Innovation and Entrepreneurship in the São Paulo Metropolis

The role of its major university

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ABSTRACT

São Paulo is considered the most important financial center in Latin America and hosts one of the most respectful universities in Brazil: the University of São Paulo (USP). In spite of having the potential to be a leader in technological innovation and startup output, this ecosystem has not produced satisfactory results in the last decades. This article analyses the innovation environment around São Paulo's largest research university, using the factor analysis technique. Based on a workshop conducted with ecosystem experts, we identified the key anchors and processes present in the region. The analysis results led to recommendations of practical actions for both public and private sectors to engage in the ecosystem evolution.

Keywords: entrepreneurship, innovation, startup, Sao Paulo, USP, startup ecosystem, factor analysis, University of São Paulo

1 Introduction

This study aimed to create a visual representation of São Paulo's innovation ecosystem. São Paulo is Brazil's largest city, 12th largest city in the world, with the 15th largest GDP (measured by purchasing power parity)[1]. It is Brazil's financial center and hosts the headquarters of many major companies and banks, including many foreign companies doing business in Brazil. São Paulo is home to the Bovespa, Brazil's stock and bond exchange, the largest in Latin America, and has several leading science and technology universities. Foremost among them is University of São Paulo (USP), founded in 1934, one of the world's largest universities, with more than 90,000 students (of whom almost 1/3 are Masters and Doctoral students); four of its 11 campuses are located in the São Paulo metropolis. First class universities all around the world have a very important role on the development of the entrepreneurship ecosystem around them (Sternberg, 2013), for example Stanford in Silicon Valley (Piscione, 2013), Technion in Israel (Kon, Cukier, Melo, Hazzan, & Yuklea, 2014), or Cornell in New York (Cometto & Piol, 2013). Similarly, USP serves as an unofficial hub for much of the entrepreneurial activity in the city of São Paulo, and has a number of entrepreneurship initiatives on campus, including specific courses, an incubator, and several student Entrepreneurship groups.

Besides having the potential to be a worldwide leader ecosystem in technological innovation and startups output, the city hub presented modest numbers in the last two decades. The 15th position in total GDP is not so amazing when compared to the 135th position in GDP per capita. The Brazilian Startups Association database[2] shows only 420 companies (758 in the whole state of São Paulo, representing 25% of all startups in Brazil). The dealbook database[3] contains only 39 deals (acquisitions or risk investment) for São Paulo startups. Even if these are not official numbers, they represent a good snapshot of the reality, and the inexistence of precise numbers itself is a sign of the low maturity of the ecosystem. In Brazil, few entrepreneurs have the opportunity to receive investments for their startups, and this can be one of the explanations why 50% of all firms shut down before 3 years (Andreassi & Madureira Rodrigues Siqueira, 2006). In Germany, opening a firm requires 9 procedures, and this number is considered one of the worst compared to other developed nations. In Brazil, to open a firm, one needs 13 procedures (Arruda, Cozzi, Nogueira, & Costa, 2013).

Economical theory shows that startups and entrepreneurs are the prime movers in modern economic development (Schumpeter, 1934). "They foster technological innovations of industries, create new jobs, and generate new wealth for society. New venture creation has been statistically linked to both job creation and regional development" (Kasturi & Subrahmanya, 2014). Some studies try to identify gaps in innovation ecosystems and propose practical actions to improve their performance. There are examples in Germany (Voss & Müller, 2009)(Sternberg, 2013), India (Kasturi & Subrah-manya, 2014) and Portugal (Vaz, de Noronha Vaz, Galindo, & Nijkamp, 2014).

To investigate why São Paulo have such modest output given its potential, we gathered a number of ecosystem leaders and experts for a workshop. The results obtained from our exercise are simple enough to grasp but complex enough to capture their key elements as a

[1] http://www.brookings.edu/research/reports2/2015/01/22-global-metro-monitor
[2] http://www.abstartups.com.br/startups
[3] http://dealbook.co

common foundation or 'language' for an enlightened discussion of policy. The systemic approach this study adopted stands in contrast to partial approaches, in which emphasis is placed on specific aspects of the innovation ecosystem, without properly mapping or understanding the system as a whole and how its various parts interact with one another. Moreover, the most significant obstacles for innovation and entrepreneurship development are not related to technological aspects or capital availability, but depend on convergence and coordination between the various components in the entrepreneurship ecosystem (Moore, 1996). The purpose of our study was to understand all these components and the interactions between them, based on the idea that successful innovation ecosystems depend on a high level of interconnectivity between its players (OECD, 1997)(Iansiti & Levien, 2004). From the point of view of the university innovation ecosystem, the basic components are: people, companies, organizations, anchors, and processes (Lemos, 2012). We gathered professionals from companies, government, academia, and NGOs to identify anchors and processes pertaining to their ecosystem.

The inputs for the innovation ecosystem map are based on a structured collaborative discussion (experts' workshop) conducted among experts from various realms and disciplines in São Paulo participating in this collaborative exercise. The methodology we used for mapping the national innovation ecosystem was developed and implemented earlier in a large-scale study (Anmon Frenkel & Maital, 2014). Our goal was to use this map to guide policy decisions that are system-wide and exploit synergies, to achieve agreed goals and to implement a common vision for São Paulo.

The remainder of this article is organized as follows. Section 2 describes the methodology used to analyze the innovation ecosystem. Section 3 presents the results of our analysis. In Section 4, we discuss the results and propose practical recommendations and actions for the private and public sectors, as well as for academic parties. In Section 5, we provide our conclusions and discuss future work.

2 Methodology

In the basis of the developed methodology was a process for collaborative discussion among experts from various realms and disciplines, in order to "map" the innovation ecosystem. The objective of the experts' workshop was to identify fundamental "anchors" and "processes" that comprise the main elements of the innovation ecosystem around São Paulo's largest research university. Here are the definitions of these two key concepts:

- "Quality anchors": these are strengths, or core competencies, of São Paulo on which innovation can be built. For example, the existence of a high level of human capital, or the existence of strong world-class scientific and technological infrastructure.
- "Processes and trends": these are processes that can enable countries or regions to overcome strategic innovation weaknesses; or constraints that hamper innovative initiatives and policies. For example, vocational training programs, tax incentives, R&D funding, etc.

Identifying the anchors and processes was done in the Experts Workshop, which took place in the University of São Paulo main campus on August 22th, 2014. To compile these results and elaborate this paper, we put together a group of two local experts from the São Paulo ecosystem and two innovation scholars from abroad, with no previous knowledge of

this local environment. Our goal was to achieve a good balance between insiders' and outsiders' views of the São Paulo culture and processes around innovation.

Experts representing all key sectors and disciplines relevant to innovation, i.e., stakeholders, service providers, policymakers, students and researchers from the academia, and professionals from the industry participated in the workshop and contributed inputs that were used to map the innovation ecosystem of São Paulo. The workshop was based on deep intimate knowledge of the experts and their familiarity with all aspects of the innovation ecosystem, including informal and ill-defined ones. The objective of the workshop was to formulate a creative systematic and inclusive list of key innovation variables that can be transformed into a visual innovation ecosystem map.

The Workshop was conducted through brainstorming and the nominal group technique (Osborne, 1963). During the workshop, each expert was asked, in turn, to propose one anchor. After a first round of this process, there were additional rounds, until no more anchors remain to be listed. After the list of 'anchors' was completed, to the satisfaction of the experts, a similar process was employed to list comprehensively the 'processes and trends'. In addition, each expert was asked, in his/her turn, to indicate whether the suggested process belong to the 'demand-driven' or to the 'supply-side' of innovation or both.

The end result of this workshop included a comprehensive crude list of anchors and processes that reflect the views and insights of experts. The list of anchors and processes were refined, organized and compiled into a final, refined list that includes 14 anchors and 10 processes. The list of processes was organized, to distinguish between 'demand-driven' and 'supply-side' innovation. This analysis enables us to show visually and clearly the key elements of demand-side innovation drivers, including consumers, businesses, labor markets, global markets and other channels, and indicate how these demand-side aspects of innovation interact with supply-side elements. Our focus is on identifying 'gaps' – crucial ecosystem needs that have not been fully met, such that innovative technologies can be leveraged to match supply with demand and create business opportunities. At the same time, we seek to identify supply-driven processes reflecting innovation driven by supply (incentives, funding, etc.), through which resources are directed toward specific markets and products, "pushed" by supply factors rather than "pulled" by demand factors.

In the following step, a cross impact analysis was employed. We evaluated the relationship between the anchors and the processes that were identified in the earlier stage on a bipolar five-point Likert scale (Jamieson, 2004) ranging from strong negative link (1) to strong positive link (5). The evaluation matrix developed was processed through Exploratory Factor Analysis – EFA (data reduction technique), a statistical tool whose purpose is to reduce a large number of variables into a smaller, more compact set (J.-O. Kim & Mueller, 1978). In the analysis, the anchors serve as observations in order to group the processes into major factors according to the similarities in their linkages with the anchors. Thus the processes were grouped according to the results of the factor analysis. The classification of anchors into clusters did not involve a similar mathematical procedure and was based on logic. In order to compute the major linkages between each process factors and anchor clusters a mathematical procedure was employed (see Annexes).

3 Results - Analysis of São Paulo's Innovation Ecosystem

3.1 Inputs for the São Paulo's Innovation System

This section provides a summary of raw inputs collected at the São Paulo experts' workshops. **Table 1** lists 14 main anchors that were identified by the experts as the pillars of São Paulo Innovation system. **Table 2** presents a list of 10 processes that were recognized by the experts as key elements driving and fostering innovation in São Paulo. 'Anchors' are essentially similar to what economists call 'stocks', or fixed assets, while processes are similar to what economists call 'flows' (changes related to various anchors, or stocks). The processes were ranked by the experts by their importance and classified according to which side of the market (supply or demand) they are assigned to.

Table 1 - List of São Paulo Innovation Anchors

No.	Anchor Name
1	High quality human capital
2	Availability of finance
3	7 business incubators
4	(Lack of) an entrepreneurial culture
5	(Lack of) integration across USP schools and faculties
6	Attraction of low-risk employment in business (negative)
7	Scientific infrastructure
8	Strong faculty, good professors
9	USP's "brand name"
10	Entrepreneurship students organizations
11	Union mentality
12	USP legal framework
13	USP intellectual property framework
14	Evaluation of students by traditional tests

Table 2 - List of Identified Processes Fostering São Paulo Innovation, Ranked by Importance and Classified by Market Side

Ranked number (by importance)	Process Name	Demand (D) Supply (S)
1	Incubation / Acceleration processes	S
2	Informal networking & activities promoting entrepreneurship	D, S
3	Seed money and venture capital	S
4	Alumnae sharing their stories	D, S
5	Collaboration with government and industry	D, S
6	Talents database	D
7	Scattered information, (lack of) a 'one stop shop' process	D

8	Technology transfer process	D, S
9	Mentoring	D, S
10	Evaluation of faculty by publications rather than innovativeness	D

The essence of an ecosystem is the interaction among its various components (Moore, 1996). We used data on 'cross impact analysis' (the perceived links between various anchors and processes) to create a bipolar five-point Likert scale (ranging from a strong negative link, score 1, to a strong positive link, score 5, for each cell in a 14x10 cross impact matrix. The results of the cross impact analysis, conducted by the expert's teams are presented in **Figure 1**.

Figure 1 - Linkages between Anchors and Processes in São Paulo Innovation Ecosystem, Sorted by the Intensity of the Linkages

Anchors/Processes	Incubation/Acceleration processes	Informal networking & activities promoting entrepreneurship	Seed money and venture capital	Alumni/ae sharing their stories	Collaboration with government and industry	'Talents' database	Scattered information, (lack of) a 'one stop shop' process	Technology transfer process	Mentoring	Evaluation of faculty by publications rather than innovativeness
High quality human capital	5	5	4	5	4	4	3	3	4	2
Availability of finance	3	3	5	3	5	3	3	3	3	3
7 business incubators	4	4	4	4	4	4	2	4	4	3
(Lack of) an entrepreneurial culture	2	2	2	2	3	2	3	1	2	3
(lack of) integration across USP schools and faculties	3	2	3	2	3	2	4	2	2	3
Attraction of low-risk employment in business (negative)	3	2	3	2	2	2	3	2	2	3
Scientific infrastructure	4	3	3	3	3	4	3	5	4	4
Strong faculty, good professors	3	3	3	3	3	4	3	5	4	3
USP's "brand name"	4	4	4	4	4	4	3	4	4	3
Entrepreneurship students organization	4	5	3	5	3	4	2	3	5	3
Union mentality	2	2	2	3	2	3	3	2	2	4
USP legal framework	2	2	1	3	2	3	5	1	2	4
USP intellectual property framework	3	3	2	3	2	3	3	2	3	3
Evaluation of students by traditional tests	3	2	3	3	2	3	3	2	3	3

1 = Strong negative link; 2 = Weak negative link; 3 = No linkage; 4 = Weak positive link; 5 = Strong positive link

3.2 Analysis of the Cross Impact Results

3.2.1 Identifying Key Processes

Factor analysis was employed on the list of processes (variables). The anchors serve as observations in order to group the processes into major factors according to the similarities in their linkages with the anchors. Tests of sample adequacy constituted the necessary preliminary conditions for conducting factor analysis and obtaining meaningful results. The Spearman correlation matrix among the processes provided the input for both the tests and the factor analysis. The linkage-pattern items obtained in the São Paulo workshop demonstrate good sampling adequacy at the overall (KMO > 0.598). The result of the Bartlett's sphericity test rejects the null hypothesis that the correlation matrix is an identity matrix ($p = 0.000$).

Exploratory principal axis factor analysis with subsequent orthogonal rotation (Varimax rotation with Kaiser normalization) produced three factors. These factors together explain 85.7% of the variance. The factor loadings are presented in **Table 3**. In order to facilitate factor labeling, the dominant items, marked in grey background in **Table 3**, were defined as those with an absolute value of the loading greater than 0.50. Through the factor analysis we distilled the existing innovation process drivers down to three key factors:

Factor 1 – Human Capital / Talent: Talents database; Mentoring; Informal networking & activities promoting entrepreneurship; Incubation / Acceleration processes; scattered information, (lack of) a 'one stop shop' process. This factor explains 45.3% of the variance.

Factor 2 – Flow of Financial Capital: Seed money and venture capital; Collaboration with government and industry; Technology transfer process. This factor adds 26.2% to the explanation of the variance.

Factor 3 – Publish or Perish: Evaluation of faculty by publications rather than innovativeness. This factor adds 14.2% to the explanation of the variance.

The first and the second factors represent both supply and demand side of innovation and the third factor is purely demand driven.

Table 3 - Factor Analysis Results for the São Paulo Innovation Ecosystem

Factor name	Items (Processes)	Component		
		1	2	3
1 - Human Capital / Talent	Talents database[4]	.918	.239	.218
	Mentoring	.910	.339	-.018
	Alumnae sharing their stories	.909	.062	-.279

[4] Several experts mentioned the need for creating a 'Talents database' that could be used to locate specialists in various areas of innovation to facilitate the development of new businesses.

	Informal networking & activities promoting entrepreneurship	.866	.280	-.354
	Incubation/Acceleration processes	.731	.443	-.309
	Scattered information, (lack of) a 'one stop shop' process	-.509	-.376	.204
2 - Flow of Financial Capital	Seed money and venture capital	.231	.901	-.278
	Collaboration with government and industry	.226	.841	-.222
	Technology transfer process	.597	.629	.399
3 - Publish or Perish	Evaluation of faculty by publications rather than innovativeness	-.176	-.341	.861
Percent of Variance		45.3	26.2	14.2
Cumulative percent		45.3	71.5	85.7
KMO = 0.598 Cronbach's Alpha = 0.837				

3.2.2 Classification of Anchors

The classification of anchors into clusters did not involve a similar mathematical procedure as was done with the processes and was based on logic. The 14 anchors identified at the expert workshop (see **Table 1**) were grouped first into four basic dimensions of innovation (Amnon Frenkel, Maital, Leck, & Israel, 2015). These are:

- Culture (shared values);
- Context (scientific and technological infrastructure, structure of the economy);
- Markets (demand, preferences);
- Institutions (system of laws & regulations, written & unwritten 'rules of the game').

In addition, the anchors in each dimension were grouped into Key Anchors and presented in **Table 4**.

Table 4: List of São Paulo Key Innovation Anchors

No.	Anchor Name	Dimension	Key Anchor
2	Availability of finance	Infrastructure, Perception	University of São Paulo Infrastructure
3	7 business incubators		
9	USP's strong brand name		
10	Entrepreneurship students' Organization		
7	Scientific infrastructure		
1	High quality human capital	Infrastructure, Economy	Human Capital
8	Strong faculty, good professors		

4	Entrepreneurial culture (lack of)	Culture	Values & Attitudes
6	Attractive low-risk employment in business		
11	Union mentality		
14	Evaluation of students by traditional tests		
5	Integration across USP schools (lack)	Institutions	Formal Legal Arrangements
12	USP legal framework		
13	USP intellectual property framework		

The table shows that the major dimension in São Paulo innovation ecosystem is the infrastructure dimension. Half of the anchors belong to this dimension that was divided into two major basic key anchors: University of São Paulo Infrastructure and Human Capital.

The five anchors capture the key infrastructure available at the University of São Paulo: laboratories; the USP brand name (regarded as a top science & technology university, not only in Brazil but worldwide); the 7 USP incubators; availability of finance for USP entrepreneurs; and the numerous organizations initiated and run by students that foster entrepreneurship.

The second key anchor, Human Capital, refers to the infrastructure economy dimension. This key anchor includes three anchors. USP has strong human capital, both in its highly selected students and its research faculty.

The third key anchor Value and Attitudes are a key part of the Culture dimension. There is a 'union' mentality, with militant labor demands that can hurt productivity and generate strikes; and a question regarding the entrepreneurial culture, which is strong among a smaller part of the USP community and not strong among other parts; the value of creative thought is hampered by standard tests that require students to regurgitate existing knowledge rather than think creatively for themselves; and the prospects of secure well-paying employment with large established businesses compete with the entrepreneurial drive.

The forth key anchor, Formal legal arrangements, refers to the institution dimension. This anchor includes the IP legal framework at USP, and the legal framework in general governing property rights to ideas, establishment of startups, etc.; and the formal organizational structure, defined by the university charter, in which schools and faculties have considerable autonomy, which limits badly-needed integration and cooperation across faculty boundaries.

3.3 Construction of Innovation Ecosystem Map for São Paulo

In the final step, an innovation map was produced for the São Paulo ecosystem (see **Figure 2**). Most interactions between the anchor clusters and the process factors proved to

be significant and positive describing the linkages between the two groups. The interactions between the group of anchors (clusters) and the group of processes (factors) was computed based on a mathematical procedure for determining and weighting the direction and strength of link between the factors and clusters (see **Appendix**). A summary of the relationships is presented in **Table 5**.

Table 5: Linkage between Factors and Clusters

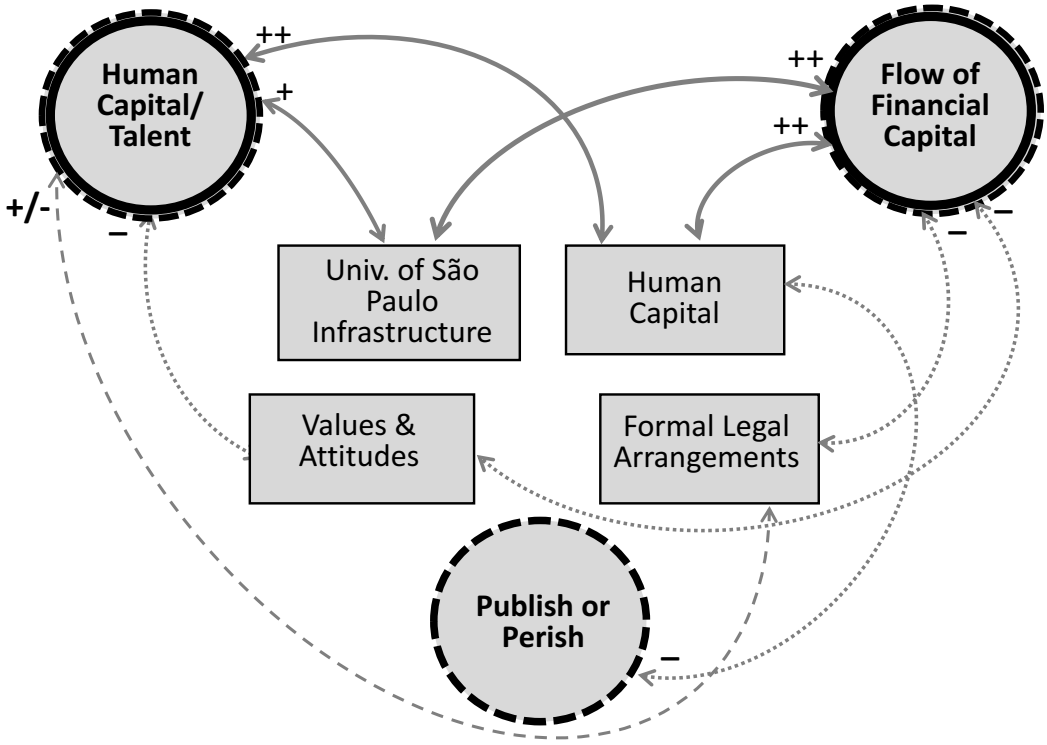
Factors (Key Processes) / Clusters (Key Anchors)	Human Capital / Talent	Flow of Financial Capital	Publish or Perish
University of São Paulo Infrastructure	+	++	no linkage
Human Capital	++	++	-
Values & Attitudes	-	-	no linkage
Formal Legal Arrangements	+/-	-	no linkage

In general, the findings show that the second key anchor 'Human Capital' significantly supported (strong linkages) two of the key processes: 'Human Capital / Talent' and 'Flow of Financial Capital'. The University of São Paulo infrastructure key anchor also significantly supports the last, showing a large potential from the university to gather human and financial resources to promote innovation. In contrast 'Values & Attitudes' key anchors that refer to the culture dimension are negatively connected to both 'Human Capital / Talent' and 'Flow of Financial Capital' key processes. Probably, (1) the lack of entrepreneurial culture and tradition, (2) courses focusing on conventional lectures and exams, rather than learn-by-doing, as well as (3) some prejudice against applied research are the main reasons.

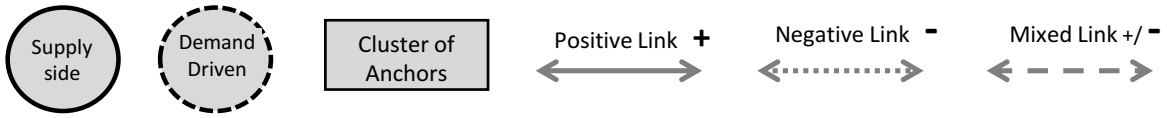
An interesting finding was encountered in regard to the 'Formal Legal Arrangements' key anchor. Mixed ties (positive and negative) exist between this key anchor and Human Capital / Talent key process, showing that there are already initiatives within the university to promote innovation but they still lack in breadth and effectiveness. In addition, it appears that this anchor has a negative effect on 'Flow of Financial Capital' key process, in particular due to the difficulties in technology transfer and in collaborations with the government and industry, which are hampered by university bureaucracy, legal obstacles, and a lack of motivation from the university supporting staff.

Finally, the 'Human Capital' key anchor has a negative effect on the Publish or Perish key process. This key process does not receive support from the other key anchors. The problem here is that the university, in general, does not value innovation activities — such as, technology transfer to large companies or government, and fostering the creation of startup companies — in the evaluation of its faculty. In a few schools, professors who concentrate on pure theoretical research with no application at all to the real problems of society are sometimes more valued than the ones that try to make a positive impact on society.

Figure 1: São Paulo Innovation Ecosystem Map



Legend



4 Discussion and Recommendations

Examining the overview linkages present in the ecosystem map, first we see obvious positive link between the Human Capital assets and Human Capital processes. Also, as a world-class university, USP appears as an asset that has only positive links with both Human Capital and Flow of Financial Capital. Beside these positive links, analyzing the elements of Human Capital processes, we can find improvements to be done, specially regarding to the ecosystem connectivity.

(Breznitz & Taylor, 2014) argue that even in the presence of all factors for the good health of a technological hub, the entrepreneurial ecosystem will not flourish if social fragmentation is observed. In other words, the local high-tech industry must develop rich multiple, locally centered social networks to enable growth of the ecosystem.

São Paulo is a huge city in area and population. There is a lack of good quality public transportation and people are always afraid to go far from their daily itinerary, because of heavy traffic and the large loss in time and stress involved. Moreover, the University of São

Paulo main campus is located far from the city center, with few good public transportation options to get there, making a large number of the students and professors to use cars. These elements generate a virtual separation of the University from the rest of the city. Having a strong faculty and high quality human capital is not sufficient if these assets are not easily accessible to the other ecosystem players like established companies or startup entrepreneurs. The university administration must have a clear strategy to deal with this problem. In the past, the university took an opposite direction with that regard, for example, by denying the construction of a subway station at the center of its campus, promoting the isolation of the university from society.

Furthermore, the distance between buildings and institutes inside the campus is also a barrier for multidisciplinary interaction. As it was pointed in the workshop, there is no "one-stop shop", neither for the whole city nor inside the USP community. Thus, new entrepreneurs need to go to tens of different places to find the information and the right people to start creating a network to support new ventures.

The inexistence of a "one-stop shop" is a factor that needs action. The first step could be to map the different informal networking activities promoting entrepreneurship and propose joint meetings and interaction between these networks. Within the USP community, more entrepreneurship activities involving different institutes could be a starting point. Another, bolder approach would be to create an 'Entrepreneurship Lounge' in the center of the campus where people from multiple disciplines would get together to discuss new ventures and work on their early-stage startups. This would be an open public space, the official USP port for entrepreneurs, promoting regular activities and offering free co-working space for startups and sharing of alumnae stories.

While the university has positive links to 'Human and Financial Capital', the 'Values and Attitudes' cultural factor has a negative link with both. This is a very important finding because this anchor should support the processes, not hinder them. The 'Formal and Legal Arrangements' also has negative impact on 'Human Capital' processes. Moreover, the technology transfer process is considered poor in terms of output, while theory shows that knowledge transfer is a key force that drives a technology hub evolution over time (J. Kim, Anderson, & Daim, 2008) (Pattnaik & Pandey, 2016) (Xu & McNaughton, 2006).

These are the aspects that need to change and some suggestions of how this can be achieved are the following:

- Lack of Entrepreneurial culture
    - Spreading the word of "entrepreneurship as a way of living" and the acceptance of failure
    - Early-stage startup competitions (hackathons, Startup Weekends, etc.)
    - More week-long and semester-long courses on Entrepreneurship for students and faculty
    - Sharing local cases of entrepreneurial successes in events, digital and printed media, as well as local and private communications
- Attractive low-risk employment in business. Lowering the risks for entrepreneurs with:
    - Differentiated tax policies for startup companies
    - Inexpensive and fast-track process for startups to open and close businesses
    - Financial incentives from funding agencies and private investment

    - Infrastructure availability: co-working spaces, Internet access
- Union mentality:
    - Create special labor rules for startups, with more flexibility and less bureaucracy
    - A small minority of union members are capable of stopping the university in very frequent strikes; they also criticize the approximation efforts between the university and the industry, causing huge losses to society. Seeking creative ways of stopping this waste would be beneficial
    - Fight the prejudice against commercial ventures born from the university; since the university is public, some people believe that everything that comes from it should be free and public. Instead, USP should be a birthplace for disruptive, innovative businesses, increasing the GDP
- Evaluation of students via traditional tests:
    - Implement new methods to evaluate students, promoting collaborative work, active participation, active learning, real-world project-based courses, and learn-by-doing
    - Give the option for students to create their own business and count the business performance as coursework credits

5 Conclusions

The objective of this article was to analyze the São Paulo innovation ecosystem using the factor analysis technique. Based on a workshop conducted with ecosystem experts, we identified the key anchors and processes present there, and how they support each other. The overall conclusion was that, although the São Paulo region and its major university, USP, have a huge potential for Entrepreneurship and Innovation, mainly due to its human capital, the current status of the ecosystem is weak and the region is not yet capable of generating significant disruptive innovation.

The major problems in the São Paulo ecosystem pointed out by the experts' workshop we conducted as part of our research were: (1) lack of connectivity / weak people networking, (2) lack of entrepreneurial culture and prejudice against businesses and applied research within the university, (3) high bureaucracy and lack of flexibility both within the university and in the market legal/tax frameworks, (4) no incentives for professors and students to pursue innovation and entrepreneurship, (5) a poor technology transfer established process.

Our analyses of the experts' workshop data identified a few key recommendations for ecosystem leaders, entrepreneurs, university administrators, and policy makers that could change this landscape significantly within a few years:

1. Creation of a vibrant 'Entrepreneurship Lounge' concentrating robust activities around entrepreneurship and innovation, gathering students, alumnae, and professors from all university schools, while promoting local, smaller activities within the various institutes.
2. Spreading the entrepreneurial culture with short and semester-long courses, events, and incentives for professors, students, and alumnae to engage in innovation activities. Entrepreneurial professors should be valued in their

career progression while students should receive credit for their innovative projects.

3. Creation of new laws with tax incentives for innovative startups, decreasing bureaucracy. Facilitating the participation of professors in innovative commercial ventures and the transfer of technology from the university to society.

Performing all these actions require a lot of effort from the few people that are engaged in the entrepreneurship community. However, we see that there is a growing overall understanding in the Brazilian society that entrepreneurship and technological innovation is a powerful mechanism to put the country in the path towards overcoming its underdevelopment history, turning the nation into a developed country within this century.

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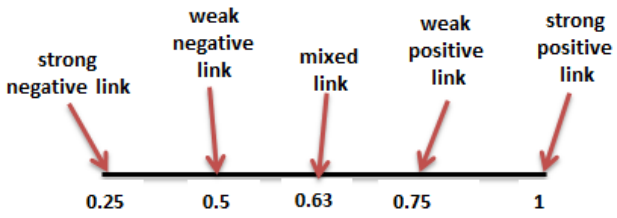
7 Appendix: Weighted Linkage and Neutral Linkage Indicators

The cells in **Figure 1** were transformed using the following key:

Old value	New value
1	1
2	2
3	n/a
4	3
5	4

Two indicators were computed for each cluster-factor combination:

1. **Weighted linkage indicator:** (Sum of values in combination)/(number of non n/a cells in combination X 4). We receive a value ranging from 0.25 to 1:



2. **Neutral linkage indicator:** (Number of n/a cells in combination)/(total number of cells in combination).

Decision rule: If the number of cells in a particular **factor** (processes) - **cluster** (anchors) **combination is greater than 50%,** than there is no linkage (NL) between the factor and the cluster; otherwise, the **weighted linkage indicator** is used to determine the direction and strength of the linkage. The midpoint between each pair of values (0.25 and 0.5, 0.5 and 0.63, 0.63 and 0.75, and 0.75 and 1) was used as a basis for calculating the minimum and maximum threshold.

0.83-1: strong positive linkage (++); **0.69-0.82:** weak positive linkage; **0.57-0.68:** mixed linkage (+-); **0.38-0.56:** weak negative linkage (-); **0.25-0.37:** strong negative linkage(--).