the researcher ends up "betting" on what may arise as a result of his research. Once the problem is formulated, a supposed, probable, and provisional answer (hypothesis) is proposed, which would be what he finds plausible as a solution to the problem.

As stated, regarding innovation laws, two circumstances arise:

a) Innovation systems considered mature or fast followers tend to present an effective framework of laws that encourage innovation. This suggests that the quality perceived of public policy in these systems is equal to or higher than the expectations of users.

b) Innovation systems considered immature tend to present the absence of laws to encourage innovation or the presence of ineffective laws. They also have difficulties with budgeting or establishing long-term planning, which might not provide the appropriate incentives for innovation. This suggests that the quality perceived of public policy in these systems is lower than users' expectations.

Therefore, the following hypotheses were built about measuring the perceived quality of the SPTec. Such hypotheses seek to understand how the IS presents itself - in terms of maturity - from the evaluation of quality by the user of a public policy of innovation in its various determinants of quality.

Hypothesis 1a: If the IS is a mature or fast follower, the average of the quality attributes of the project will likely be of partial or total agreement.

Hypothesis 1b: If the IS is immature, likely, the average of the attributes in quality of the project is partially or disagreed.

Hypothesis 2a: If the IS is a mature or fast follower, the average of the attributes in the quality of the process is likely partial or total agreement.

Hypothesis 2b: If the IS is immature, likely, the average of the quality attributes of the process is partially or disagreed.

Hypothesis 3a: If the IS is a mature or fast follower, the average of the attributes in the quality of the relationship is likely partial or total agreement.

Hypothesis 3b: If the IS is immature, the average of the attributes in the quality of the relationship will likely be partial or total disagreement.

Hypothesis 4a: If the IS is a mature or fast follower, the average of the attributes in quality of the result will likely be of partial or total agreement.

Hypothesis 4b: If the IS is immature, the average of the attributes in quality of the result will likely be of partial or total disagreement.

Hypothesis 5a: If the IS is a mature or fast follower, the average of the attributes in reliability is likely of partial or total agreement;

Hypothesis 5b: If the IS is immature, the average of the attributes in reliability is likely to be partial or total disagreement.

Field research

The review built on quality in the public sector presented the theoretical framework with the variables (attributes of quality) necessary for its measurement. Through the construct, it was possible to identify the determinants of quality in the public sector, which will be explored in factor analysis.

After the factor analysis, we will find the determining factors of quality in the public policy SPTec.

Preparation of the questionnaire

In this phase through the defined determinants and attributes a questionnaire based on the SERVPERF is developed. This questionnaire is configured as a quantitative research instrument as it uses information listed on a 7-point Likert scale, thus quantifying qualitative data (Example: grade "1" is equivalent to "totally disagree"). The 7-point Likert scale was chosen because it proved useful in capturing social perception in several studies related to the expectation gap, such as Best, Buckby and Tan (2001), for example.

The bibliographic review on IS, recent innovation policies in the State of São Paulo, and quality in the public sector allowed us to identify a set of perceived quality attributes related to the public policy SPTec.

For the weighted measurement of the quality of SPTec public policy, a scale was added to the proposed questionnaire so that users of the policy assign the relevance of each of the attributes of perceived quality about public policy on a scale of "little relevant to innovation", "relevant to innovation" and "very relevant to innovation".

Furthermore, this paper proposes that the level of user satisfaction is associated with the level of maturity of the IS. Thus, a question was added to the research instrument regarding general satisfaction with public policy. The respondent will be able to evaluate public policy at 7 levels of satisfaction from (1) dissatisfied to (7) satisfied.

Pilot test

In this step, the adapted SERVPERF model was validated by an expert panel and by an employee of a company hosted in a technological park of SPTec, obtaining an assessment of the perceived quality of the service, in addition to information related to suggestions for improvement in the questionnaire. It was also possible to validate the Likert scale.

Sample selection

The sample comprised companies located in SPTec technology parks. A population of 168 companies was identified for data collection. Considering 95% confidence, with a 15% error margin and using the equations to determine the representative sample according to Agranonik and Hirakata (2011), the sample size must be, as shown is equation 1:

$$n = p(1-p)Z^2 n / (\epsilon^2 (N-1) + Z^2 p(1-p))$$

Where n is the sample size, p is the expected proportion, Z is the normal distribution value for a given confidence level, N is the population size and ϵ is the size of the confidence interval. Substituting the values in the equation, we have:

$$n = (0{,}5 \times (1-0{,}5)1{,}96^2 168) / (〚0{,}15〛^2 (168-1) + 1{,}96^2 0{,}5(1-0{,}5)) \cong 34{,}19$$

For a population of 168 companies, for the sample to be representative, at a 95% confidence level, it should involve approximately 35 companies located in the technology parks. This sample is composed of companies of different sizes and different sectors and will be better detailed in the description of the results.

Data collect

The questionnaire was sent to all companies selected in the sample until it reached a return rate of approximately 10%. The first round of data collection comprised between the months of August and December 2017. The total of two rounds of data collection resulted in 48 responses.

Data analysis

The data analysis included a descriptive analysis, a factor analysis, and an analysis of the hypotheses. The descriptive analysis aimed to characterize the responding industries and to identify the public policy quality performances. The analysis of the hypotheses focused on discussing the maturity of the IS based on the perceptions of quality obtained.

After data collection, the reliability and validity of the measurement scales used through Cronbach's alpha were verified.

After the examination, the tabulated data was analyzed, allowing the analysis of the performance in the evaluated attributes, the identification of the intervention priority (Freitas et al., 2006) on the attribute through the analysis of quartiles, and then the establishment of improvement proposals for the IS.

Then, a factor analysis was carried out, to regroup the attributes of quality in SPTec public policy in new determinants of quality, specific to this public policy. According to Hair et al. (2009), factor analysis is a generic name given to a class of multivariate statistical methods whose main purpose is to define the underlying structure in a data matrix.

Finally, a regression analysis was performed, a statistical model used to predict the behavior of a quantitative variable (dependent variable or Y) from one or more relevant variables of an essentially interval or ratio nature (independent variables or X) informing about the margin of error for these predictions.

The SPSS® software (Statistic Package for Social Study, version 20.0) was used to perform the statistical analyses. The next step was the interpretation of the partial results of this research.

RESULTS

The result section is divided into five periods, namely: a) characterization of the sample; b) reliability analysis; c) descriptive analysis; d) factor analysis, and e) multiple linear regression analysis.

Sample characterization

Initially, it is worth noting that the survey was answered by 48 companies in a universe of 168 companies located in SPTec technology parks that were identified. Thus, this research had a return of 28.57% of the universe of companies located in SPTec.

Regarding the respondents' residence time in the parks, it was found that the majority (62.5%) were located in the parks for 2 to 5 years. Another 25% have been living in the parks for about 1 or 2 years. Finally, another 12.5% have lived in the parks for more than 5 years.

It was possible to observe that 81.2% of respondents have product innovation as the most significant type of innovation practiced by the company while another 18.8% have process innovation as the main type. In addition, 87.5% of respondents carry out R&D projects while 12.5% do not.

Analysis of the Reliability of the Data Collection Instrument

The value of Cronbach's alpha was calculated using the statistical software SPSS, to determine whether the questionnaire was reliable or not, and consequently, to continue the research. Then, the mean and standard deviation of each item and dimensions were calculated. The highest averages represent the best-rated items, that is, the service that has the best perceptions of quality.

The alpha coefficient was obtained from the SPSS, checking the internal consistency of the questionnaire. The model proposed by Cronbach (1988) was used. The author considers that each item must be satisfactorily correlated with its dimension (or factor) and, on the other hand, there should be no negative correlations between an item and the total scale, as in equation 2.

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum Si^2}{St^2}\right)$$

In which,
k= nnumber of items on the scale
$\sum \llbracket Si^2 \rrbracket$ =sum of the variance of the items

St^2=variance of the entire scale
α =reliability coefficient

According to Pestana and Gageiro (2008), the alpha value must be positive, varying between 0 and 1, as shown in Table 2.

Table 2 - Valuation of Cronbach's alpha and internal consistency

Alpha Value	Internal consistency
Greater than 0.9	Very good
Between 0.8 and 0.9	Good
Between 0.7 and 0.8	Moderate
Between 0.6 and 0.7	Weak
Less than 0.6	Inadmissible

Source: Pestana and Gageiro (2008).

Considering the complete instrument (Table 3) for reliability analysis, we obtained a Cronbach's alpha value considered good (0.873) in terms of internal consistency by the classification of Pestana and Gageiro (2008).

Table 3 - Reliability statistics for the complete questionnaire (5 determinants)

Cronbach's alpha	Cronbach's alpha based on standardized items	No. of items
0,873	0,885	29

Source: The authors themselves.

In addition, through the analysis of Cronbach's alpha for each determinant, it was possible to verify an internal consistency considered reasonable by Pestana and Gageiro (2008) for the five quality determinants, as shown in Table 4.

Table 4 - Reliability statistics for the Project Quality Determinant

Determinant	Cronbach's alpha	Cronbach's alpha based on standardized items	No. of items
Project Quality	0,716	0,72	4
Process Quality	0,789	0,834	11
Relationship Quality	0,729	0,737	6
Result Quality	0,735	0,773	5
Reliability	0,719	0,793	3

Source: The authors themselves.

Therefore, it was observed reliability was considered adequate for the determinants of quality as well as for the instrument.

Quality analysis of attributes and determinants

To measure the quality of attributes and determinants by the SERVPERF model, the formula proposed by Salomi et al. (2004) was used, according to equation 3.

$$SERVPERF\ QS = \frac{1}{m}\sum_{j=1}^{m} w_{jk}D_{jk}; 1 \le k \le 5$$

In which,
QS=Value attributed to the quality of the public policy attribute.
D_jk=Performance of a characteristic j of dimension k.
w_(jk)=Importance of a characteristic j of dimension k.
m=Total population responses.

After that, the standard deviation was calculated for each of the attributes evaluated.

To understand the criticality of intervention to improve the evaluated attributes, quartile analysis was used. The Quartile Analysis was proposed by Freitas et al. (2006), to contribute to the proposal of criticality levels for the classification of the evaluated quality attributes.

Table 5 shows the relationship between the quartiles calculated for the present sample and their relationship with the priority of intervention and with the quality of the evaluated attribute.

Table 5 - Intervention priority (criticality of resolution of the attributes) and division by quartiles for the average of the samples

Intervention Priority	Quartile	Attribute quality
Low	Fourth Quartile (from position 24 to position 29)	Acceptable, Adequate performance of public policy
Moderate	Third Quartile (from position 16 to position 23) - value 14	Next to Neutral, does not have extraordinary performance or very bad or generates little value for the user
High	Second Quartile (from position 8 to position 15) - value 8.6875	Next to Very poor, very low performance of public policy
Very High	First Quartile (from position 1 to position 7) - value 14	Unacceptable, requires urgent intervention

Source: The authors themselves.

The subsection below presents the analysis of the quality of the attributes by determinant.

Project Quality

Table 6 presents the average QS value of the attributes that make up the Project Quality determinant, followed by the standard deviation and the priority of intervention on the attribute.

Table 6 - QS value of the Project Quality determinant

Variable	Attribute	Average	Standard deviation	Intervention priority
Proj1	Consultation of the Public Power to the target audience during the formulation of public policy aimed at the needs of users.	13,313	6,3385	Moderate
Proj2	Location of the technology park close to universities, research institutes and knowledge centers.	14,813	4,8495	Low
Proj3	Institution of the technological park according to regional economic vocations.	15,938	2,7784	Low
Proj4	Alignment of public policy with other Laws to encourage innovation.	15,063	4,9953	Low
Averages of Determinant attributes		14,781		Low

Source: The authors themselves.

About the attribute Proj1, it was possible to observe a moderate intervention priority considering the classification of quartiles. About the other three attributes analyzed in this determinant (Proj2, Proj3, and Proj4) these were considered a low intervention priority.

In terms of Project Quality, it was possible to observe average performances in the range of 13.31 and 15.93. It should be noted that the maximum possible value to be reached (in the case of an excellent public policy) would be 21.00 and the minimum possible value would be 1.00. Therefore, the average of the dimension (14.78) - no matter how much in the analysis of quartiles is considered a low intervention priority - is not close to the best possible performance.

Through this analysis, it would be possible to consider the IS as mature in terms of project quality, considering the values achieved in the attributes that compose it.

Process quality

Table 7 shows the average QS value of the attributes that make up the Process Quality determinant, followed by the standard deviation and the priority of intervention on the attribute.

Table 7 - QS value of the Process Quality determinant

Variable	Attribute	Average	Standard deviation	Intervention priority
Proc1	Offering sufficient and adequate physical space for the installation of companies.	14,25	4,354	Low
Proc2	Facilitating access to researchers and R&D professionals.	7,6875	3,9581	High
Proc3	Facilitating access to technological services relevant to the company (testing and testing laboratories, certifications, training, patent offices, etc.).	6,6875	2,2799	High
Proc4	Facilitating access to university equipment and/or research institutes.	8,75	4,2049	Moderate
Proc5	Facilitating the formation of partnerships to innovate.	9,125	4,1648	Moderate
Proc6	Facilitating the incubation of ideas.	8,9375	3,856	Moderate
Proc7	Provision of financing lines to carry out innovative activities.	5,875	1,5929	Very High
Proc8	Providing access to high-level Information and Communication Technology.	6,1875	1,9963	High
Proc9	Facilitating access to international joint research opportunities or foreign direct investment (FDI).	4,75	1,4947	Very High
Proc10	Provision of training on the use of the mechanisms proposed by the Law.	15,938	5,9409	Low
Proc11	Funding of non-reimbursable financial resources from Development Agencies.	5,4375	1,5966	Very High
Average of Determinant attributes		8,5114		High

The attributes Proc4 (8.75), Proc5 (9.12), and Proc6 (8.93) were considered to be of moderate intervention priority to the other attributes evaluated in the research. The performances of these attributes were below the midpoint (10). Considering the core of a public policy like SPTec - aimed at the articulation between the elements of the IS - the performances of such attributes deserve concern on the part of the Public Power and the management organizations of technology parks, even though they are considered a priority moderate intervention about the other evaluated attributes.

The attributes Proc2 (7.68), Proc3 (6.68), and Proc8 (6.18) were considered a high intervention priority.

Finally, regarding the attributes Proc7 (5.87), Proc9 (4.75), and Proc11 (5.43), it was possible to

verify a very high intervention priority.

About the determinant quality of the process, it was possible to observe different degrees of priority of intervention in its determinants. However, the majority is classified as moderate, high, or very high, implying a high criticality of this determinant for the quality of the public policy in question. Considering the average performance of this determinant, it could be said that the IS is immature in terms of process quality.

QS quality of the relationship

Table 8 shows the average QS value of the attributes that make up the Quality of Relationship determinant, followed by the standard deviation and the priority of intervention on the attribute.

Table 8 - QS value of the Quality of Relationship determinant

Variable	Attribute	Average	Standard deviation	Intervention priority
Rel1	As for conducting satisfaction surveys and handling complaints.	3,375	1,0644	Very High
Rel2	As for transparency in the use and distribution of resources for innovation.	4,125	1,8175	Very High

Source: The authors themselves.

The Rel3 attribute (11.5) was classified as a moderate intervention priority. The decentralization of public policies has the effect of dispersing execution among different levels of government.

The Rel5 attribute (12.37) was also classified as a moderate intervention priority. Thus, it is suggested to use these in a wider scope to streamline and improve the quality of the relationship with users.

Finally, the attributes Rel1, Rel2, and Rel6 were classified as having a high intervention priority. The performance of the Rel1 attribute suggests the need for systematic and periodic satisfaction surveys and handling user complaints.

The performance of the Rel2 attribute suggests the need for greater transparency in the use and distribution of resources for innovation.

Finally, the Rel6 attribute suggests the need for innovations in the public sector to increase the quality of the relationships between the agents involved in the innovative process.

The average performance of the Quality of Relationship determinant can be considered as a high intervention priority, showing itself as a critical element to undergo reformulations for better execution of SPTec public policy. From the analysis of this determinant, one can consider the IS as immature.

Result quality

Table 9 shows the average QS value of the attributes that make up the determinant Quality of Result, followed by the standard deviation and the priority of intervention on the attribute.

Table 9 - QS value of the Result Quality determinant

Variable	Attribute	Average	Standard deviation	Intervention priority
Res1	Facilitating the maturation of the company's technological innovation capacity.	8,6875	4,8429	High
Res2	Increase in the number of R&D projects conducted by the company.	6,875	2,7877	High
Res3	Facilitation of product	6,8125	2,8632	High

Variable	Attribute			Intervention priority
	innovations.			High
Res4	Facilitating the realization of process innovations.	6,4375	1,5966	High
Res5	Promotes job creation	5,6875	1,9478	Very High
Average of Determinant attributes		6,9		High

Source: The authors themselves.

This determinant proved to be very critical. About the attributes Res1, Res2, Res3, and Res4, the performance suggests the need to conduct a study to understand which levels of technological innovation capacity of companies hosted in the parks so that it is possible to establish more methodically what the needs of these companies in terms of innovation and technological development.

Finally, the performance of the Res5 attribute, highlights the social role of this public policy, considering that it also aims at the economic and social - and not only technological - development of the regions in which it is implemented.

Overall, the performance of this determinant was classified as a high intervention priority and calls into question the effectiveness of the public policy SPTec, considering that the main objective of the public policy in question - to encourage innovation and technological development - is not being achieved with excellence.

Reliability

Table 10 shows the average QS value of the attributes that make up the determinant Reliability, followed by the standard deviation and the priority of intervention on the attribute.

Table 10 - QS value of the determinant Reliability

Variable	Attribute	Average	Standard deviation	Intervention priority
Reliab1	Reduction of financial risks to innovate.	13,938	4,7058	Low
Reliab2	Provision of resources necessary for innovation in an ideal time and with regularity.	5,5	1,5574	Very High
Reliab3	Presence of attentive and trained employees to explain any doubts about the Laws of Innovation.	18,188	4,3499	Low
Average of Determinant attributes		12,542		Moderate

Source: The authors themselves.

It is possible to verify that the performance can be considered acceptable for Conf1 and Conf2. On the other hand, SPTec public policy presents a very high priority for intervention in terms of providing the necessary resources for innovation in an ideal and regular time. Such performance suggests the need for proposing a long-term Strategic Plan in Science, Technology, and Innovation that can be carried out through different public administrations.

Thus, in terms of the mean of the determinant Reliability, it was possible to verify a moderate intervention priority. It requires special attention to provide the necessary resources for innovation regularly, a difficulty that seems to be inherent in the public sector due to party changes accompanied by changes in the focus of public policies exercised by the representatives as well as the resources distributed.

Factor analysis of the independent variables

According to Pestana and Gageiro (2008), factor analysis is a set of statistical techniques that seeks to explain the correlation between observable variables, simplifying the data by reducing the number of variables necessary to describe them.

The first step of this analysis consisted of choosing the method of rotation of the factors so that they are more interpretable (PESTANA; GAGEIRO, 2008). According to Hoss and Ten Caten (2010), the most popular method for this purpose is called varimax. For Pestana and Gageiro (2008) this method minimizes the number of variables with high indexes in one factor, obtaining a solution in which each main component approaches ± 1, in the case of association between both, or zero,

in the case of absence of Association.

The second stage consisted of assessing the quality of factor analysis, using two criteria. The first was the Kaiser-Meyer-Olkin (KMO), which according to Pestana and Gageiro (2008), measures the quality of the correlations between the variables to proceed with the factor analysis, it can vary between zero and one. The second was Bartlett's sphericity, which also allows to assessment of the quality of the correlations between the variables, by testing the null hypothesis that the correlation matrix is an identity matrix, which implies the existence of the relationship between the variables (Pestana and Gageiro, 2008).

According to the result of the factor analysis, the level of significance is approximately zero and the KMO index resulted in 0.710, being above 0.6, so the grouping is acceptable. Bartlett's test showed a significance level of 0 (less than 0.05), therefore also considered acceptable. This suggests that there is a correlation between some variables, according to Pestana and Gageiro (2008).

The grouping was done through the factor analysis of the quality attributes, using the Bartlett method. The factor analysis indicated the existence of 9 factors, from the cut to eigenvalues (eigenvalues) greater than 1 according to the recommendations of Figueiredo and Silva (2010). The result of this grouping is shown in Figure 2.

Figure 2 - Several factors formed
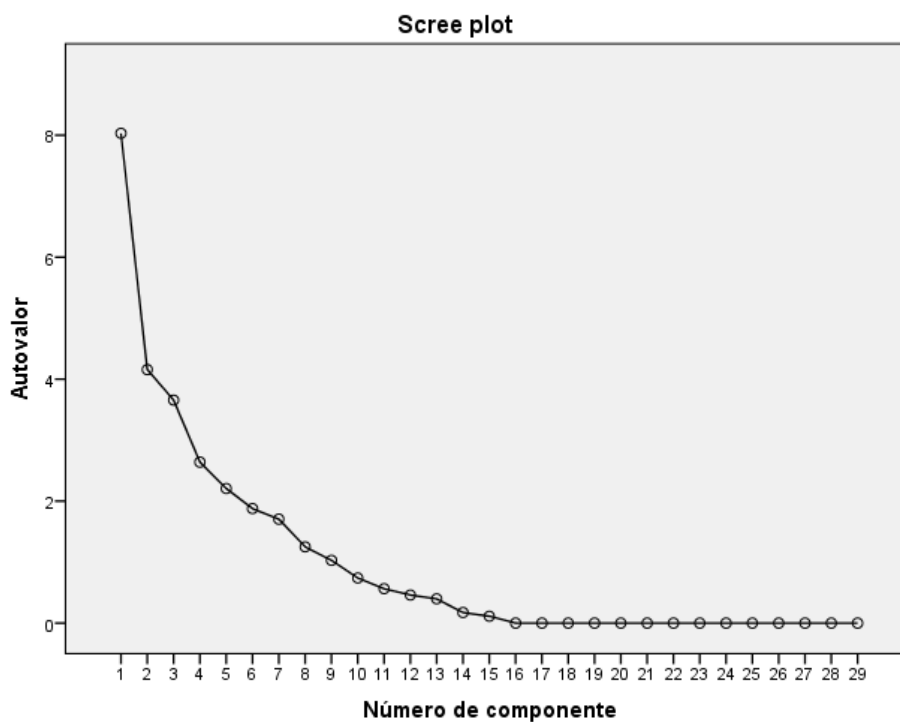
Source: The authors themselves.

By Kaiser's criterion, 9 factors are retained, responsible for 91.56% of the total variance. In addition to this information, Table 11 summarizes the results of the explained variance for the 9 factors associated with the quality of SPTec public policy. It is observed that these factors explain approximately 91.56% of the total variance before and after the rotation, which is acceptable according to Hair et al. (2009), who recommend that the factors explain at least 60% of the accumulated variance.

Table 11 - Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Square Loadings			Rotation Sums of Squared Loadings		
	Total	% of variance	% cumulative	Total	% of variance	% cumulative	Total	% of variance	% cumulative
1	8,032	27,696	27,696	8,032	27,696	27,696	4,454	15,36	15,36
2	4,157	14,333	42,029	4,157	14,333	42,029	4,422	15,247	30,607
3	3,657	12,609	54,638	3,657	12,609	54,638	3,035	10,466	41,072
4	2,639	9,1	63,738	2,639	9,1	63,738	3	10,346	51,419
5	2,207	7,61	71,348	2,207	7,61	71,348	2,781	9,59	61,009
6	1,878	6,475	77,823	1,878	6,475	77,823	2,684	9,256	70,265
7	1,704	5,876	83,699	1,704	5,876	83,699	2,37	8,174	78,439
8	1,251	4,312	88,011	1,251	4,312	88,011	2,257	7,782	86,22
9	1,029	3,55	91,561	1,029	3,55	91,561	1,549	5,34	91,561

Source: The authors themselves.

From Table 11, it is possible to observe that the first factor (hereinafter called R&D and innovative activities) is responsible for 27.69% of the variance, the second (hereinafter called Coordination and Financing) is responsible for 14.33% of the variance, and the third (Openness to innovation) is responsible for 12.6% of the variance. Together, they explain 54.62% of the variability of the four original determinants.

The next step in evaluating the quality of the factor analysis was the evaluation of the commonality coefficients, which, according to Pestana and Gageiro (2008), deal with the total variance of the variable explained by the common factors, its value indicating the amount of variance of a variable that it is shared at least with another variable in the set (PESTANA; GAGEIRO, 2008) and, according to Garson (2008), it can vary between 0 and 1, zero means that the common factors do not explain any variation between the measured variables; and one means that the common factors explain the variations, and it must be at least 0.5. Table 12 shows the value of the commonality for the variables (statements).

Table 12 - Communalities (Extraction Method: Principal Component Analysis)

	Initial	Extraction
Proj1	1	0,969
Proj2	1	0,94
Proj3	1	0,886
Proj4	1	0,892
Proc1	1	0,972
Proc2	1	0,942
Proc3	1	0,914
Proc4	1	0,845
Proc5	1	0,941
Proc6	1	0,97
Proc7	1	0,787
Proc8	1	0,818
Proc9	1	0,951
Proc10	1	0,92
Proc11	1	0,944
Rel1	1	0,916
Rel2	1	0,857
Rel3	1	0,889
Rel4	1	0,881
Rel5	1	0,942
Rel6	1	0,925
Res1	1	0,983
Res2	1	0,973

Res3	1	0,922
Res4	1	0,945
Res5	1	0,96
Conf1	1	0,94
Conf2	1	0,779
Conf3	1	0,95

Source: The authors themselves.

From Table 13, it is possible to observe that all variables have a strong relationship with the factors arranged. In addition, it can be observed that the commonality coefficients were satisfactory, as they are greater than 0.5, continuing with the analysis of the results.

Through the quality assessment of the factor analysis, the rotation matrix is presented by the varimax method, as shown in Table 16. This matrix shows the proximity of the variables, being useful to designate the meaning of the factors, essentially when the variables have weights elevated in more than one component (PESTANA; GAGEIRO, 2008).

From the coefficients of that same table, it is possible to identify which factors the variables belong to, according to the analysis of the magnitude of the coefficients of the columns from left to right and from top to bottom, and the variables should be grouped in the same column until the moment. where the coefficient of the column under analysis is lower than that of the subsequent column, according to the shading of the cells in Table 13.

The first factor was named "R&D and innovative activities". The interaction with other organizations in the IS - whether for obtaining technological services or for access to R&D professionals and researchers - can assist companies in their innovative processes.

The second factor identified was called "Coordination and Financing". A structured IS requires the institution and effectiveness of policies to encourage innovation, including those related to the granting of credits and tax benefits to companies that invest in innovation.

The third factor identified was called "Openness to innovation". The consultation with the target audience in the formulation of public policy allows the development of a public policy that is aligned with the needs of its future users.

The fourth factor identified was called "Infrastructure and reliability". The decentralization and the recent movements in quality in the public sector and the Brazilian public sector allow a greater adjustment of the policy to the user's needs.

The fifth factor was called "Transparency". The attribute related to the satisfaction survey is inherent to the adoption of a quality approach based on user satisfaction in the Public Sector. The realization of such surveys allows the accomplishment of a cycle of feedback of information that allows the managers to take measures directed to the increase of the quality.

The attribute related to the ideal environment proposition analyzes innovation in terms of conflict resolution, proximity between agents, governance, and bureaucracy. Innovation legislation is expected to remove obstacles to innovation, and this refers to providing an institutional environment that increases the relations between the productive sector, the knowledge sector, and the financial sector for carrying out innovations.

The sixth factor was called Social Role. It included two variables: one related to promoting job creation (RHEE; RHA, 2009; GESPÚBLICA, 2014) and the other related to the reduction of financial risks to innovate (OECD, 2005).

The seventh factor was called Process Innovations. This factor is composed of a single variable, which deals with the realization of process innovations (OECD, 2005).

The eighth factor was called User Relationship. As the literature review points out, the use of ICT in the provision of services is fundamentally a facilitator in the delivery of service delivery policies and results, be it continuous access to government services, a more productive and committed workforce, or an open and participatory government.

The ninth factor was called Location. It is understood that the location of the technological park must be strategic, to bring together the centers of knowledge and the provision of technological services with the productive sector (GOVERNMENT OF THE STATE OF SÃO PAULO, 2008).

Table 13 - Grouping of Factor Analysis

Factor		Component 1	2	3	4	5	6	7	8	9	Attributes
R&D and innovative activities	Proc3	0,916	0,140	-0,036	-0,077	0,025	0,026	-0,169	0,128	-0,038	Access to relevant technological services
	Proc2	0,886	-0,130	0,074	-0,286	0,056	0,053	-0,190	0,083	-0,060	Access to researcher / R&D professional
	Res2	0,839	-0,042	0,123	0,170	0,084	0,391	0,050	0,234	0,074	Increase in the number of R&D projects
	Proc4	0,784	0,169	0,030	0,295	0,188	-0,201	0,190	0,040	-0,023	University / institute equipment access
	Proc8	0,699	0,381	0,180	0,237	0,080	0,159	0,026	-0,125	0,217	Access to high-level ICT
Coordination and Financing	Proc9	-0,136	0,912	0,085	0,218	0,170	0,082	-0,050	0,048	-0,076	International research opportunities / FDI
	Rel4	0,240	0,858	0,014	0,071	-0,020	0,002	0,080	0,274	-0,001	Participation in C, T&I planning
	Rel3	0,098	0,820	0,266	0,075	0,094	-0,008	0,265	0,228	-0,002	Coordination between IS elements
	Proc11	0,140	0,646	-0,048	0,116	0,253	-0,097	0,600	-0,229	0,073	Funding of Funding Agency
	Proj4	0,237	0,536	-0,229	0,360	0,145	-0,071	-0,084	0,516	0,261	Alignment of public policy with other laws
	Proc7	0,389	0,524	-0,395	0,295	-0,116	0,140	0,112	0,018	-0,267	Financing lines for carrying out innovative activities
Openness to innovation	Proj1	-0,003	-0,002	-0,836	0,244	0,192	0,258	-0,019	0,297	0,130	Consultation with the target audience in the formulation
	Res1	0,155	0,231	0,789	0,188	0,422	0,138	-0,006	0,165	-0,154	Ripening of technological capacity
	Proc5	0,538	0,261	0,628	0,078	0,036	-0,299	0,028	0,290	-0,086	Forming partnerships to innovate
	Proc6	0,337	0,119	0,627	0,012	-0,188	0,471	0,434	0,015	0,051	Facilitating the incubation of ideas
Infrastructure and reliability	Proc1	0,115	0,120	0,001	0,928	0,086	-0,104	-0,099	0,016	0,234	Offering sufficient physical space
	Proc10	0,028	0,439	0,135	0,737	0,033	0,277	0,209	0,209	-0,013	Provision of training in the use of the Law
	Proj3	-0,187	0,126	-0,387	0,577	-0,291	-0,091	0,411	0,257	-0,158	Park according to regional economic vocations
	Conf2	0,057	0,105	-0,144	0,493	-0,212	0,384	-0,464	-0,061	0,299	Resources for ideal and regular innovation
Transparency	Rel1	0,167	0,103	0,024	-0,098	0,893	0,180	0,057	-0,176	-0,057	Conducting satisfaction surveys
	Rel6	-0,050	0,098	0,150	0,098	0,762	0,056	-0,406	0,260	0,255	"Atmosphere" ideal for innovation
	Res3	0,176	-0,047	-0,102	0,063	0,614	0,357	0,114	0,521	-0,293	Realization of product innovations
	Rel2	0,167	0,371	-0,489	0,023	0,596	0,069	0,299	-0,044	-0,018	Transparency of use/distribution of resources
Social role	Res5	0,030	-0,018	0,059	-0,039	0,253	0,931	-0,062	-0,078	-0,110	Promotes job creation
	Conf1	0,123	0,129	-0,269	0,137	0,146	0,810	-0,299	0,165	0,152	Reduction of financial risks to innovate
Process Innovations	Res4	0,186	-0,212	-0,046	-0,024	0,075	0,176	-0,892	0,001	-0,175	Realization of process innovations
Relationship with the user	Rel5	0,294	0,402	0,078	0,077	-0,036	-0,054	-0,059	0,821	0,009	Virtual mechanisms of interaction and provision
	Conf3	0,057	0,481	-0,122	0,545	-0,031	0,235	-0,044	0,566	-0,155	Attentive and trained staff
Localization	Proj2	0,021	-0,072	-0,141	0,150	-0,007	0,014	0,122	-0,018	0,936	Technology park location

Source: The authors themselves.

Linear Regression Analysis

This analysis was carried out to understand whether there is a dependency relationship between the performance of the attributes and the level of general satisfaction of public policy. Thus, it is assumed that the level of general satisfaction of public policy depends on the performance of the attributes. In this sense, it could be hypothesized that mature ISs would be marked by the fact that the good performance of attributes has the effect of good levels of satisfaction. On the other hand, inadequate performance would lead to dissatisfaction, considering the IS as immature.

Regression is a statistical model used to predict the behavior of a quantitative variable (dependent variable or Y) from one or more relevant variables of an essentially interval or ratio nature (independent variables or X) informing about the margin of error of these forecasts (PESTANA; GAGEIRO, 2008).

According to Table 14, this regression analysis obtained an R^2 value of 1. This means that 100% of the variation in general satisfaction with public policy is explained by the attributes of quality.

Table 14 - Summary of the Regression Model

Model	R	R square	Adjusted square R	Standard error of estimate
1	1,000ᵃ	1,000	1,000	,00000
a. Predictors: (Constante), Conf3, Res4, Rel1, Proj2, Proc5, Proc6, Proc7, Proc1, Proc9, Proc8, Proc4, Conf2, Rel5, Rel2, Rel6				
b. Dependent Variable: Level				

Source: The authors themselves.

In Table 15, each B is a partial regression coefficient, indicating the expected variation in Y for each variation unit of a variable X, keeping other variables X constant or with their effects controlled. The Beta value corresponds to the slope of the line (increase or decrease) in the average value of Y associated with a unitary increase in X (PESTANA; GAGEIRO, 2008).

Table 15 - Linear Regression Coefficients between variables and level of satisfaction

	Nonstandard coefficients		Standardized coefficients		
	B	Standard Error	Beta	t	Sig.
(Constant)	1,570	,000		279501503,213	,000
Proj2	-,014	,000	-,203	-74565369,741	,000
Proc1	-,004	,000	-,046	-13596976,540	,000
Proc4	,021	,000	,259	74034878,183	,000
Proc5	,006	,000	,077	20453404,542	,000
Proc6	,020	,000	,236	94833950,759	,000
Proc7	-,028	,000	-,133	-36466544,165	,000
Proc8	-,037	,000	-,221	-56039225,508	,000
Proc9	-,044	,000	-,197	-86258958,358	,000
Rel1	-,038	,000	-,122	-29405862,936	,000
Rel2	,074	,000	,404	98599154,251	,000
Rel5	-,003	,000	-,051	-13968351,710	,000
Rel6	-,015	,000	-,112	-23792441,162	,000
Res4	-,001	,000	-,004	-1072927,175	,000
Conf2	,073	,000	,340	66539347,574	,000
Conf3	,071	,000	,928	237843200,980	,000

Source: The authors themselves.

In all, fifteen factors were considered significant. The rest were not of sufficient significance to allow making statements.

Through the Beta coefficients, it is possible to infer that for each increase of a unit in the general satisfaction with the SPTec there are decreases of different magnitudes (but not greater than 0.25) in the variables Proj2, Proc1, Proc7, Proc8, Proc9, Rel1, Rel5, Rel6, and Res4.

In addition, it is also possible to state that for each increase of a unit in general satisfaction

with SPTec, there are increases of different magnitudes in the variables Proc4, Proc5, Proc6, Rel2, Conf2, and Conf3.

It is worth noting that for each increase of a unit in general satisfaction with public policy, there is an increase of 0.928 in the attribute related to the presence of attentive and trained employees to explain any doubts about the Laws of Innovation.

It is also worth noting that for each increase of a unit in general satisfaction with public policy, there is a considerable increase of 0.404 in the attribute related to transparency in the use and distribution of resources for innovation and an increase of 0.340 in the attribute provision of resources necessary for innovation in time. ideally and regularly.

Thus, it is possible to state that satisfaction with SPTec's public policy is significantly dependent on the presence of attentive and trained employees to explain any doubts about the Innovation Laws. Therefore, considering the hypothesis of the beginning of the subsection that adequate performance in the attribute generates satisfaction with the IS, and that this relationship is a mature IS, it can be said that the São Paulo State IS is only mature about this attribute.

FINAL CONSIDERATIONS

The maturity of the IS in the State of São Paulo can be classified as mature in terms of project quality and reliability. On the other hand, it might be classified as immature in terms of the quality of the process, the quality of the relationship, and the quality of the result. In this sense, the following measures are suggested to promote greater satisfaction for users of this public policy:

In terms of the quality of the project, it is necessary to conduct a study aimed at understanding in more depth (or revising) the needs of public policy users, which will make it possible to adjust the execution of public policy as an instrument to facilitate innovation.

In terms of the quality of the process, actions related to:
I. Facilitating access to researchers and R&D professionals.
II. Facilitation of access to relevant technological services.
III. Provision of credit lines for carrying out innovative activities.
IV. Providing access to high-level ICT: it is necessary to survey the technological base installed in the SPTec parks as well as map the needs in terms of ICT infrastructure of the installed companies.
V. Facilitation of access to international joint research opportunities or FDI.
VI. Funding of non-reimbursable financial resources from Development Agencies.

In terms of the quality of the relationship, actions related to:
    i. conducting satisfaction surveys and handling complaints.
    ii. transparency in the use and distribution of resources for innovation.
    iii. Providing an ideal atmosphere for innovation.

In terms of the quality of the result, actions related to:
i. Facilitating the maturity of technological innovation capacity, increasing the number of R&D projects, and carrying out product and process innovations.
ii. Job creation.

In terms of reliability, actions related to the provision of resources necessary for innovation are made in an ideal and regular manner.

Among the limitations of the research, we can mention the fact that the factorial analysis of the public policy SPTec can only be generalized for itself.

It is suggested as a future study a replication of this research to understand if there were changes in the quality of the evaluated attributes as well as if there can be a new regrouping of the factors or the appearance of new correlation and dependence relationships between the analyzed variables. Finally, it is suggested to carry out this research at the national level, to check for state or regional disparities and also to carry out this research in a comparative way with innovation systems from other countries, especially those considered mature innovation systems, to verify if there is the superior quality of the innovation system in these locations.

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