The Metropolitan Region of Campinas, Brazil: applying the technopolis framework

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Executive Summary

This paper examines the potential of the Metropolitan Region of Campinas (MRC) for becoming a technopolis. Located an hour from São Paulo, in Southeastern Brazil, the MRC has been internationally recognized as an important world technological center.
This paper maps the economic and technological environment of the region and develops an analysis of the strengths, weaknesses, opportunities and threats in the MRC with respect to entrepreneurship and becoming a technopolis. We begin by looking at selected high-technology industry and service sectors as well as the infrastructure supporting technological innovation and entrepreneurship in the form of research institutes, a research university (Unicamp), support groups, and three incubators. We then discuss the results of two surveys of companies associated with Unicamp or one of the incubators to determine the reliance of these companies on the MRC infrastructure for financing and marketing to networking and legal assistance, as well as their policy recommendations for improving entrepreneurship in the region. We conclude that the region is attractive to many companies and has great potential for future success as a technopolis due to its high levels of both hard and smart infrastructure, the strength of support available from a variety of local institutions, and the high level of economic activity in potentially innovative industrial and service sectors. However, there are several ways that the university, incubators, and public policies could better support entrepreneurship in the MRC. Specifically, an increase in public and private partnerships as well as greater capitalization options for start-ups are key areas the region could change to provide support for greater diversification of the start-ups in the area and further development of the MRC as a technopolis.

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1. Introduction

In Brazil, the Metropolitan Region of Campinas (MRC) has long been characterized as an important information technology and communication (ITC) pole associated with research & development (R&D) and higher education excellence. Thereby, the region configures itself as an important science and technology center, making it attractive for both small and multinational technology-based companies. In addition, the MRC has received not only national, but also international recognition as a technological center. In 2000, Wired Magazine elected Campinas as one of the 46 most preeminent technological centers in the world; together with the city of São Paulo they were the only two Latin American cities on the list[1].

Concerned with investigating the region's real capacity for high-technology company development, the technopolis framework, developed by IC[2], is applied to the region. The framework sees the modern technopolis, among other characteristics, as an area "that interactively links technology commercialization with the public and private sectors to spur economic development and promote technology diversification" (Smilor *et al.*, 1988)[2]. This conceptual framework is expressed in a 'wheel'[3] upon which actors interactively develop a network capable of sustaining the four factors, according to Smilor *et al*. (1988), specially important to the technopolis: the achievement of scientific preeminence, the development and maintenance of new technologies for emerging industries, the attraction of major technology companies, and the creation of home-grown technology companies.

To achieve the goal of benchmarking the region as a possible technopolis this paper maps the region's economic environment - with special emphasis on technology-related industry and services -, describes research institutes, the research university (Unicamp), support groups, and incubators. Special attention is given to two sets of companies: those associated with Unicamp[4], and those associated with the three incubators present in Campinas: CIATEC, SOFTEX and INCAMP[5]. Two distinct surveys were developed and distributed to these companies. The response rates for the university-related company survey and the incubator-related company survey were 24% and 31%, respectively. Finally, a SWOT - strengths, weaknesses, opportunities, and threats – analysis is presented to summarize the region's characteristics in relation to what is expected from a technopolis.

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[1] The magazine graded cities on a scale of 1 to 4 in four categories: universities, big companies, entrepreneurship, and venture capital attraction. Campinas received a 4 for universities, 3 for companies, 1 for entrepreneurship and 0 for venture capital.

[2] Available at <http://dev.ic2.org/icc2004/publications/creatingthetechnopolis.pdf>

[3] Contained in the appendix.

[4] To be considered related to the university a company needs a present or former faculty member, staff member, or student, as a partner.

[5] CIATEC: Company for Development of the Campinas High-Technology Pole
SOFTEX: Brazilian Society for the Promotion of Software Export
INCAMP: Unicamp's Incubator of High-Tech Based Companies

2. Mapping the Economic Environment of the Metropolitan Region of Campinas (MRC)

In this section, we look at selected high-technology industry and service sectors in order to map the economic environment of the MRC for the technopolis framework. Henceforth, the analysis will be based on the following data: investment dynamics, jobs created, added value created, personnel allocated to R&D, innovation & patents requests, sources of information for technological innovation, and decision factors for location in the MRC.

Section 2.1 presents the research methodology, in order to specify and better understand the data sources and analysis method used throughout the economic environment mapping. Section 2.2 presents a brief introduction to the MRC with some useful characteristics, providing an overall panorama. Sections 2.3 and 2.4 then sets out the industrial and the services economy, respectively. Finally, section 2.5 provides a summary.

2.1 Research Methodology

Throughout the economic mapping three databases are largely used. The method of analysis was developed in relation to the databases' characteristics, where possibilities and limitations arise throughout the empirical analysis.

The São Paulo's State Data Analysis System (SEADE) Foundation, which is part of the State Secretariat of Economy and Planning, produces two of the three databases. The first, Announced Investments Research (PIESP), is set to register all investment intentions by private and public sector companies that are announced in the major media outlets, then checked directly with the companies for its trustiness. Although it does not represent the global investments in the economy, neither does the announced intentions represent the exact value spent in the year announced, the database can be a valid proxy, keeping in mind these restrictions. The values are presented in US dollars, converted from Brazilian Reais, in relation to the average exchange rate of the month in which the investment was announced.

The other database, São Paulo's Economic Activity Survey (PAEP), is periodically based on surveys - this paper is based on the last one available (2001) - and was used to gather information on: added value, innovation & patents requests, sources of information for technological innovation, and decision factors for location in the MRC. The considered enterprise population is composed by all companies that have their headquarters in state and part by the companies that have headquarters off state, however only if 30 or more people are employed in São Paulo. To control the enterprise population for the database sample, the following premises were adopted: in the industry, for companies with 5 to 29 employees the surveys were sent randomly, for companies with 30 or more employees the surveys applies to all; whereas in the services sectors, companies with 1 to 99 employees were randomly investigated and companies with 100 or more employees the surveys applies to all, again. To gather information on added value and decision factors

for location in the MRC, the surveys considered information from local production units only, regardless if some companies have headquarters where else, thereby, the information can be regionalized. Whereas the information on innovation & patents request and sources of information for innovation was requested from the headquarters, even if not located in the region analyzed.

Furthermore, information on jobs created and personnel allocated to R&D were extracted using a database from the Work and Employment Ministry (MTE) called Annual Registry of Socioeconomic Information (RAIS). This database is set to capture all formal employment in Brazil, due to the fact that all establishments that formally employ at least one person are complied to deliver annually some select information with the Ministry.

2.2 Introduction to the MRC

Before beginning our analysis, we must first look at the context of the MRC, located only an hour away from the largest city in South America, São Paulo. The Metropolitan Region of Campinas was legally established in 2000, in recognition of the growing interconnectedness among 19 neighboring municipalities, centered around the city of Campinas. Growth in each of these neighboring municipalities had left no recognizable physical boundaries for the population and created a large conglomerate of economic, social, and cultural activities. The geographic region of the MRC is highlighted in the shaded area around Campinas in Figure 1. In addition, the region's demographic and socio-economic characteristics are presented in Table 1.

Figure 1 – The Metropolitan Region of Campinas

Source: Campinas' Scientific and Technological Park <http://www.inova.rei.unicamp.br/tmp/parque/parque/>

Table 1 - Socio-Economic Information - MRC	
Population	2,664,618 (2007)
GDP ($US)	$34,155,558,000 (2005)
GDP - Percentage of the State	8% (2005)
GDP per capita ($US)	$19,967 (2005)
Industrial Production – Percentage of the Country	10.5% (1998)
Average Annual Formal Income ($US)	$11,724 (2006)
Exports Value ($US)	$6,104,203,803 (2008)
Exports Value - Percentage of the State	9.4% (2008)
Airport Cargo Transportation - Percentage of the Country	18.1% (1999)
Average Years of Study (population 15 to 64 years old)	7.72 (2000)
Population in Higher Education (engineering, construction, production, science, mathematics, and computation)	19,423 (2002)
Population Graduating in Higher Education (engineering, construction, production, science, mathematics, and computation)	2,459 (2002)
3rd City in Brazil that Most Generates Industrial Jobs (2005)	
8th Best Place to Work in Brazil (2006)	

Sources: SEADE Foundation; SENAI – Industrial Census 2005; Você S/A-FGV 2006.

In the following sections, we look in more depth at the economic environment of the region, focusing on the industrial and services economy. These two economic sectors supply approximately 78% of the jobs in the region – 46.6% services and 31.3% industry[6].

2.2 The Industrial Economy

According to the 2005 Technological Innovation Survey conducted by the Brazilian Institute of Geography and Statistics (PINTEC-IBGE), six industrial sectors out of 22 represent 42.37% of all research and development expenditures in Brazil. These include the following: (1) Machinery and Equipment; (2) Electric Machinery, Devices and Equipment; (3) Electronic Material, Communication Devices and Equipment; (4) Oil Refining, Coke Fabrication, Nuclear Fuel, and Ethanol Production; (5) Chemical Products; and (6) Automotive Production and Assembly. Two other sectors were chosen, despite representing only 2% in R&D expenditure: (7) Computers and Office Related Equipment and Machinery and (8) Medical Instruments, Optics and Precision Instruments, and Industrial Automation Equipment. Due to their potential for innovation and involvement in high-tech endeavors, we decided to analyze these eight sectors to assess their impact on the MRC.

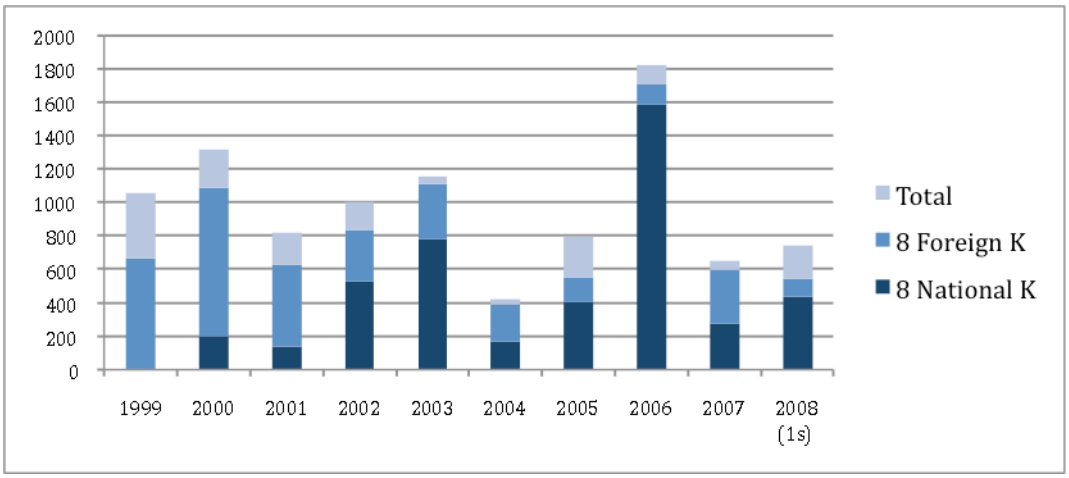
In first place we should access the industrial investment dynamics of the region. Hereby, investment dynamics is defined as how investment intentions behave, in relation to value

[6] Source: MTE – RAIS 2007.

(in US dollars), composition (national or foreign capital), and type (installation, amplification, modernization, or R&D), in a specific time frame (1995 to first semester of 2008). The importance of this analysis combined with other forthcoming data in this paper relays on the fact that it becomes possible to evaluate if the productive investment pattern in the region is leading to desirable results.

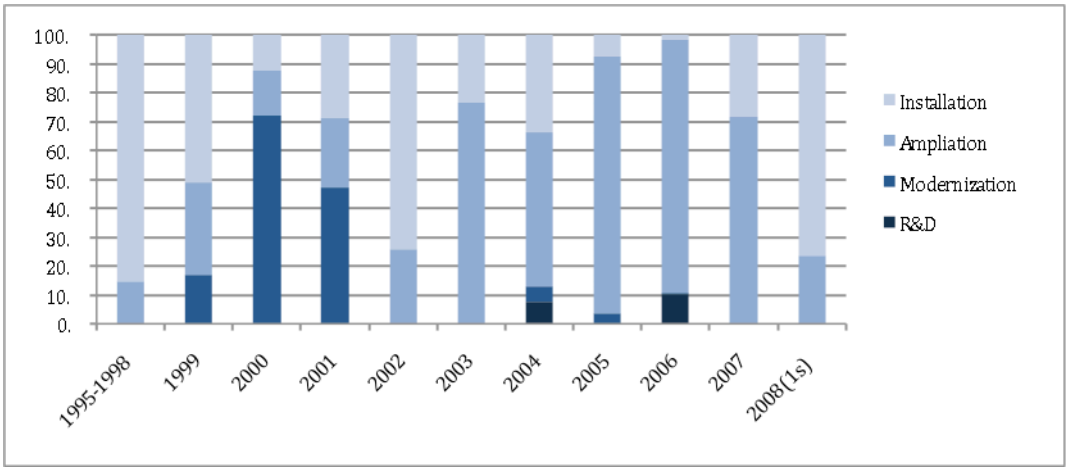
Figure 2.1 presents the value and composition of the capital from 1999 to the first semester of 2008, the figure sets out the total industrial investment with the eight selected sectors represented and divided by capital nationality. Whereas figure 2.2 demonstrates the annual distribution among the investment types.

Figure 2.1 – Value (Millions of US dollars) and Composition of Industrial Investment in the MRC (1999 to first semester of 2008)



Source: Adapted from SEADE Foundation - PIESP

Figure 2.2 – Industrial Investment Types in the MRC (1995 to first semester of 2008)



Source: Adapted from SEADE Foundation - PIESP

From 1995 to 1998 industrial investments sum up to US$ 7 bi, with an average of US$ 1.7 bn por year, 78% going to the eight selected sectors, divided in half approximadetely among national and foreing investers.[7] These investments are mostly defined as installation type (87%), characteristic of industrial sectors under economic liberilazation policies. The year 1999 was marked by a curency crisis[8], explaining the slump in national investment, which recuperates only in 2002. Meanwhile, modernization investments sore up in response to more competiveness opportunities in the international market. Posterior to 2001, ampliation investment types are the most sought for, while R&D investments appear in very small quantities in 2004 and 2006. Furthermore, the annual investment average from 1999 to 2007 dropped to approximadetley US$ 1 bn; the slump in 2004 may reflect the prior year's bad economic performance and politican incertenty influence in the investors' return expectancy, whereas the large increase in 2006 is due to one major investment[9].

The dominance of the selected eight high-technology sectors in relation to the industrial economy is noted in figure 2.1 – these sectors account for an average of 79% of all industrial investments per year. Whereas the industrial investment in the MRC represents an annual average of 10% of overall state industrial investments.

In the sequence we analyze other variables for the industrial economy. Table 2 demonstrates jobs and added value created for the region by the eight high-tech sectors and by the remaining fourteen sectors, totalizing 22 sectors.

[7] Not shown in Graphic 2.1.

[8] In response to market pressures, the fixed exchange rate regime was replaced with a floating regime, causing the real to start a sharp devaluation until the end of 2002, when it started to valuate.

[9] US$1.3 bi related to an oil refinery.

Table 2 – The Industrial Economy[10] - MRC

	Absolute Frequency of Jobs Created (1)	Relative Frequency in Relation to MRC Total (2)	Relative Frequency in Relation to State Total (3)	Added Value US$[11] (1)	Relative Frequency in Relation to MRC Total (2)	Relative Frequency in Relation to State Total (3)
Oil Refining, Coke Fabrication, Nuclear Fuel, and Ethanol Production (n=4 | 2)[12]	1,448	0.62	4.43	2,065,351,856	24.83	39.71
Chemical Products (n=345 | 152)	23,292	9.93	13.35	1,337,755,036	16.08	11.84
Machinery and Equipment (n=641 | 193)	20,957	8.94	9.40	376,317,382	4.52	7.26
Computers & Office Related Equipment and Machinery (n=24 | 9)	2,338	1.00	14.83	50,703,471	0.61	15.04
Electric Machinery, Devices and Equipment (=167 | 103)	9,023	3.85	9.12	242,304,061	2.91	9.02
Electronic Material, Communication Devices and Equipment (n=68 | 29)	10,678	4.55	28.32	844,389,245	10.15	32.45
Medical Instruments, Optics and Precision Instruments, and Industrial Automation Equipment (n=105 | 44)	3,259	1.39	10.75	73,109,019	0.88	10.52
Automotive Production and Assembly (n=105 | 87)	32,408	13.82	13.72	763,714,353	9.18	10.60
Remaining 14 (n=5,510 | 2,476)	131,139	55.91	8.14	2,564,254,675	30.83	7.11
MRC Total - 22 Sectors (n=7,025 | 3095)	234,542	100.00	9.54	8,317,899,101	100.00	11.67

Source: Adapted from MTE – RAIS 2007 and SEADE Foundation - PAEP 2001.

[10] The formulation of the tables in this paper obeys the following pattern: (2) is calculated by dividing (1) of each sector by the MRC total in the same column and multiplied by 100 to set the percentages – example: the "Machinery and Equipment" sector in Table 2 has 20,957 people employed in the MRC, divided by 234,542, which is the MRC total number of people employed considering all 22 sectors of the industrial economy, equals 0.0894, multiplied by 100, equals 8.94%; (3) is calculated by dividing (1) of each sector by the State's total of the sector, which is not shown in the tables, and multiplied by 100 to set the percentages. Column (3) does not add up because only the MRC is represented in the tables.

[11] The values in Reais were converted to US dollars on a US$1 = R$1.70 basis, which was the approximate exchange rate at the time of the first version of this paper.
Conversion Rate: ~US$1 = R$1.70 / €$1 = R$2.70 (03/27/2008)
Conversion example: 2006 Budget = R$958 mn ÷ 1.70 = U$563.52 mn
R$958 mn ÷ 2.70 = €$354.81 mn

[12] (n=number of establishments in the RAIS database | number of establishments in the PAEP database)

Table 2 – Continuation

	Absolute Frequency of Jobs Created in R&D (1)	Relative Frequency in Relation to MRC Total (2)	Relative Frequency in Relation to State Total (3)	Absolute Frequency of Jobs Created in Science and Engineering (1)	Relative Frequency in Relation to MRC Total (2)	Relative Frequency in Relation to State Total (3)
Oil Refining, Coke Fabrication, Nuclear Fuel, and Ethanol Production (n=4)	0	0.00	0.00	163	3.50	17.74
Chemical Products (n=345)	89	43.84	22.65	839	18.03	13.31
Machinery and Equipment (n=641)	1	0.49	1.41	375	8.06	8.13
Computers & Office Related Equipment and Machinery (n=24)	0	0.00	0.00	196	4.21	25.55
Electric Machinery, Devices and Equipment (n=167)	1	0.49	2.86	233	5.01	8.60
Electronic Material, Communication Devices and Equipment (n=68)	72	35.47	78.26	607	13.05	33.48
Medical Instruments, Optics and Precision Instruments, and Industrial Automation Equipment (n=105)	0	0.00	0.00	58	1.25	5.27
Automotive Production and Assembly (161)	26	12.81	20.97	1,274	27.38	17.75
Remaining 14 (n=5,510)	14	6.90	7.22	908	19.51	5.24
MRC Total - 22 Sectors (n=7,025)	203	100.00	21.83	4,653	100.00	10.89

Source: Adapted from MTE – RAIS 2007.

The notably high values of the sector labeled "Oil Refining, Coke Fabrication, Nuclear Fuel, and Ethanol Production" are due to the concentration of much of this production statewide in the MRC. The region contains some of the few refining plants in the state, which produces a very high share of state activity in the sector.

As expected, the production shares of "Electronic Material, Communication Devices and Equipment" are very significant. The sector comprises 10% of the industrial production added value in the MRC, concentrating one-third of all state production added value in the sector. Although the "Electronic Material, Communication Devices and Equipment" sector creates considerable added value for the region, the number of jobs created is not as much as several of the other sectors. Analyzing the number of jobs, the chemical, automotive, and machinery sectors employ far more people than the communication sector. However, despite employing fewer people, the communications devices sector is a big employer in the MRC compared to other regions, employing somewhat more than one-forth of the state's total workforce in the sector. Furthermore, the combination of these eight potentially high-tech sectors composes 44% of the region's industrial workforce.

Pertaining to added value, the total of the eight sectors in relation to the MRC total is even higher, providing almost 70% of the added value created in the industrial economy.

In effect, the numbers connected to R&D, science and engineering are even more complacent with the region's high-tech profile, as sought for when selecting the sectors.[13] Three sectors – chemical & pharmaceutical, automotive, and electronic material & communication devices – then arise as the most potential sectors for high-technology activities showing great concentration of jobs created both in regional and state scale.

Another proxy that can be used to analyze the innovative potential of a region is patents production. Table 3 presents the number of companies that requested one or more patents from 1999 to 2001. The data in the table is provided both for innovative companies and companies that did not execute any innovation at all. Companies categorized as innovative were those that indicated in the SEADE survey that they had introduced – from 1999 to 2001 – a technologically new (or significantly improved) product or service, which was new not just for the company, but also for the national market. The companies do not need to necessarily request a patent to be considered innovative.

[13] Jobs connected to science and engineering were also included, due to the fact that many employees relevant for S&T development are not register with the MTE pertaining only to R&D activities.

Table 3 – Innovation & Patents Requests – 8 Selected Industrial Sectors for MRC (1999 – 2001)			
		Absolute Frequency of companies (1)	Relative Frequency in Relation to MRC Total (2)
Innovative Companies	National or International patent request	45	7.27
	Both National & International patent request	9	1.45
	No patent request	67	10.82
	No innovation	493	73.18
	Total	619	100.00

Source: Adapted from SEADE Foundation - PAEP 2001.

Analyzing Table 3, approximately 27% of the companies in the MRC were considered innovative, and approximately half of those had a patent requested. Based upon the sectors analyzed, the presented rate of innovative companies – as well as patent requests - can be considered low. A possible explanation is that the period analyzed reflects investments in previous periods shown to be connected mostly to installation types in Graphic 2.2. Additionally, the period is characterized of uncertainty in the exchange rate, as well as in the international economic scenario, which can unstimulate company decisions towards innovation.

It is now useful to analyze how companies rate the importance of different sources of innovation in order to determine the most important sources in the industrial economy. This will give us an understanding of networking strength and ways in which networking can better improve levels of innovation.

Table 4 – Sources of Information for Technological Innovation – 8 Selected Industrial Sectors for MRC[14]						
	Consultancy Firms	Suppliers	Research Institutes	Other Departments Within the Company	Partner (Joint-Venture)	University
No Information	6.79 (42)	6.81 (42)	6.80 (42)	6.81 (42)	6.83 (42)	6.80 (42)
Indifferent or Null	85.14 (527)	80.39 (489)	83.66 (517)	80.06 (494)	86.34 (531)	84.14 (520)
Somewhat Important	5.17 (32)	2.92 (18)	5.02 (31)	2.92 (18)	1.95 (12)	5.02 (31)
Important	2.91 (18)	6.16 (38)	3.07 (19)	7.62 (47)	3.58 (22)	2.27 (14)
Very Important	0.00 (0)	3.73 (23)	1.46 (9)	2.59 (16)	1.30 (8)	1.78 (11)
	100 (619)	100 (617)	100 (618)	100 (617)	100 (615)	100 (618)

Source: Adapted from SEADE Foundation - PAEP 2001.

[14] All data presented on the tables, if not specified otherwise, follows this convention: first the relative frequency, with the absolute frequency in brackets.

Table 4 – Continuation						
	Acquisition of Licenses, Patents & Know-how	Clients	Competition	Conferences & Publications	R&D Department	Fairs & Exhibitions
No Information	6.81 (42)	6.82 (42)	6.81 (42)	6.81 (42)	6.80 (42)	6.77 (42)
Indifferent or Null	85.09 (525)	79.38 (489)	82.33 (508)	82.82 (511)	80.42 (497)	82.26 (510)
Somewhat Important	2.76 (17)	1.46 (9)	3.08 (19)	4.21 (26)	0.49 (3)	2.58 (16)
Important	2.43 (15)	5.68 (35)	5.35 (33)	5.02 (31)	5.18 (32)	4.84 (30)
Very Important	2.92 (18)	6.66 (41)	2.43 (15)	1.13 (7)	7.12 (44)	3.55 (22)
	100 (617)	100(616)	100 (617)	100 (617)	100 (618)	100 (620)

Source: Adapted from SEADE Foundation - PAEP 2001.

The numbers demonstrate that information for innovation is sought for, in first place, from the R&D department, closely followed by clients. Suppliers, other departments within the company and fairs & exhibitions are then next most important sources evaluated by the companies. The option "acquisition of licenses, patents & know-how", which can also be referred as technology transfer and commercialization (TTC), appears discreetly in last positions with research institutes and university. However, if we compute only the very important category, companies rank TTC in fifth position.

The ranking of sources of information suggest that companies are aware, firstly, of R&D departments' pivotal role in the innovation process. Secondly, companies share the view that integrating with clients and suppliers will give them more edge on the market then acting alone. Furthermore, TTC's result implies that companies who characterize the practice with some importance do often as "very important". In addition, companies grant relatively more importance to the practice than networking with research institutes and universities; however, all three are less looked for then seven other options, suggesting the fact that these institutions are not fully embedded in the innovation and commercialization network. In effect, TTC's, research institutes', and universities' present modest results considering their potential for enhancing technology innovation and diversification.

Moreover, if the universities and research institutes in the region, known for their excellence, do not act as sources for innovation they might not have served as business attractors for the region. Table 7 rates the level of importance of decision factors that might have influenced companies to move or start-up in the region after 1997.

Table 5 – Decision Factor for Location in the MRC – 8 Selected Industrial Sectors					
	Very Important	Important	Somewhat Important	Indifferent or Null	
Low cost of labor	16.56 (27)	9.8 (16)	29.4 (48)	44.2 (72)	100.0 (163)
Workforce Qualification and Training	1.84 (3)	36.2 (59)	23.9 (39)	38.0 (62)	100.0 (163)
Proximity with suppliers	10.37 (17)	23.8 (39)	20.7 (34)	45.1 (74)	100.0 (164)
Proximity with market	26.99 (44)	26.4 (43)	11.7 (19)	35.0 (57)	100.0 (163)
Transportation system accessibility	18.29 (30)	38.4 (63)	14.0 (23)	29.3 (48)	100.0 (164)
Telecommunication infrastructure	12.27 (20)	30.7 (50)	13.5 (22)	43.6 (71)	100.0 (163)
Urban infrastructure	17.9 (29)	58.0 (94)	6.2 (10)	17.9 (29)	100.0 (162)
Life quality for employees	9.15(15)	57.3 (94)	14.0 (23)	19.5 (32)	100.0 (164)
Proximity with technology diffusion and research centers	5.42(9)	24.1 (40)	15.1 (25)	55.4 (92)	100.0 (166)
Technical services and industry support infrastructure	4.17(7)	27.9 (46)	17.6 (29)	50.3 (83)	100.0 (165)
Fiscal incentives offered by the local, state or federal government	5.17 (17)	17.9 (59)	13.7 (45)	63.2 (208)	100.0 (329)
Low cost of land	16.87 (28)	12.7 (21)	14.5 (24)	56.0 (93)	100.0 (166)

Source: Adapted from SEADE Foundation - PAEP 2001.

Appearing as preferred factors for location decision by the enterprises is the region's hard infrastructure – urban infrastructure, transportation system accessibility, and telecommunication infrastructure –, proximity with the market, and life quality for employees.[15] Next, in an approximate preference scale, it is noted that companies consider smart infrastructure – workforce qualification and training and technical services and industry support infrastructure – on the same level as cost reduction features – low cost of labor and land. In last place, companies consider state fiscal incentives.

The importance of urban infrastructure and transportation system accessibility can be observed by noting the location of the big companies in the region (IBM, Acer, Alcatel, HP, Nortel, Qualcomm, Lucent, Samsung, Erikson, Siemens, Compaq, Motorola, Bosch, GE/Dako, Benchmark Eletronics, Texas Instruments, Pirelli, Merck Sharp & Dohme Farmaceuticals, Dow Corning, Toyota, Honda, GM, Goodyear, Rhodia, Shell, Replan, Dupont, Cargill, Petrobras, Exxon, and Unilever). All of these companies are near primary highway nodes.

[15] The region has both a large consumer market and good transportation possibilities, presenting the second largest consumer market in the state and the largest highway junction in the country with the main state highways connecting strategically where the University of Campinas, the technological park and the main companies are located.

2.3 The Services Economy[16]

A brief analysis of sectors in the services economy is now presented. Some selected sectors relevant for the technopolis are presented with their respective amount of jobs and added value created. The formulation of table 6 follows the same pattern described for table 2.

Table 6 – The Services Economy – MRC

	Absolute Frequency of Jobs Created (1)	Relative Frequency in Relation to State (3)	Added Value US$ (1)	Relative Frequency in Relation to State(3)
Digital Media [17]	359	4.36	-	-
Telecommunications (n=258 | 12) [18]	4,623	8.54	119,625,331	2.48
IT and related activities (n=403 | 68)	8,774	11.57	827,434,23	2.38
Research & Development (n=45 | 8)	2,922	43.99	79,163,101	33.78

Source: Adapted from MTE – RAIS 2007 and SEADE Foundation - PAEP 2001.

Table 6 – Continuation

	Absolute Frequency of Jobs Created in R&D (1)	Relative Frequency in Relation to State (3)	Absolute Frequency of Jobs Created in Science and Engineering (1)	Relative Frequency in Relation to State (3)
Digital Media	0	0,00	0	0,00
Telecommunications (n=258)	9	5,08	199	3,96
IT and related activities (n=403)	1	4,55	3832	14,48
Research & Development (n=45)	245	37,63	1432	68,68

Source: Adapted from MTE – RAIS 2007.

Shortly, the amount of jobs created, including R&D, science, and engineering, in the telecommunications, IT and related activities, and R&D sectors leans towards the common diagnosis of the region as a pole related to ITC and R&D services. However, information about the relation of these service companies in relation to the industrial sector and the region's smart and hard infrastructure is not available through the used databases.

2.4 Summary Comments

In effect, the MRC industrial economy has innovative potential due to its concentration in sectors that can utilize high levels of technology. The eight sectors described create 44% of the industrial jobs, 70% of the added value, and three sectors – chemical and pharmaceutical, electronic material, communication devices and

[16] No significant statistics for investment dynamics, innovation & patents request, sources of information for technological innovation, and decision factors for location in the MRC.

[17] No data available for added value.

[18] (n=number of establishments in the RAIS database | number of establishments in the PAEP database)

equipment, and automotive production and assembly – concentrate job and added value creation in relation both to the industrial economy in the MRC and the sector in relation to the state. Nevertheless, these selected sectors have low initiative for implementing innovative products or process and patent creation. Broadly speaking, considering also figures on R&D investment, the region's full potential for R&D in the productive economy is not currently utilized. In addition, analyzing further data presented, the region's smart infrastructure is not fully embedded in the region's economy.

The sectors analyzed within the services economy reveal a considerable amount of jobs and added value. The Telecommunications, IT, and R&D sectors can be considered to have high levels of activity in the region, especially judging by the job creation figures. However, by analyzing the information gathered, it is still not possible to know if these service sectors fill the industrial economy R&D gap.

Ultimately, we conclude that the region attracts companies due to a combination of resources smart and hard infrastructures have to offer, not just one or two factors, which could be diagnosed otherwise without a careful mapping of the region. Completing, we can empirically affirm that the region acts as a ITC and R&D pole in the state.

3. MRC's Innovation and Commercialization Infrastructure

Very few regions in Brazil have the assets that the MRC has: a technological park, research institutes, a research university, support groups, and incubators. These are of great value and need to be further analyzed and integrated to bring forward the region's capacity for developing means for becoming a technopolis.

Section 3.1 provides a brief description of the technological park. Section 3.2 follows with brief descriptions of the renowned research institutes in the region. Section 3.3 presents a more detailed description of the research university (Unicamp), one of the most important universities in Latin America. Indicators about students, faculty, budget, financing, scientific production, technological production (measured by the intellectual property production), and, start-ups and spin-offs related to the university are exhibited. Finally, section 3.4 provides a description of the support groups and incubators. The start-ups, spin-offs, and the companies related to the incubators are further analyzed with the data provided by the surveys in section 4. Summary comments are then displayed in section 3.5.

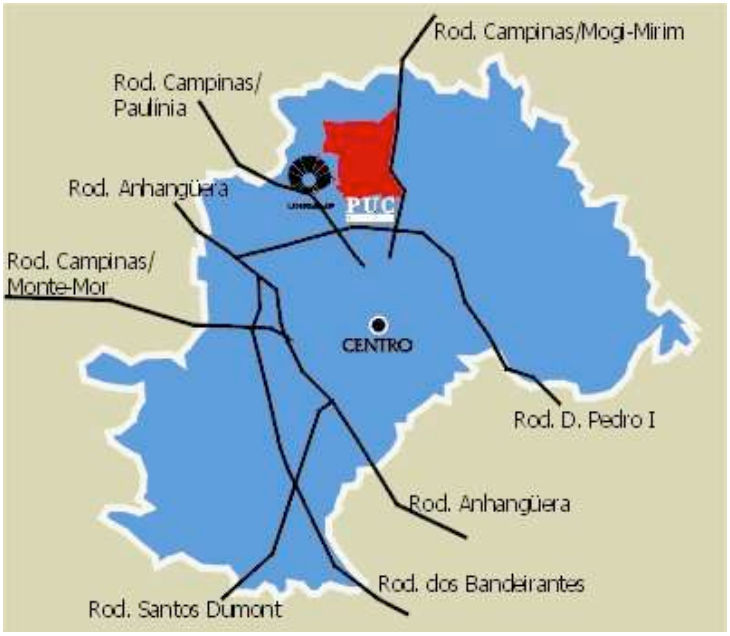
3.1 The Technological Park

In 2004 the government of the State of São Paulo created the State System of Technological Parks, where Campinas was marked as the 2nd Pole of High Technology. The local government and the federal Financier of Studies and Projects (FINEP) allied with Unicamp to start an expansion plan for the park that will possibly transform regional development. Despite being part of a government initiative, the park has a private governance system to create a more favorable environment to attract private companies, high-technology research institutions, and especially

venture capital to finance new start-ups. Special attention is given to key companies that can generate spin-offs, the spin-off themselves, and the technology-based companies graduated from the incubators. The park is currently focused on ITC, biotechnology, laser and optics, electronic material, and chemical products.

The technological park is located strategically with access to the main highways and the university (See Figure 2).

Figure 3 – The City of Campinas



Source: Campinas' Scientific and Technological Park <http://www.inova.rei.unicamp.br/tmp/parque/parque/>

The black symbol represents the University of Campinas, the white symbol the other university (Pontificia Universidade Catolica), the small region demarked within the large area representing the city is the technological park, and the black dot represents downtown. The main highways are illustrated as black lines with their names. Most of the companies are located at Rod. D. Pedro I, Rod. Campinas/Mogi-Mirim, Rod. Anhanguera, and Rod. Santos Dumont.

3.2 The Research Institutes

According to Suzigan (2005) the MRC is the second region in the state that most concentrates R&D institutes of natural and physical sciences – 16 establishments employing 1542 people. Some of these centers are now presented:

- LNLS - National Laboratory of Synchrotron Light (*Laboratório Nacional de Luz Síncrotron*)

Created in 1987 by the Ministry of Science and Technology the lab is operated by the Brazilian Association for Synchrotron Light Technology (ABTLuS), under a

contract with the National Scientific and Technological Development Council (CNPq), and is funded by the Ministry of Science & Technology. The lab has the only particle accelerator - a synchrotron - in the southern hemisphere, which was designed and built in Brazil by a team of physicists, technicians, and engineers. Over 180 professionals conduct research in physics, chemistry, material engineering, and environmental and life sciences.

- CPqD – Center for Research and Development in Telecommunications (*Centro de Pesquisa e Desenvolvimento em Telecomunicações*)

Created in 1976 by the Ministry of Telecommunications to be the R&D center for Telebrás (former state telecommunications company) it contributed to the formation of the government's national intelligence program, in the telecommunications and IT areas. Between 1976 and 1998 it was a state company, after 2000, as a private company it began to invest more heavily in the international market, becoming an international resource for solutions in telecommunications and IT. The center has the impressive record of 297 national and 159 international patents, 380 registered software's, and seven spin-offs, including one in U.S.A. Currently, it employs over 1100 professionals – 31 PhDs and 135 with masters degree.

- CenPRA –Renato Archer Research Center (*Centro de Pesquisas Renato Archer*)

The CenPRA is a research center created in 1982 by the Ministry of Science & Technology. It acts in the computer science sector assisting university and industry in IT, components design, systems, and software. The center has 12 labs and 230 researchers.

- EMBRAPA – Brazilian Enterprise of Agriculture and Farming (*Empresa Brasileira de Agropecuária*)

EMBRAPA was created in 1973 to promote the sustainable development of the Brazilian agribusiness through adaptation, transfer, and development of technology and knowledge. Affiliated with the Ministry of Agriculture, it has 37 centers, 3 service centers, and 11 central units throughout the country, with 8540 workers, of these, 2223 are researchers - 45% with masters, and 53% with PhDs. Four centers are present in the MRC: agriculture and farming computer science center, technology transfer center, satellite monitoring center, and the environmental center.

- IAC –Agronomic Institute of Campinas (*Instituto Agronômico de Campinas*)

The IAC is the oldest research institute of Brazil, created in 1887 by the emperor Dom Pedro II to support the coffee business; in 1892 it was transferred to the São Paulo State government for more effective coordination. Currently the mission is to develop and transfer science and technology to agribusiness, optimize the vegetal production systems, and make socioeconomic development with environmental quality possible. In 1999 a postgraduate course was created. The staff consists of 563 workers, of these, 172 are researchers.

- IB – Biological Institute (*Instituto Biológico*)

The IB was created in 1927 by the São Paulo State government. The mission is to develop and transfer agribusiness science and technology in the area of animal and vegetal health, aiming at life quality improvement for the population and their relation with the environment. The institute, through research, acts more in the area of animal diseases transmittable to humans, sanitation campaigns, food security, and the productive chain.

- ITAL – Food Technology Institute (*Instituto de Tecnologia de Alimentos*)

The institute was created in 1969 by the São Paulo State government and works in technological development for agribusiness. Essentially, ITAL provides R&D and industrial technical assistance for the food sector.

- CATI – Coordination for Fulltime Technical Assistance (*Coordenadoria de Assistência Técnica Integral*)

With the main office in Campinas, CATI has 610 local offices and 40 regional offices, primarily in the state of São Paulo. It provides rural educational services to transfer and disseminate production technologies.

- IZ – Zoological Institute (*Instituto de Zootecnia*)

Created in 1905 by the government of the state of São Paulo, the objective of IZ is to develop and transfer technologies and products for the sustainability of animal production systems.

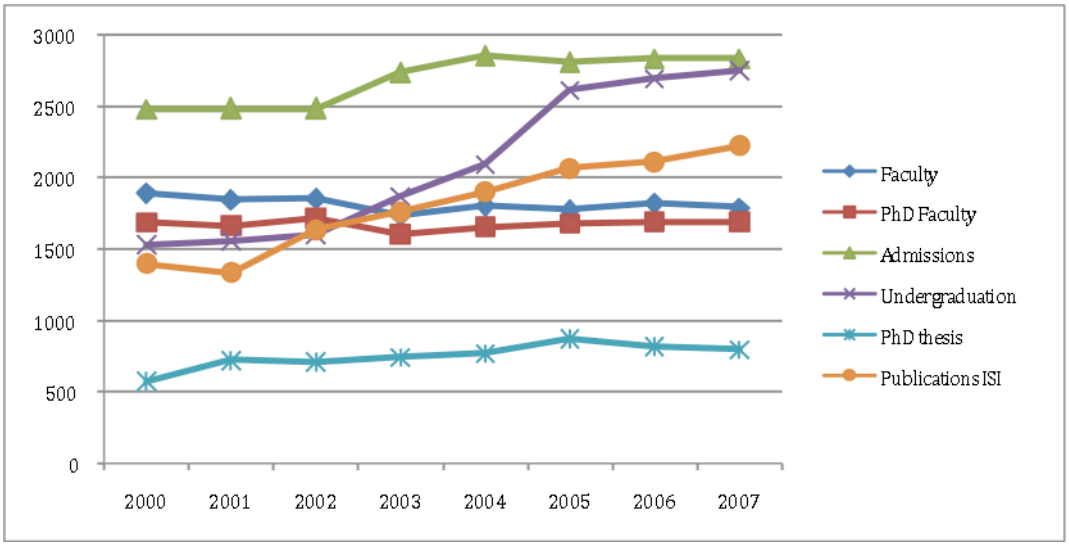
3.3 The University of Campinas

Unicamp fulfills the role of the research university required in the technopolis model. Created in 1966 it has always been committed to excellence in research and education. Despite being a relatively new university, Unicamp established itself as one of the most important universities in Latin America. Together with the University of São Paulo, Unicamp is included in the top 200 world university rankings for 2007, holding the 177th position. The two Brazilian universities are two of only three Latin American universities on the list.[19]

The university represents approximately 15% of all national research and 10% of all national graduate courses. It has 20 units of education and research, 127 undergraduate courses, 58 graduate courses, and 1786 scholars in 2007, 95% carrying PhDs. Figures 4.1 and 4.2 demonstrate some indicators to better understand the university.

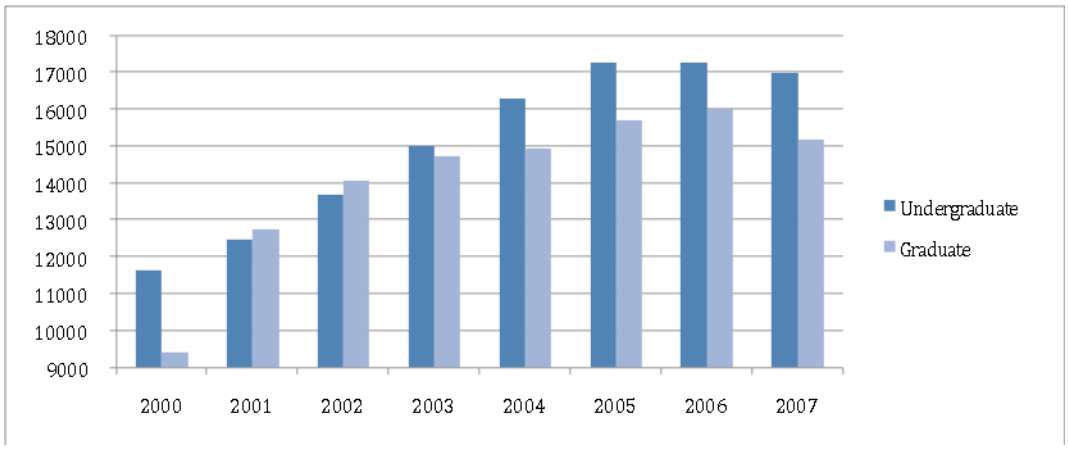
[19] World University Rankings 2008. *Times Higher Education/QS*. The other Latin American university on the list is Universidad Nacional Autónoma de México.

Figure 4.1– Unicamp´s indicators



Source: Adapted from the Research and Extension Information System (SIPEX) - Unicamp

Figure 4.2 – Number of Students at Unicamp

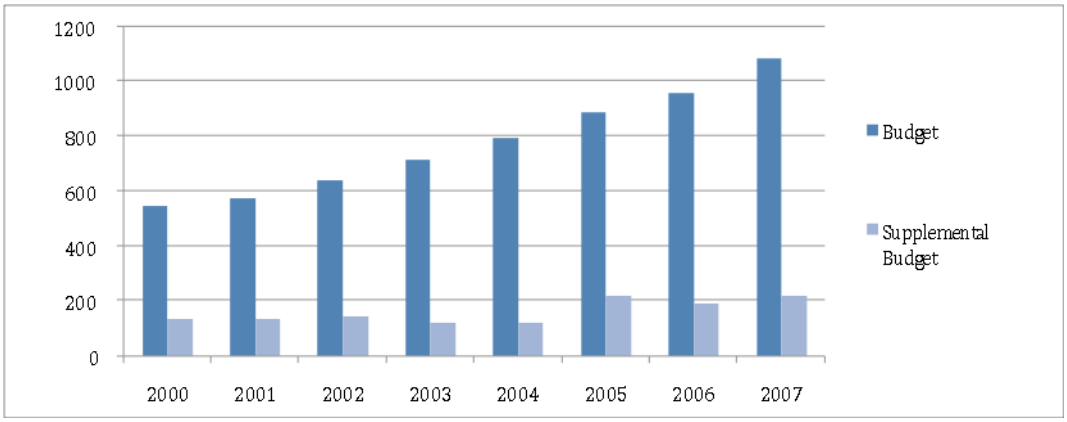


Source: Adapted from SIPEX - Unicamp

The trends demonstrate that, despite a small decrease in the number of faculty, the productivity – here measured by the number of publications indexed by the Institute for Scientific Information (ISI), the number of students graduating and the number of PhD theses – has been increasing consistently. Thus, the university can be considered one of the most productive universities in Brazil.

Figures 5.1 and 5.2 describe the budget of the university. The budget increase is linked to changes in the economy. Because it is a state public university that does not charge tuition or fees, the budget is determined by a percentage (around 10%) of the state products and services circulation state tax (ICMS). When the economy is expanding and the tax collection increases, the university budget also increases. When the economy is contracting, the university budget decreases.

Figure 5.1– Budget in R$ Million

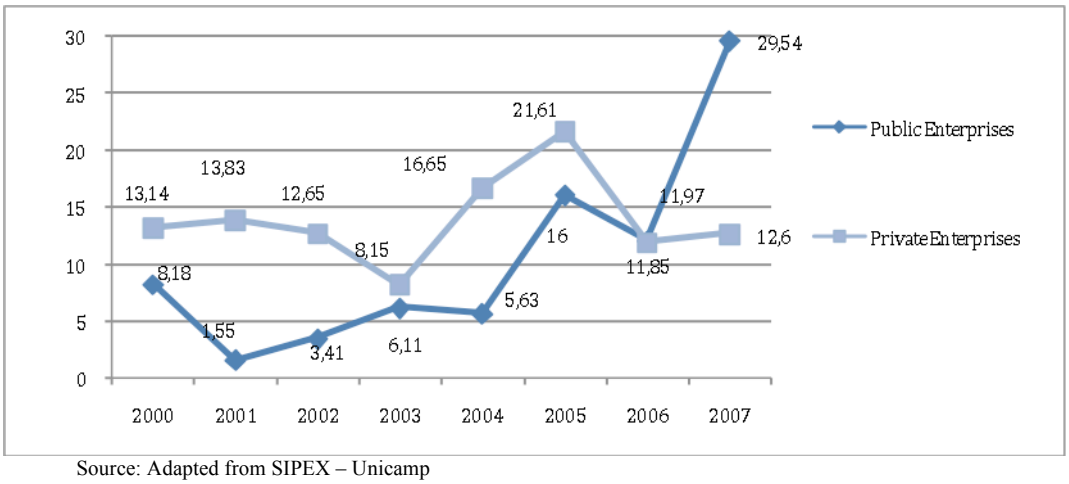


Source: Adapted from SIPEX – Unicamp

On the other hand, the supplemental budget is variable and depends almost entirely on state and federal agencies supporting research. International institutions and enterprises also have a share. Figure 5.1 demonstrates that, regardless of the steady increase in budget linked to the state tax, those entities that finance the supplemental budget are not increasing in value over time.

A relatively small participation by enterprises in the supplemental budget is observed in Figure 5.2.

Figure 5.2 – Enterprise Participation in R$ million



Source: Adapted from SIPEX – Unicamp

The level of enterprise financing is still modest in comparison to other sources of financing. The private financing level dropped in 2006 from a steady growth since 2003, and in 2007 was surpassed by the public enterprise financing.

Furthermore, to demonstrate what kind of enterprise participation takes place at the university, an analysis using the CNPq Directory of Research Groups is presented. The Directory of Research Groups is a database constantly updated and available to the public every two years. The database registers information about:

- Human resources – researchers, students, and technicians.
- Lines of research in progress.
- Specific sector of the research in progress.

- Scientific, technological, and artistic production.
- Interaction with the productive sector.
- Location – region, state, and institution.

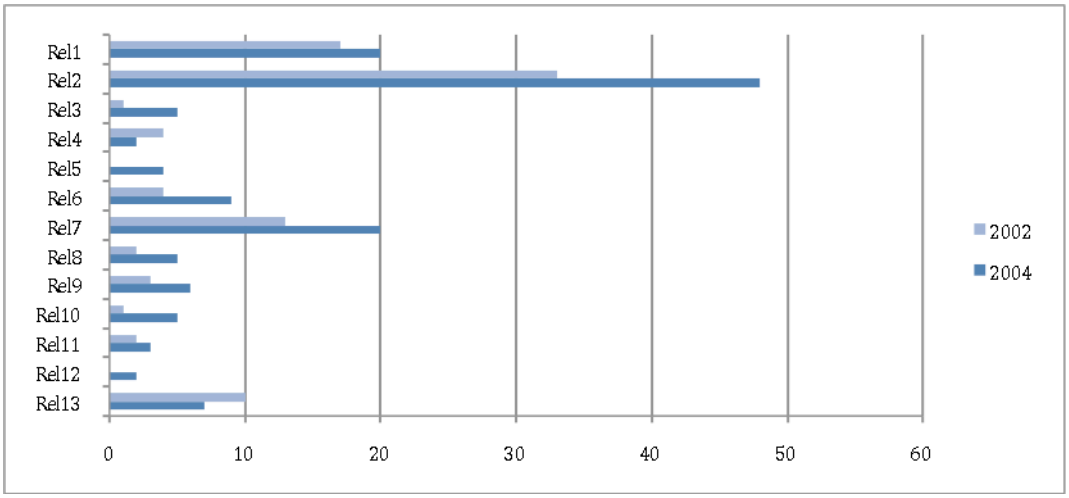
Questionnaires are applied to institutional research directors, group leaders, researchers, and students participating in every research group in the country. The database does not apply to research carried out by private enterprises.

The interactions between enterprises and research groups can be divided into many categories based on the type of research being conducted as well as the end goal:

- Scientific research without immediate consideration of use (Rel1).
- Scientific research with immediate consideration of use (Rel2).
- Engineering activities for development of prototype for the enterprise (Rel3).
- Development/fabrication of equipment for the research group (Rel4).
- Software development for the research group (Rel5).
- Software development for the enterprise (Rel6).
- Technology transfer for the enterprise (Rel7).
- Technology transfer for the research group (Rel8).
- Technical consultancy (Rel9).
- Supply of inputs for the research group by the enterprise (Rel10).
- Human resource training including "on the job" training for the enterprise by the research group (Rel11).
- Human resource training for the research group by the enterprise (Rel12).
- All other relation types (Rel13).

Figure 6 quantifies the types of relation according to the description above.

Figure 6 – University-Company Relation Types

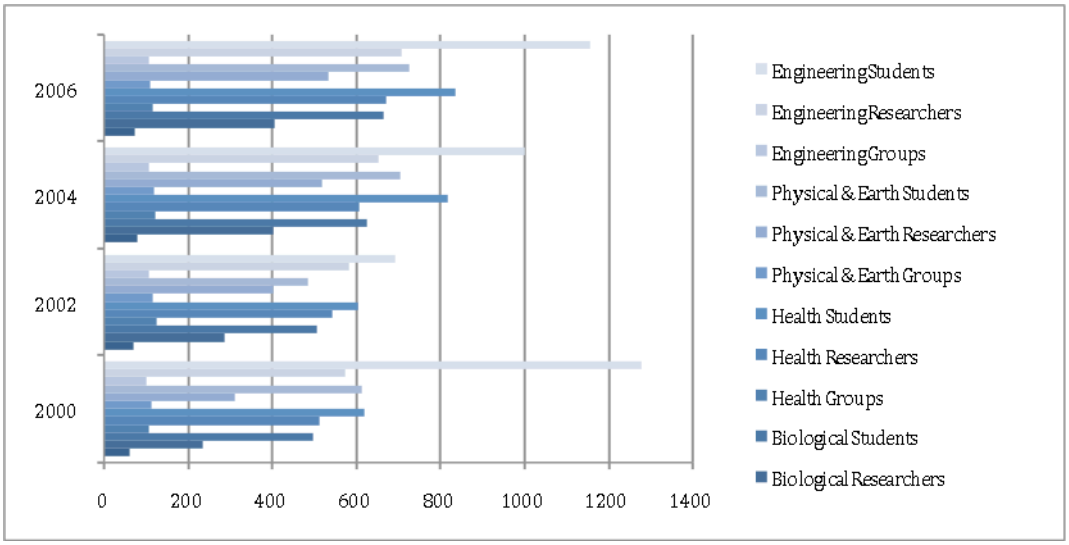


Source: Adapted from CNPq – Directory of Research Groups

Scientific research with immediate consideration of use is by far the most common type of relationship. On the other hand, scientific research without immediate use in 2004 reached the same level as technology transfer for the enterprise, which almost doubled from 2002 to 2004. Similarly, software development relations and development of prototypes have increased rapidly.

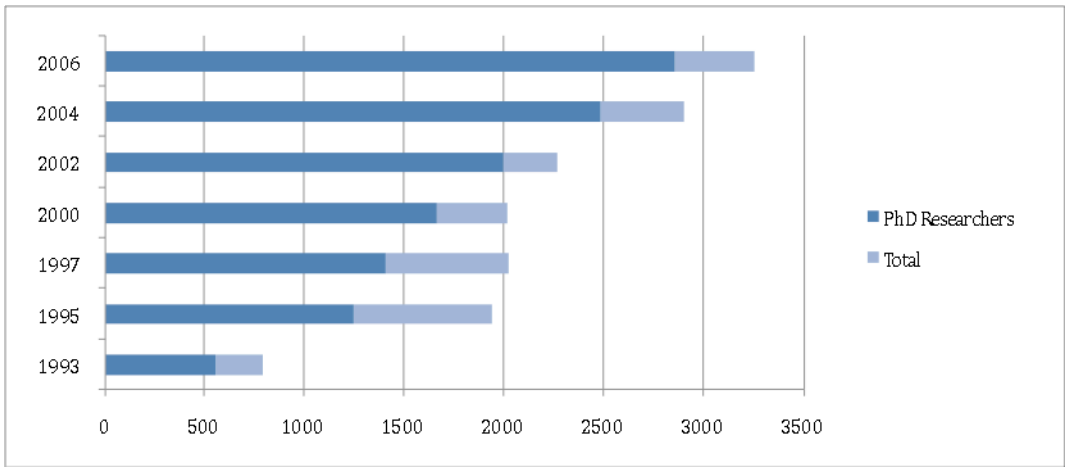
To quantify the number of people involved in research, Figure 7.1 presents the total number of students and researchers related to research groups, as well as the number of research groups in the chosen areas. Figure 7.2 displays the total number of people in the university involved with research and the amount with PhDs. Despite the decrease of the number of engineering students in comparison to the year 2000 all other variables are increasing.

Figure 7.1 – Number of Students, Researchers and Research Groups



Source: Adapted from CNPq – Directory of Research Groups

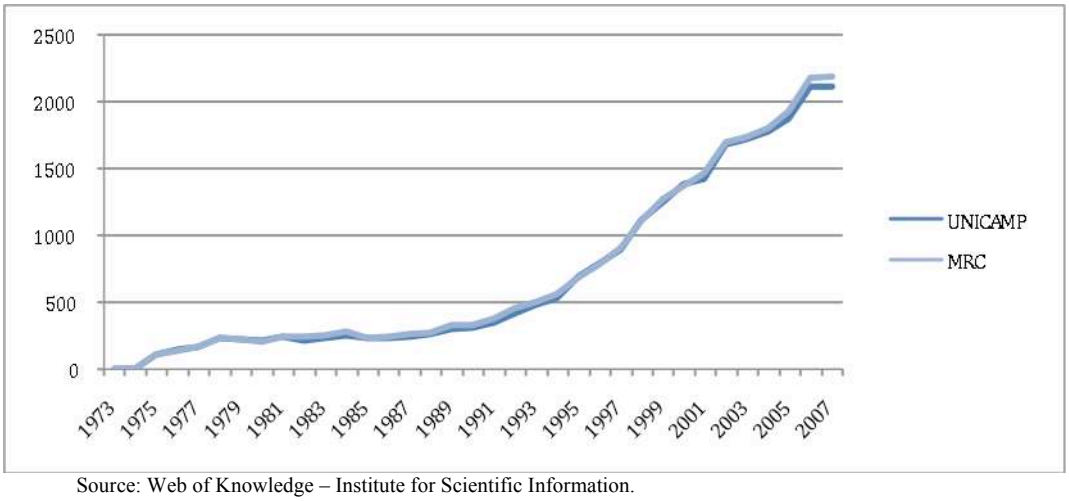
Figure 7.2 – Number of Researchers and PhD Researchers



Source: Adapted from CNPq – Directory of Research Groups

Figure 8 exposes the number of Unicamp publications since 1973 compared to the total number of publications of the MRC in the sciences area indexed by the ISI. This perspective is helpful in demonstrating the concentration of the scientific production at Unicamp. The region's figures include publications of Unicamp, other universities and colleges, research institutes, and companies in the region. The data reveals an almost absolute correlation between Unicamp's publications and the publications of the whole MRC region.

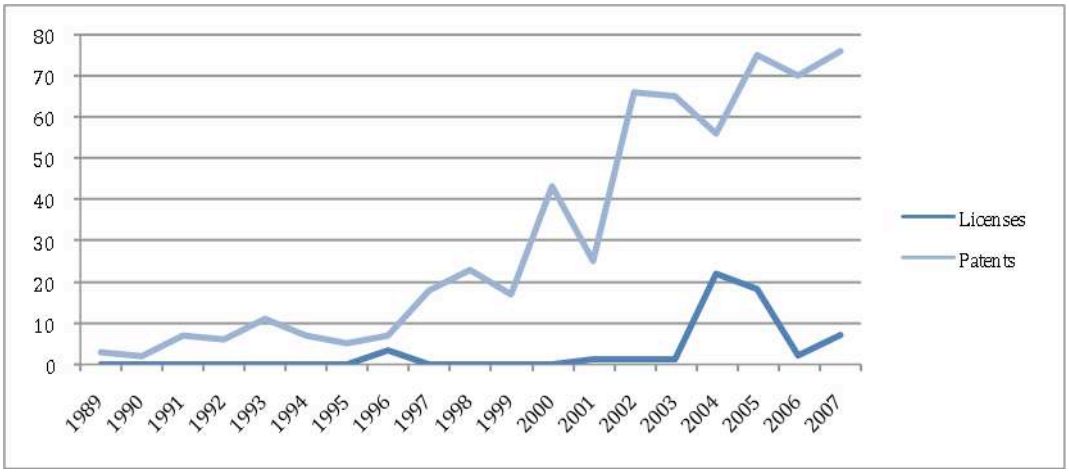
Figure 8 – Science Publications indexed by the ISI (1973 – 2007)



Source: Web of Knowledge – Institute for Scientific Information.

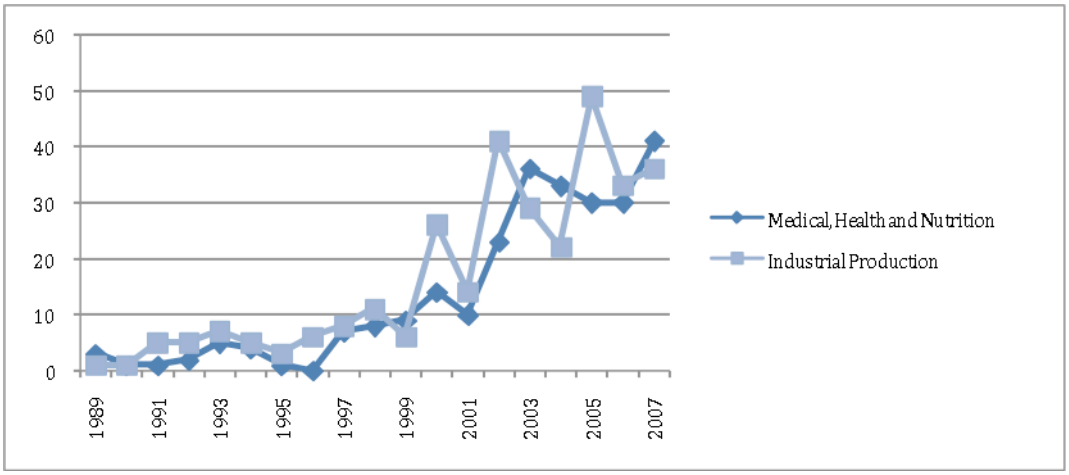
Over the period from 1999 to 2003, the university was the Brazilian leader in technological production, measured by the number of patents registered in the National Institute of Intellectual Property (INPI), according to a report by INPI. It is quite possible that the university remains the leader currently, since the number of patents has increased since 2002. Figures 9.1, 9.2 and 9.3 demonstrate the level of technological production in Unicamp.

Figure 9.1– Licenses and Patents Registrations (1989 – 2007)



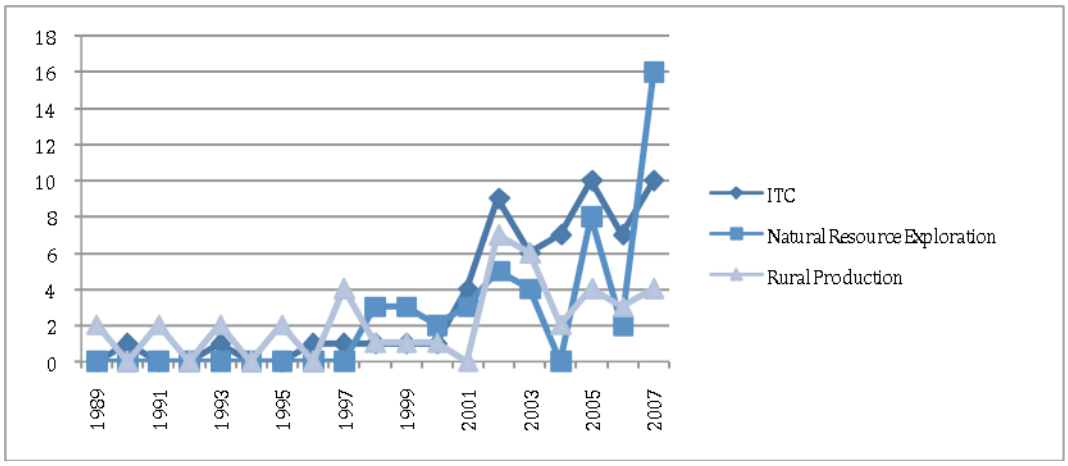
Source: Adapted from the Inova's database.

Figure 9.2 – Patents Registrations divided by sector (1989 – 2007)



Source: Adapted from the Inova's database.

Figure 9.3 – Patents Registrations divided by sector (1989 – 2007)

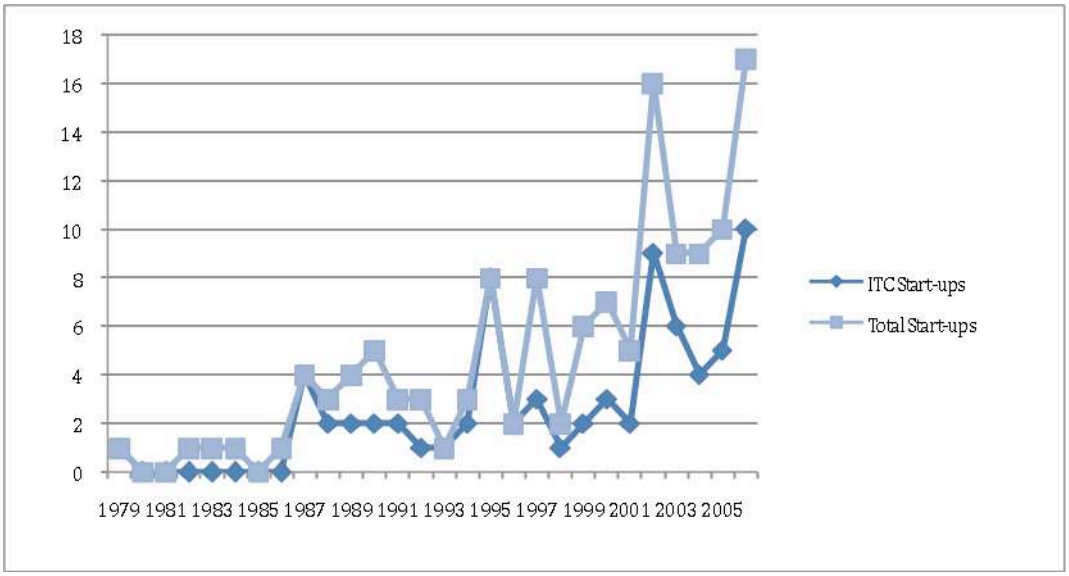


Source: Adapted from the Inova's database.

Patent registration trends do not follow the region's inclination for ITC and a greater number of patents originate from the "Industrial Production" and the "Medical, Health and Nutrition" sectors. Furthermore, figure 8.1 indicates a rapid increase in the level of patents developed in the university and also a rapid increase in the number of licenses. The number of patents shows consistent increases since 1999, demonstrating the entrepreneurial vocation of the university. The increase in licenses, however, is made possible, in large part, by the creation of the Innovation Agency (Inova). Inova focuses on managing the Intellectual Property developed at the university and prospecting this potential, as well as other functions described ahead in section 4.

The Innovation Agency registers almost all university-related companies in a database. (Companies are considered related to the university when a current or former faculty member, student or staff member is a company partner.) A time-series of the start-ups related to the university from 1979 to 2005 is displayed in figure 10.1. In the database, ITC start-ups show consistency and a sharp increase after 2001.

Figure 10.1– University-Related Start-Ups (1979 – 2006)

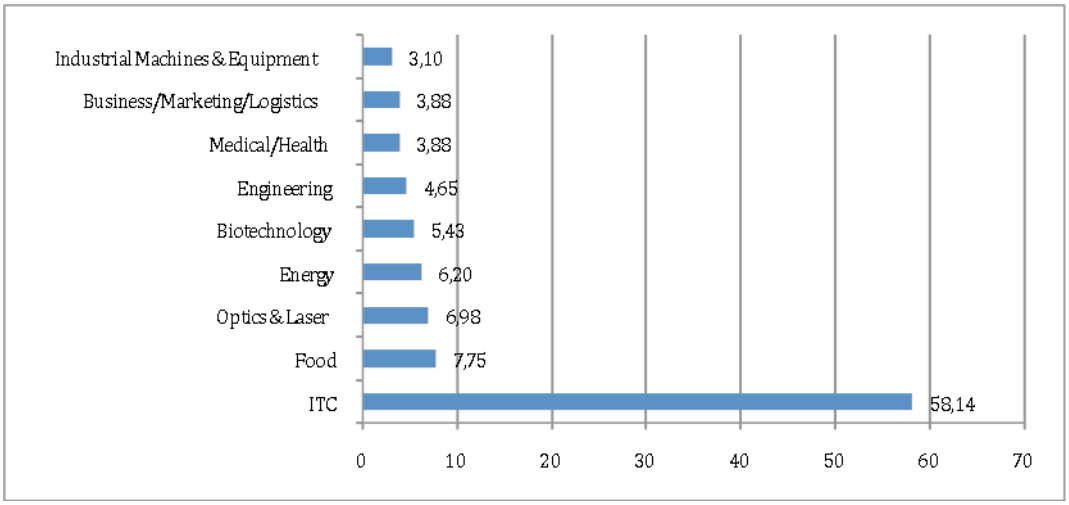


Source: Adapted from Inova's database.

If spin-offs are defined as "new ventures that are dependent upon licensing or assignment of the institution's intellectual property for initiation" (Lockett & Wright, 2005) the number of formal spin-offs from Unicamp is zero. [20] However, the surveys conducted and presented in section 4 found that there are three spin-offs – if a spin-off is defined more broadly as research done within the facilities of the university and explored commercially with the start-up of a company. This demonstrates that, notwithstanding the university entrepreneurial orientation, with many patents and start-up creations, the practice of TTC is still somewhat underdeveloped.

Figure 10.2 quantifies the percentage of start-up companies related to the university by sector.

Figure 10.2 – University-Related Start-Ups by Sector



Source: Adapted from Inova's database.

[20] Personal communication with Paulo Lemos, who is responsible for technological entrepreneurship and pre-incubation of projects at the Innovation Agency, April 2008.

The total number of jobs created by 116 companies is 5175. Excluding one company that has 1000 employees from the calculations, the employee average is 36.3 per company, with a standard deviation of 60.8. Further analysis of these companies will follow in section 4.

3.4 Support Groups and Incubators

This section provides a description of the support groups and incubators present in the MRC. The IC^2 Institute views incubation as a very important activity – a chance to create jobs and wealth through technology entrepreneurship, and to provide unparalleled opportunities for the community. Working with early technology-based companies will increase their odds of success and decrease their time to attain capital and reach markets.

Key support groups include the following.

- CIATEC – Company for Development of the High-Technology Pole of Campinas (*Companhia de Desenvolvimento do Pólo de Alta Tecnologia de Campinas*)

CIATEC was founded in 1982 to coordinate action between the companies, university, and R&D institutes. In 1996 an incubator for technology-based companies was founded, plus an additional virtual incubator. So far 29 companies have graduated, and 23 are being helped currently. Whereas 17% of the graduated companies have ceased operations, more than half (56%) of all start-ups in the state have shut down.

- SOFTEX – Brazilian Society for the Promotion of Software Exportation (*Sociedade Brasileira para Promoção de Exportação de Software*)

SOFTEX was created in 1993 for the coordination and promotion of companies with software R&D activities. It works in 6 areas: qualification, quality, entrepreneurship, funding, excellence, commercialization, and exportation. In 1995 an incubator was created exclusively for software companies in the ITC area. To date 15 companies have graduated, and four are currently incubated. The death rate of the graduated companies is approximately 30%.

- INOVA – Unicamp's Innovation Agency (*Agência de Inovação da Unicamp*)

Created in 2003, the functions of the agency include: managing the intellectual property developed at the university, stimulating partnerships with society (e.g., private companies, public sector, institutes, foundations), amplifying the synergies of all external relations, augmenting the types of relations possible with the private and public sector and facilitating access to the university by those sectors, stimulating technology-based start-ups through the incubator, prospecting financial opportunities with government agencies and venture capital investors, and supporting the development of the technological park.

INOVA also overviews the incubator that was created in 2001, INCAMP, uniting the university with SEBRAE – Brazilian Agency for Support of Micro and Small Enterprises –, and government, with the mission of creating and developing technology-based companies. The incubator has capacity for 10 companies and has graduated 11 companies thus far, with 10 incubated at the present. The death rate of the graduated companies is 16%.

All incubators have practically the same services available, INCAMP's difference is that companies there are supposed to have more interaction with the university, mainly through such tasks as identifying researchers that can contribute to the company. The services available in all three incubators include: physical space, technical assistance for resources capitation, project presentation to investors, intellectual property management support, orientation for business plans, management, financing, marketing, production, and operations.

3.5 Summary Comments

The Technological Park is still not fully integrated into the region's economy and the park is not yet completed. Thus far, a more complete analysis of its influence in the region is not currently possible.

The research centers, on the other hand, are fully established and properly functioning. While this paper is not focused on evaluating each center, we can conclude that the region presents some excellent centers with national and international recognition. However, the integration at the regional level among the research centers, the university, and the companies and their embeddedness in the system is still partially known.

Likewise, Unicamp is a preeminent center of excellence in education and research, representing 15% of all national research and 10% of all national graduate courses. The university can be considered one of the most productive in Brazil, with an ever-growing number of researchers linked with high levels of scientific and technological production. On the other hand, budget increases for the university are closely correlated with economic growth in the region. State and federal agencies and enterprises have not increased financing over the years, especially in the case of private enterprising, which has been decreasing. The university-company relations have followed the tendency of increasing technology transfer and commercialization from the university, as observed with the high increase in the number of licenses and with the directory of groups' data. Software and prototype developments relations have increased at a fast rate as well. Furthermore, the entrepreneurial tendency of the university is demonstrated by the level of start-ups, which has also been increasing. These results suggest that the university needs to develop a strong infrastructure of technology transfer and commercialization to nourish higher levels of academic entrepreneurship, of which Unicamp is certainly capable.

In addition, the support groups can be considered well integrated in the region's network, demonstrating coordination to develop technology-based companies through their incubators with connections to Unicamp, government, and other companies.

4. Surveys of Incubator-Related Companies and University-Related Companies[21]

Up to this point a broad view of the region was made, starting with a selected economy mapping, which makes possible an understanding of high-technology industrial and services environment – the foundation for a technopolis. In sequence, some actors pertaining to the technopolis wheel were studied – university, research institutes, support groups. In this section we attempt to go further around the 'technopolis wheel'[22], in an effort to maximize the 'analytical spin' over the MRC.

Technology-based start-ups is the actor chosen for this 'maximization', we view that this category of endeavors are the most indispensable production units to attain the kind of economic development proposed by Smilor *et al.* (1988). In investigating these firms through surveys it is also possible to increase knowledge about the incubators and university, since we are interested in start-ups linked with these two institutions. Furthermore, these actors are an important source on government policies and actions recommendations and location preferences.

4.1 Methodology

The surveys were produced echoing IC^2's knowledge in business venturing and public policy. The focus of the two surveys is basically in three fronts: characterization of technology-based companies, incubator and university rating, and policies and actions recommendations.

Information was extracted from the companies to: (1) establish metrics for the incubators' performance; (2) analyze if the incubators are delivering value-added services to the companies; (3) ensure that the companies have access to necessary human and financial resources for a successful growth; (4) extract information and establish metrics for the companies´ performance as measured by job and wealth creation, capital raised, R&D levels, and IP production; (5) probe the companies' interaction with the university and future expected relationship; (6) gather policy opinions; (7) set out market exploration preferences; (8) bring to light areas in which the companies are in need of more assistance; (9) evaluate Unicamp's entrepreneurial orientation; and (10) analyze factors contributing to companies' decisions to establish operations in the MRC.

To achieve this objective we developed an Incubator-Related Company Survey (IRCS), and the University-Related Company Survey (URCS).

For the IRCS sample a database was created with all companies graduated and that are currently incubated in one of the three incubators. This database was compiled through the Internet and identified 95 companies. Fifty-eight companies had valid email addresses, which was the only channel used to get in contact with the

[21] Surveys available upon request.

[22] Contained in the appendix.

companies. Of those receiving the survey, 18 companies answered, for a 31% response rate.

The URCS sample is based on the database provided by INOVA. The electronic survey was sent to all companies that had a valid email address. Twenty-two of 90 companies from this database responded, marking a 24% response rate.

The surveys were sent in March 2008 and two remainders sent following up on two weeks-intervals.

Since the sample was not random we cannot affirm that these results have statistical inference for the whole university-related and incubator-related company population. However, due to the good response rate and data convergence, we consider the sample results a good approximation of the population. Further statistical tests are required to confirm our position.

4.3 Survey Results

To characterize the companies the following questions were asked: start-up date, incubated or graduated (for the IRCS), number of employees and gross revenue in 2007 (R$).

Table 7 – Absolute Frequency of Start-Up Date

	URCS	IRCS
1984	1	0
1987	2	0
1991	1	0
1995	3	0
1997	2	2
1998	0	1
2000	5	0
2002	1	3
2004	3	2
2005	1	1
2006	1	7
2007	2	1
2008	0	1

Source: Survey Data

It is observed in Table 7 that most of the companies are relatively new, mainly the incubator-related companies, with a lifetime of less than a decade.

The number of jobs created by the companies that responded to this question in the survey (three in the IRCS and two in the URCS did not answer) is: 255 and 908, by the incubator-related and the university-related companies respectively. The graduated companies provide 89% of the jobs compared to the companies still being incubated (the number of companies graduated and incubated in the sample are exactly equal). The MRC accounts for 931 of the jobs, with the remaining 232 jobs in companies outside the region. Despite the approximately equal size of the sample, it is noted that the companies of the URCS offer far more jobs than those from the IRCS. Table 8 offers an explanation for this fact, since it is noted that far more companies in

the URCS sample have small and medium size, opposed to most micro sized companies in the IRCS sample.

Table 8 – Company Size[23]		
	IRCS	URCS
Did not answer	22.2 (4)	9 (2)
Micro (1 to 19)	61.1 (11)	40.9 (9)
Small (20 to 99)	11.11 (2)	31.8 (7)
Medium (100 to 499)	5.5 (1)	18.1 (4)
Big (+500)	0 (0)	0 (0)
	100.0 (18)	100.0 (22)

Source: Survey Data

In Table 9 presents revenue values for the year of 2007. Cross-referencing the revenue level with start-up date and company size there isn't any significant correlations implying older or bigger companies have higher revenues.[24] It is a good indicator that companies related to incubators and universities can have fast growth, possibly indicating the existence of a less time dependent learning curve than of regular companies.

Table 9 – Revenue in 2007 (R$)		
	IRCS	URCS
Did not answer	16.67 (3)	4.55 (1)
<120,000	33.33 (6)	22.73 (5)
120,000 – 1,200,000	38.89 (7)	27.27 (6)
>1,200,000	11.11 (2)	45.45 (10)
	100 (18)	100 (22)

Source: Survey Data

In contrast, regarding capital raised by IRCS companies, 38.8% answered they are raising sufficient capital to successfully grow the company, whereas 61.1% of the companies report they have been unable to raise sufficient capital. Whereas, for URCS companies, 57.1% are raising sufficient capital, and 42.9% are not. Tables 10.1 and 10.2 demonstrate the sources of capital.

Table 10.1 – Amount of Capital (R$) Raised Since Start-Up - IRCS								
	0	1-50.000	50.001-100.000	100.001-150.000	150.001-200.000	200.001-250.000	>250.000	
Governmental Programs	33.33 (6)	11.11 (2)	5.56 (1)	11.11 (2)	0	0	38.89 (7)	100 (18)
Venture capital	88.89 (16)	0	0	0	0	0	11.11 (2)	100 (18)
Private Banks	88.89 (16)	5.56 (1)	0	0	0	0	5.56 (1)	100 (18)
Partners	38.89 (7)	22.22 (4)	5.56 (1)	11.11 (2)	11.11 (2)	0	11.11 (2)	100 (18)
Own sources such as family, friends, and myself	44.44 (8)	33.33 (6)	22.22 (4)	0	0	0	0	100 (18)

Source: Survey Data

[23] Classification according to SEBRAE.

[24] Not shown in the tables to protect companies' confidentiality.

Table 10.2 – Amount of Capital (R$) Raised Since Start-Up - URCS								
	0	1-50.000	50.001-100.000	100.001-150.000	150.001-200.000	200.001-250.000	>250.000	
Governmental Programs	55 (11)	10 (2)	10 (2)	5 (1)	0	0	20 (4)	100 (20)
Venture capital	90 (18)	5 (1)	0	0	0	0	5 (1)	100 (20)
Private Banks	65 (13)	20 (4)	0	5 (1)	0	0	10 (2)	100 (20)
Partners	15 (3)	40 (8)	10 (2)	0	5 (1)	5 (1)	25 (5)	100 (20)
Own sources such as family, friends, and myself	40 (8)	30 (6)	0	10 (2)	0	5 (1)	15 (3)	100 (20)

Source: Survey Data.

For most of the companies in both surveys, most capitalization comes from partners, followed by their own sources and government programs. Private banks and venture capital were the least used form of raising capital. It is clear now that previous capital accumulation and government programs are responsible for the capitalization of many start-ups. The survey results (both surveys) show that government programs was the most used form for raising R$ 250,000 or more, followed closely by "Partners". Only 11% of the companies in the IRCS and 10% in the URCS used venture capital.

As of applying capital into R&D activities, two positive figures related arise:

- 100% of the companies of the IRCS sample have R&D activities. 61% with a structured R&D department or section, and 39% without one.
- 91% of the companies of the URCS sample have R&D activities. 39% with a structured R&D department or section, and 61% without one.

Research and development expense (as percentage of gross revenue) is dispersed in both samples, as observed in Table 11. A small concentration at the level of 30% is observed in the IRCS, and in the URCS most companies spend 20% or less.

Table 11 – R&D Expense as Percentage of Gross Revenues		
	IRCS	URCS
Did not answer	16.6 (3)	9.1 (2)
0	0.0	9.1 (2)
1	0.0	13.6 (3)
3	5.5 (1)	4.5 (1)
5	5.5 (1)	9.1 (2)
10	11.1 (2)	18.2 (4)
15	5.5 (1)	9.1 (2)
20	5.5 (1)	13.6 (3)
25	0.0	4.5 (1)
30	22.2 (4)	0.0
50	5.5 (1)	4.5 (1)
80	16.6 (3)	0.0
100	5.5 (1)	4.5 (1)
	100.0 (18)	100.0 (22)

Source: Survey Data

From R&D activities Intellectual Property (IP) may arise as result, or in many cases these companies started-up developing on IP produced in the university or a research institute and applied for the market. As shown in table 12, about half of the companies (44%) in each group own some kind of intellectual property. Almost all IP was reported to be part of companies' production processes.

Table 12 – Intellectual Property

		Did not answer	None	Patents	Licenses	Copyrights	
IRCS	Frequency of Companies with IP	11.1 (2)	44.4 (8)	22.2 (4)	16.6 (3)	5.5 (1)	100.0 (18)
	Absolute Frequency of IP	-	-	18	5	1	24
URCS	Frequency of Companies with IP	18.2 (4)	36.4 (8)	13.6 (3)	9.1 (2)	22.7(5)	100.0 (22)
	Absolute Frequency of IP	-	-	3	6	16	25

Source: Survey Data

Several questions were asked about past and current relationships and expectations about future relationships with the university. In the IRCS sample 83.3% of the companies said at some point in the past they had and/or currently have some type of relationship with the university. Those that never had a relationship with Unicamp (16.6%) were asked why not. Those that had and/or have were asked to specify the relationship type. We have grouped the descriptions given by the companies in a taxonomy based on Vedovello (1998). Results are exhibited in Tables 13.1 and 13.2.

Table 13.1 – University-Company Interaction - IRCS

Never had a relationship with Unicamp	16.6% (3)
Why? • Bureaucracy • Lack of research on the company's area	
Had and/or have a relation with Unicamp	83.3% (15)
What type of relationship? • **Informal Links**: personal contact with university academic staff, access to specialized literature, access to university department research, attendance at seminars and conferences, access to university equipment, and attendance at general education/training programs. • **Human Resource Links**: student involvement in projects, recruitment of experienced scientists and engineers, and formally organized training of firm's personnel in university. • **Formal Links**: university academic staff engagement for consultancy, company staff as course professor, analysis and testing in university department, participation in university-related enterprises venture, and establishment of joint researches and joint lab.	
Expectations about future relations: • New technology development in conjunction with university researchers – R&D links in general; • Technology commercialization; • Technology transfer; • Utilization of the university network; • Human Resource Links: staff training, university academic staff and student engagement in partnerships, and student recruitment; • Commercial relations; • Modification of the academic culture to set a more favorable environment for university-company relations.	

Source: Survey Data

Table 13.2 – University-Company Interaction - URCS	
Had and/or have a relation with UNICAMP	100% (22)
What type of relation? • **Informal Links**: personal contact with university academic staff, access to university department research, and attendance at seminars and conferences. • **Human Resource Links**: all companies have partners that are current or former students or professors, and recruitment of students and graduates. • **Formal Links**: sponsor of university events, university academic staff engagement for consultancy, pre-incubation project with university and public company, and establishment of joint researches.	
Expectations of future relations: • New technology development in conjunction with university researchers – R&D links in general; • Technology commercialization; • Technology transfer; • Utilization of the university network; • Student recruitment; • Participation for creating workshops, courses, and seminars; • More discussion about innovation with company participation; • More attention to companies not related to high-technology; • Direct support; • Assistance with marketing and management.	

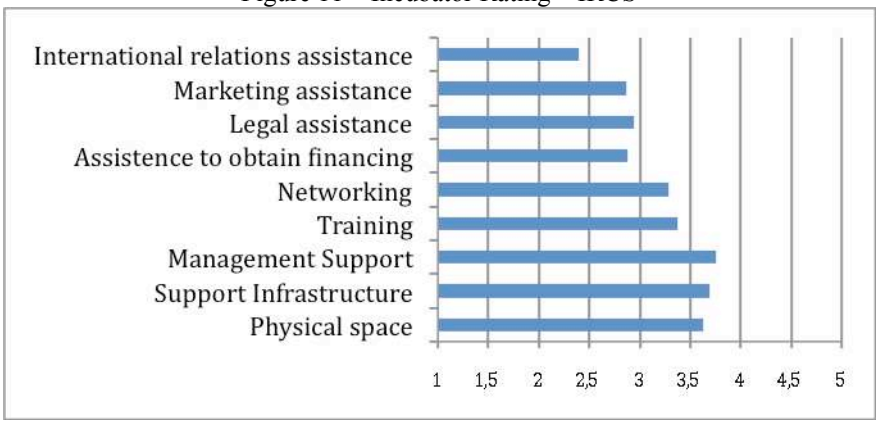
Source: Survey Data

To reach a full level of interaction with the university of companies incubated, the negative issue cited, namely bureaucracy, in the IRCS should be addressed. Of serving as role models for new technology-based start-ups not related to incubators, the publicizing of the existing links could form new expectancies within these companies for an approximation with the university.

As for future expectations, the key is to develop, in the first place, a strong system at the university for technology transfer and commercialization. After that, the other relationships will develop with more ease.

In both surveys the companies were asked to rate important aspects that can serve as benchmarks for future research. In the IRCS, companies were asked to rate the incubators' value-added services and concrete components that all incubators should have in order to successfully nourish entrepreneurship and company growth. Companies were asked to evaluate the services and infrastructure provided at the time of incubation on the following scale: Excellent (5), Good (4), Satisfactory (3), Somewhat Unsatisfactory (2), and Very Unsatisfactory (1). The results are presented in Figure 11.

Figure 11 – Incubator Rating – IRCS



Source: Survey Data

Management orientation received the best rating; followed by support infrastructure (e.g., computers, telephones, Internet, etc.), physical space, training, and networking receiving a rating between good and satisfactory levels. Marketing assistance, legal assistance, and assistance to obtain financing received a less than satisfactory evaluation. International relations assistance lagged behind all, close to the somewhat unsatisfactory level.

The companies were then asked how the incubators could improve generally and/or in the items graded satisfactory or worse. Survey respondents were also asked in what areas the incubators were most useful.

Table 14.1 – Evaluating the Incubators – IRCS Survey

How to improve generally and/or in the items graded somewhat satisfactory or worse
• Specific legal assistance staff; • Specific international relations assistance staff; • Marketing assistance can't be voluntary; needs more practicability and less theory; • Management assistance ready to create a business case, especially with real dimensioning of production value; • Specify bureaucracy necessary to request the incubator services; • Bring more entrepreneurs, executives, and investors for networking; • More executives related to management assistance; • More synergies between incubation management and university innovation staff; • More networking among the incubated companies; • Partnerships and networking with venture capital funds and investors, especially international ones; • Press assistance for dissemination of technologies and projects in forums and events. Collaboration with other entities to exchange information. Permanent dissemination/press center; • Collaboration with international incubators especially in USA and Europe to form an exchange program between companies and incubators; • Building specifically planed for an incubator with space for meetings and networking.
How was the incubator most useful?
• Networking; • Management support and business plan; • Opportunities to apply for government financing programs that have a collaboration with the incubator; • Training; • Frequent meetings securing the investor's attention to the project; • Physical space and support infrastructure; • Proximity with research centers in the university; • Visibility by the press and the market.

Source: Survey Data

It is noted that quality improvement in the value-added services is needed, especially for those services that received the worst ratings. One suggestion cited more than once was the need for more executives in management support and network. Increased networking opportunities is suggested many times, especially with respect to the creation of networks among incubated companies, international incubators, other entities in general, and the innovation agency. The need for venture capital was cited only once.

According to respondents, the incubators were most useful for management support and physical space & infrastructure, followed by training, networking, and financing opportunities - exactly those features that receive higher ratings.

In the URCS, companies were asked to rate some features that the university should have in order to successfully stimulate entrepreneurship. The results are displayed in Table 14.2.

Table 14.2 – Evaluating the University – URCS Survey

	Very Unsatisfactory	Somewhat Unsatisfactory	Satisfactory	Good	Excellent	Unaware of Existence	Did not exist	Not applicable	
Workshops dealing with Entrepreneurship	0.0 (0)	9.1 (2)	**18.2 (4)**	13.6 (3)	13.6 (3)	**18.2 (4)**	**18.2 (4)**	9.1 (2)	100 (22)
Entrepreneurship Forum	0.0 (0)	9.1 (2)	**22.7 (5)**	9.1 (2)	9.1 (2)	**31.8 (7)**	13.6 (3)	4.5 (1)	100 (22)
Conferences dealing with Entrepreneurship	0.0 (0)	9.1 (2)	**22.7 (5)**	4.5 (1)	9.1 (2)	**36.4 (8)**	13.6 (3)	4.5 (1)	100 (22)
Courses about Entrepreneurship	0.0 (0)	13.6 (3)	18.2 (4)	4.5 (1)	4.5 (1)	**27.3 (6)**	**22.7 (5)**	9.1 (2)	100 (22)
Junior Enterprises – enterprises controlled by undergraduate students linked with the departments and oriented by faculty	0.0 (0)	13.6 (3)	13.6 (3)	**40.9 (9)**	**22.7 (5)**	0.0 (0)	4.5 (1)	4.5 (1)	100 (22)
Support with IP – orientation about and/or register of patents, licenses, and copyrights	4.5 (1)	9.1 (2)	9.1 (2)	4.5 (1)	**13.6 (3)**	**27.3 (6)**	**13.6 (3)**	18.2 (4)	100 (22)
Innovation Agency Efficiency	0.0 (0)	4.5 (1)	**18.2 (4)**	**22.7 (5)**	13.6 (3)	**22.7 (5)**	13.6 (3)	4.5 (1)	100 (22)
Access to research about entrepreneurship/ start-ups	0.0 (0)	**13.6 (3)**	9.1 (2)	9.1 (2)	**13.6 (3)**	**31.8 (7)**	**13.6 (3)**	9.1 (2)	100 (22)
Access to business mentors & role models	4.5 (1)	9.1 (2)	**22.7 (5)**	4.5 (1)	9.1 (2)	**27.3 (6)**	18.2 (4)	4.5 (1)	100 (22)
Access to information about start-up financing – government programs, business angels, venture capital,	4.5 (1)	**13.6 (3)**	4.5 (1)	9.1 (2)	9.1 (2)	**36.4 (8)**	**13.6 (3)**	9.1 (2)	100 (22)

Source: Survey Data

As Table 14.2 demonstrates, a large portion of respondents was unaware of many of the features of the university. This is significant considering that the survey was administered to entrepreneurs, who frequently would be the primary clientele for these specific activities. Thus, within the university as a whole, awareness is likely to

be much less. The only feature that nearly all respondents were aware of is the Junior Enterprise. [25]

Most of the other features, when known, were rated satisfactory. The Innovation Agency and support with IP were the highest rated, with most respondents rating them good and excellent, respectively. Access to information about financing had the worse rating.

Furthermore, when dealing with companies affiliated with incubators it is important to determine whether assistance is needed, and the relevance of the assistance in each area, in order to analyze if the incubators are offering good services. Table 15 presents the results.

Table 15 – Assistance

	Very Important	Important	Somewhat Important	Not at all Important	Does not need assistance	
Finance	**64.71 (11)**	**23.53 (4)**	5.88 (1)	0.0 (0)	5.88 (1)	100 (17)
R&D	**41.18 (7)**	**29.41 (5)**	11.76 (2)	0.0 (0)	17.65 (3)	100 (17)
Legal	17.65 (3)	**41.18 (7)**	**35.29 (6)**	0.0 (0)	5.88 (1)	100 (17)
Product Design	**23.53 (4)**	17.65 (3)	17.65 (3)	**23.53 4)**	17.65 (3)	100 (17)
Manufacturing	11.76 (2)	11.76 (2)	5.88 (1)	**41.18 (7)**	29.41 (5)	100 (17)
Marketing	**47.06 (8)**	**47.06 (8)**	5.88 (1)	0.0 (0)	0.0 (0)	100 (17)
Talent	**41.18 (7)**	**41.18 (7)**	11.76 (2)	0.0 (0)	5.88 (1)	100 (17)

Source: Survey Data

Here it is important to note that all companies need marketing assistance, thus a stronger marketing service needs to be created in the incubators, as pointed already. Finance assistance is another desired assistance with the greatest number of respondents rating this as "very important," followed by talent and legal assistance. The finance assistance requirement level follows information demonstrated before - approximately 61% of the companies are not raising sufficient capital, assistance to obtain financing is lagging behind in incubators, and access to information about financing with the worse rating. As with the marketing assistance requirement level, the legal assistance requirement level demonstrates that more attention is needed for this service in the incubator as well. Most (82.35%) of the companies indicate they need R&D assistance, with 41% rating it as very important. This result possibly indicates that although the companies have research connections with the university, these relations may be underexplored, thus have much potential yet to arise. Product design and manufacturing are in least need of assistance, an expected result as most companies in the survey are involved in the services economy.

Table 16 evaluates the companies' market expansion, and the need for assistance in this area.

[25] However, most of the companies that were unaware of activities were the oldest companies, and we have to consider that some activities are very recent.

Table 16 – Market Preferences and Assistance

	Currently explores this market and does NOT need assistance	Currently explores this market and needs assistance	Would like to explore in the future but will NOT need assistance	Would like to explore in the future and will need assistance	Has no interest in this market	
Brazil (outside São Paulo)	11.76 (2)	**41.18 (7)**	0.0 (0)	**47.06 (8)**	0.0 (0)	100 (17)
Other Latin American countries	0.0 (0)	**35.29 (6)**	0.0 (0)	**52.94 (9)**	11.76 (2)	100 (17)
USA	0.0 (0)	17.65 (3)	0.0 (0)	**64.71 (11)**	17.65 (3)	100 (17)
European Union	0.0 (0)	**23.53 (4)**	5.88 (1)	**58.82 (10)**	11.76 (2)	100 (17)
Other	0.0 (0)	11.76 (2)	0.0 (0)	**29.41 (5)**	**58.82 (10)**	100 (17)

Source: Survey Data

All companies also need assistance with market exploration as shown in columns two and three. The rate of companies that are already exploring an international market is 52%, and all of them need assistance. The other 48% of companies, which are not in the international market would like to enter this market and will need assistance. Furthermore, companies have slightly more penetration in the European Union and Latin American markets, than in the USA.

To conclude the IRCS survey companies were asked about policies and actions of government and other institutions that could influence companies' performances. The questions and the responses are shown in Table 17.

Table 17 – Policies and Actions

What action (s) or policy (ies) by the Brazilian national government or local government is making your company's survival and growth more difficult at this time?
• Tax Burden. • Bureaucracy in all aspects – import and export process, and in the government support programs for small enterprises. • Labor laws – difficulty in hiring and training of specialized talent. • Government programs take too long to evaluate the projects. The evaluation process has more academic orientation than market orientation because the evaluators are mostly from universities without any connection to innovative enterprises, which can generate unpredictability in the process. • Delay in the installation of the technological park.
What action (s) or policy (ies) by the Brazilian national government or local government could help your company at this time?
• Tax exemptions or tax benefits. • More interest and investment and less bureaucracy from the Entrepreneur and Small Business Support Agency. • More and faster government programs. • Flexibility of labor laws. • Adapt the fiscal system for micro and small enterprises. Currently a micro enterprise in revenue and number of employees can be considered a small enterprise by the government. • Seed capital fund. • Lower interest rates.
What action/policy from government or other institutions do you consider to be the most important at this time for your company's success?
• Less taxes. • More financing opportunities.

• Labor law flexibility. • Seed capital funds. • Investment in education. • Motivation of the partners.
What action (s) or policy (ies) by the Brazilian national or local government would generally improve entrepreneurship in Brazil?
• Less bureaucracy in the process of opening and closing enterprises. • Tax exemptions. • Labor lax flexibility. • Capacitating of government officials that deal with the support programs. • Entrepreneurship education from the lowest grades. • Information for the population in general about entrepreneurship and modification of the present culture in which entrepreneurs are seen as corrupt or thieves. • More incentives for a closer relationship between public universities and enterprises and for technology poles with more capacity for investment and innovation. • More agile government funds and with less restrictions. • Faster import of materials and fewer taxes on imported materials for tech-based companies. • More seed capital funds. • More financing for the incubators. • Incentive programs for young entrepreneurs and researchers.
What would improve the collaboration and cooperation between Brazilian companies and universities to increase the number of new, successful companies?
• Applied research with commercial application. • Assistance in technology transfer and commercialization. • Investments by the government with straightforward objectives and evaluation criteria for the return of these investments in the form of taxes, jobs and wealth creation. • Networking opportunities between companies and universities. • Cutting-edge education. • Consultancy for the universities', high schools' and technical schools' boards towards entrepreneurship education. • More policies towards this kind of collaboration, and the compromise of policymakers in making them work. • More incubators related to universities. • Transformation of the academic culture against entrepreneurship in the university. • Strengthening of alumni relations and divulgation of alumni success cases. • Creation of entrepreneurship centers in the universities.

Source: Survey Data

Table 17 illustrates already known problems with the Brazilian State – distortions in the labor system, incompatible tax burden, a flawed fiscal system, high levels of bureaucracy, inadequate government programs, and a lack of opportunities for capitalization. Localized government action is urgently needed to improve entrepreneurship. First of all, overall reform to improve government management will make other actions easier to address. Realistically, at the regional level, there is a need for more qualified government staff and university staff who focus on entrepreneurship. Also the attraction of more private capital investment is needed to spare the state from such large burden. And university management can improve the situation by increasing the perception that academic entrepreneurship will create jobs and foster high quality development in the region.

Finally, to conclude the URCS, the question from the SEADE economic activity survey on rating the importance of different decision factors in deciding on a location was asked. This question is important to create some economic geography data only for the group of companies studied here, which is not available through the SEADE survey. It also serves as a possible, albeit rough, comparison with the SEADE survey.

Table 18 demonstrates that 66% of the companies are located in the MRC, and these companies were asked the same question as in Table 5 on the importance of different factors for deciding to establish the company in the region, along with two new factors: “family reasons” and “other”.

Table 18 – Decision Factors for Location in the MRC - URCS

	Very Important	Important	Somewhat Important	Indifferent	Not Applicable	
Low cost of labor	7.1 (1)	**14.3 (2)**	**64.3 (9)**	7.1 (1)	7.1 (1)	100 (14)
Workforce Qualification and Training	**42.9 (6)**	**50.0 (7)**	0.0 (0)	0.0 (0)	7.1 (1)	100 (14)
Proximity with suppliers	**28.6 (4)**	7.1 (1)	**28.6 (4)**	**28.6 (4)**	7.1 (1)	100 (14)
Proximity with market	**42.9 (6)**	21.4 (3)	0.0 (0)	**35.7 (5)**	0.0 (0)	100 (14)
Transportation system accessibility	**28.6 (4)**	14.3 (2)	**35.7 (5)**	21.4 (3)	0.0 (0)	100 (14)
Telecommunication infrastructure	**28.6 (4)**	**50.0 (7)**	21.4 (3)	0.0 (0)	0.0 (0)	100 (14)
Urban infrastructure	**35.7 (5)**	**35.7 (5)**	21.4 (3)	7.1 (1)	0.0 (0)	100 (14)
Life quality for employees	**28.6 (4)**	**35.7 (5)**	21.4 (3)	14.3 (2)	0.0 (0)	100 (14)
Proximity with technology diffusion and research centers	**42.9 (6)**	**50.0 (7)**	0.0 (0)	7.1 (1)	0.0 (0)	100 (14)
Technical services and industry support infrastructure	**21.4 (3)**	**50.0 (7)**	14.3 (2)	7.1 (1)	7.1 (1)	100 (14)
Fiscal incentives offered by the local, state or federal government	7.1 (1)	**28.6 (4)**	14.3 (2)	**28.6 (4)**	21.4 (3)	100 (14)
Family reasons	**28.6 (4)**	14.3 (2)	21.4 (3)	14.3 (2)	21.4 (3)	100 (14)
Other	14.3 (2)	0.0 (0)	0.0 (0)	0.0 (0)	**85.7 (12)**	100 (14)

Source: Survey Data

It is noted that the surveyed companies differ substantially from the overall population of companies analyzed by the SEADE survey. Small to medium high technology companies in the survey place more emphasis on smart infrastructure. Highly preferring proximity to technology diffusion and research centers, and workforce qualification and training, whereas the overall population of companies in the region prefers transportation system accessibility and urban infrastructure.

The reasons of those two that answered the “other” option were: partners already lived in the MRC and high development of the region.

Note that in both surveys, the lowest priority is placed on low cost labor and fiscal incentives as an important decision factor.

4.4 Surveys Summary

Summarizing the data gathered from the surveys the following conclusions can be made:

- Technology-based companies related to incubators or universities present great potential for growth, thus creating a fair amount of jobs and wealth for the region.

- Capital is raised mostly from partners, own sources, and government programs.

- High levels of R&D exist.

- Almost half of the companies have some kind of intellectual property and almost all of them are utilizing their intellectual property.

- Companies present high levels of interaction with Unicamp. The companies from the IRCS present more formal and informal links, whereas the URCS companies present more human resources links.

- In both surveys most of the relations expected in the future with the university involve R&D partnership, technology transfer and commercialization, and networking development.

- The incubators had overall good ratings in networking, training, management assistance, support infrastructure, and physical space. Somewhat unsatisfactory ratings were observed in international relations, marketing, legal, and availability of financing assistance.

- Companies related to the incubators are still in need of assistance, mostly in areas rated somewhat unsatisfactory. These companies also do not have much international market penetration and are in need of assistance to do so.

- The university entrepreneurial orientation and support is largely unknown to companies. However, when known, companies rate the activities positively as with the junior enterprises, Inova, and support with intellectual property.

- The decision factors for location in the MRC differentiate from most of the companies in the region (reached by the SEADE survey). An inversion of the most important factors was observed, from hard infrastructure (transportation system) to smart infrastructure (proximity with research centers and workforce qualification and training) for the surveyed companies.

5. SWOT Analysis

Based on the information presented in this paper, a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis of the MRC is now possible:

- *Strengths*
  - High level of economic activity in potentially innovative industrial and service sectors.
  - Technological Park in development linked with the university, incubators, and research centers.
  - Presence of preeminent research centers.
  - Excellent university with increasing levels of researchers, scientific and technological production, and interaction with enterprises.
  - Increasing levels of academic entrepreneurship – many start-ups related with the university.
  - Three well functioning incubators.
  - Good hard and smart infrastructure, especially transportation system accessibility and workforce qualification.

- *Weaknesses*
  - Low levels of R&D in the industry.
  - No private preeminent research center.
  - Start-ups lack capitalization options.
  - Low enterprise participation in the university financing.
  - Lack of strong technology transfer and commercialization infrastructure in the university.
  - Overall unawareness of entrepreneurial support and orientation in the university.
  - Incubators lack quality in some value-added services.
  - Lack of overall regional coordination.

- *Opportunities*
  - Investment opportunities in incubator and university related enterprises, especially for venture capital.
  - Regional coordination can possibly trigger faster high-technology development for the region.
  - More attention to technology transfer and commercialization can lead to higher levels of academic entrepreneurship.
  - Increasing networking among the actors analyzed can create synergies, especially among universities and small to medium technology-based companies, to spur academic entrepreneurship.

- *Threats*
  - Absence of more capitalization options for start-ups slows regional development.
  - Lack of more collaborative public-private partnership in the university creates dependence on the government and prevents faster development in R&D activities.

- Lack of start-ups in non-ICT areas, such as biotechnology, can diminish the attractiveness of the region for investors and the diversification of the region for a faster development.
- Paucity in regional coordination and network development can lead to a halt in high-technology entrepreneurship.

6. Concluding Comments

This paper worked the way in clarifying the Metropolitan Region of Campinas' real potential for nourishing high-technology development through entrepreneurship networks among the university, research centers, incubators, support groups – including the government, and already existing small, medium, and big technology-based enterprises.

While the real interconnectedness among these actors is still unknown, separately they have shown to be in the right direction, thus we can classify the MRC as an emerging technopolis.

To achieve full technopolis scale many actions and policies are yet to be developed and executed – many were suggested in the survey. In effect, entrepreneurs can start by giving back to the university and research centers, increasing funding for research, awareness of academic entrepreneurship, and availability of business mentors and role models, while amplifying and straightening this network. Positive effects include synergies that will accelerate the creation of market perception in the university and research centers, diminish the time necessary from idea to product, and increase odds of success. Whereas big company executives need also to be included in this network, creating internal R&D labs or linking the existing ones. Synergies will then expand to the whole high-technology industry, creating more spin-off possibilities, higher rates of innovation, and increasing competiveness for the region. In addition, university and research centers officials should pay more attention to technology transfer and commercialization, which would facilitate this process.

Moreover, local, state, and federal government should take in account private sector demands with more efficiency. While core reforms of the tributary and labor systems are complex and polemic, many other issues, mostly related to microeconomic reforms, can be made easier. These issues would include augmenting the support groups and government funding sources effectiveness by reforming the bureaucratic system. Diminishing bureaucracy is also in large demand at customs for importing and exporting, in enterprise opening and closing process, and in tax paying process. Possibilities also lay in modifications in the education system, by including entrepreneurial orientation and education at high schools and universities – especially others then not Unicamp –, which can yield returns in the future by enlightening large portions of the population of the broad possibilities derived from entrepreneurship, science, and technology.

In summa, all policies and actions should lead to greater institutional embeddedness, which sparks off greater flows of knowledge and information, creating a permanent balance of competition and collaboration among all actors. In turn, the region will

suffer a transformation process, channeling more capitalization options for new start-ups, culminating with higher rates of growth, inclusive development, and technology diffusion and diversification.

Further research on the topic can include many issues; in relation to the first part of this work a new methodology for a better economic environment mapping can be developed. In parallel, the expansion of the survey sample, perhaps firstly, to companies in the science park and greater exploration of the current sample in some topics – such as business internationalization or better understanding of the networking process – are research possibilities that can bring forward new and interesting results. Additionally, the surveys can be modified and applied to more actors in a way to supply longitudinal benchmarking – for the economy, university, incubators, and research centers – and better understand the current state of interconnectedness among these institutions.

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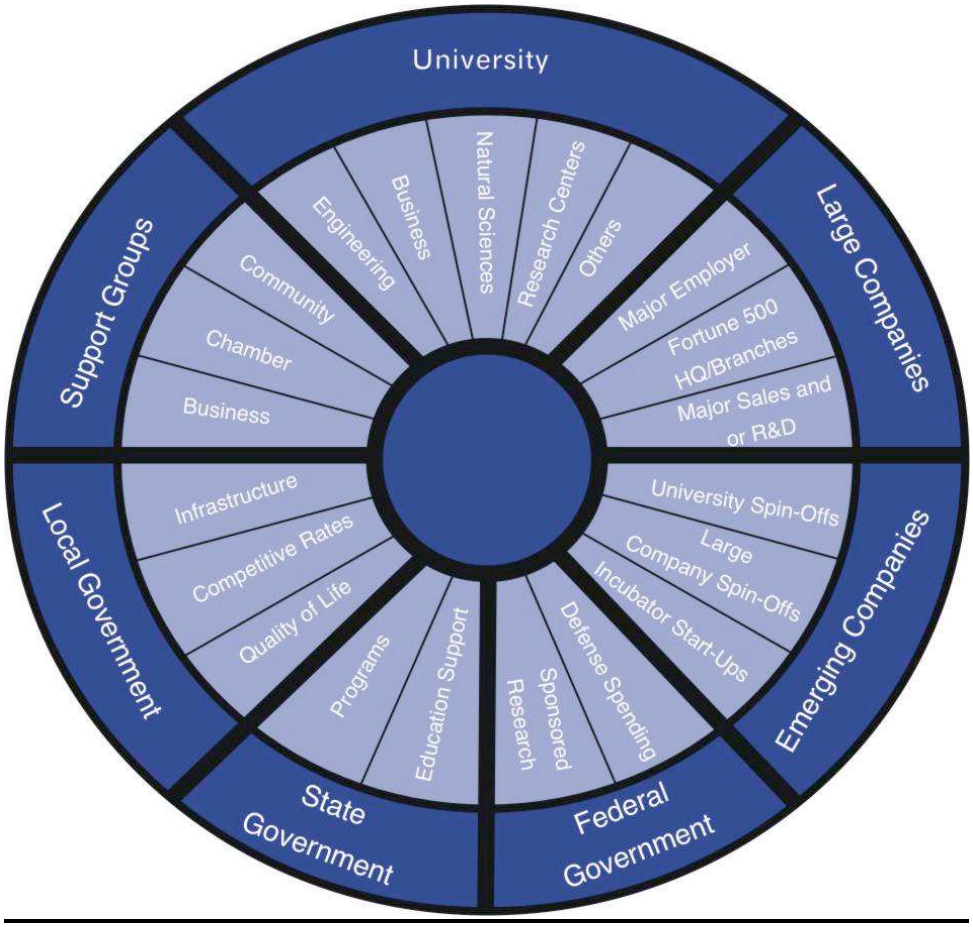
Appendix

1. The Technopolis Wheel



Source: Smilor *et al.,* 1988.