Analysis of supply and demand of technological services (TSs) in Londrina: strengthening technological competencies and structuring a regional innovation system

Análise da oferta e demanda de serviços tecnológicos na região de Londrina visando ao fortalecimento das competências tecnológicas e à estruturação de um pólo de inovação tecnológica

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Resumo

Este artigo visa analisar as potencialidades e os problemas inerentes à estruturação de um pólo de inovação tecnológica na região de Londrina-PR. Pelo lado da demanda de serviços tecnológicos, foram conduzidas investigações junto a empresas de três setores industriais: agroalimentar, fármaco-químico e eletroinfocomunicação. Pelo lado da oferta desses serviços, foram conduzidas entrevistas com universidades e centros de P&D que possuem recursos humanos e laboratórios especializados e que ofertam serviços tecnológicos às empresas. No total, foram entrevistadas mais de 100 empresas e instituições do eixo Cornélio Procópio – Londrina – Apucarana. Os resultados do levantamento indicaram que as capacitações em serviços tecnológicos existentes na região ainda estão bastante direcionadas para fins científicos e pouca pesquisa aplicada, vinculada às reais necessidades das empresas em nível regional, tem sido conduzida. Adicionalmente, poucas empresas ainda demandam serviços tecnológicos de instituições da região.

Palavras-chave: inovação, tecnologia, Tecnópolis.

Abstract

The purpose of this paper was to analyse the available resources and the major impediments to the structuring of a regional innovation system to improve the technological development in Londrina, in Northern Paraná, South of Brazil. The study focused on three industrial sectors, as follows: 1. food and beverages; 2. chemical / pharmaceutical / veterinarian and 3. software / electronic / telecommunication / electrical and electromechanical. The existing resources and capabilities to supply technological services (TSs) to industries of these three sectors, as well as the industrial demand for such services, were investigated. These services are carried out in labs and include dosages, determinations, gauging, calibration, and performance tests to provide industrial processes and products qualification. Over than 100 structured interviews were carried out in universities, research centers and private companies. The results showed that these S&T institutional resources and capabilities are directed to scientific ends and only a little research has been applied. Also only a few local university and research center labs have some tradition of supplying TSs to companies of the food/beverage and chemical industries. On the other hand, only a few companies from these two sectors look for TSs in these local S&T institutions.

***Key words**: innovation, technology, Tecnópolis.*

1 Introduction

The idea of structuring an innovation system in the Londrina region was first introduced in mid-1992 by Professor Ivan Lupiano Dias, a physics professor from Londrina State University (UEL). Innovation system refers to an environment in which there is a continuous interaction between S&T institutions and industries, so that favorable conditions to foster innovation can be created.

This idea grew in importance as leaders from both the public and private sectors pointed out that investments in S&T would be the one possible way to promote social and economic development in Northern Paraná (ADETEC) in mid-1993.

After the creation of this Association, discussions on the regional technological system were implemented and, by the end of 1999, a project aimed to conceive the technological strategic planning of the Londrina region was finally funded. CNPq, the Euvaldo Lodi Institute, Paraná Technology, and Londrina City Hall are among the major partners that are presently supporting the project. This project has been conducted since January 2000 and presently a number of actions pointed out in a Strategic Plan for the Technological Development of the Londrina Region (2000) is being implemented.

This paper presents the preliminary results of the project survey carried out from January to December/2000. The objective of the paper is to confront the supply and the demand of TSs in the Londrina region to understand the existing scientific and technological capabilities that can be strengthened, as well as the major constraints that should be removed to set up the foundations of a regional innovation system. This region comprises seven municipalities surrounding Londrina: Cambé, Ibiporã, Jataizinho, Arapongas, Apucarana e Cornélio Procópio (Figure 1). Agribusiness is the major economic activity of all these municipalities, although Londrina – which is the most important city in the area - also concentrates a number of companies that deal with software, electronics, telecommunications, electricity, eletromechanics, agrochemical, pharmaceutics and veterinarian products and services.

The basic assumption of this paper is that the technological development of the Londrina region will be possible only if a favorable environment to provide technological innovation emerges. Technological innovation is the process to bring new ideas to productive use, but it does not necessarily mean a new invention. It can be only incremental, via improvement in products and/or productive processes (BACARELLI, 1999).

Figura 1 – Geographical localization of the Londrina region.

2 Survey Methodology

The methodology of this study involved office and field surveys and consisted of four steps.

2.1 Literature review and selection of the companies to be interviewed

The literature review focussed on gathering information on the three industrial sectors / complexes studied as well as on national and foreign experiences related to the structuring of local and regional technological systems. Specific information regarding TSs was also obtained from the Brazilian Metrology Institute and the Institute for Technological Research of São Paulo State's publications.

The data basis consisting of over 100 company addresses resulted from the compilation of several company addresses obtained from public organizations at the local and state levels. Contacts with local professionals with expertise in these three sectors / complexes were also very helpful in refining the company sample to be interviewed. The number of companies, classified by industrial sectors, is presented in box 1, as follows:

INDUSTRIAL SECTORS	NUMBER OF COMPANIES
Food	43
Chemical / Pharmaceutical / Veterinarian	11
Electronics / Electrical / Electromechanical / Telecommunication / Software	49

76 out of 93 companies were interviewed from April to June 2000. Thirteen public and private institutions, including 2 research centers, 2 universities, 5 colleges, 3 technical schools that offer training at professional levels (second grade) and 2 incubators were also included in the survey sampling. 10 out of these 13 institutions have already been interviewed.

2.2 Field Survey

The field survey consists of interviewing private companies from the three studied sectors / complexes as well as the S&T institutions. The major goal of the interviews carried out in the private companies is to identify the existing and potential demand for TSs. Semi-structured questionnaires were designed to gather

the necessary information. Open-end questionnaires were also designed to survey the existing and potential supply of TSs in the S&T institutions.

2.3 Formulation of Prospective Scenarios

Since the technique of formulating scenarios is now recognized as an important tool for technological planning and development, scenarios to envisage possible technology transfer mechanisms to help the structuring of the regional innovation system were built. A brainwriting session was carried out in April 8, 2000.

A local group with some expertise in both regional and technological development was used as a creative thinking tool to generate new ideas related to the expected future of Londrina as the center of a regional innovation system.

As the present study is part of a long-term program to transform Londrina into a technopolis, on a time horizon of 10 years from now, the participants of the brainwriting session were oriented to focus their attention on situations that they considered as possible to occur. They were oriented to support their ideas on possible transfer technology mechanisms that could be implemented to facilitate the flow of new ideas to benefit companies from the three industrial sectors / complexes that are being studied.

The following three questions were presented to help the experts to explore their creative thinking:

– Question 1: How do you envisage Londrina 10 years from now?
– Question 2: Which innovation systems and/or technology transfer mechanisms will enable the approximation of companies from the productive sector to the suppliers of S&T in the Londrina region in the next 10 years?
– Question 3: How to change the culture of both the industries' managers and universities' researchers, in order to promote cooperative efforts between them and create a favorable environment for a technological innovation thrust? (The results of this exercise are described on pages 12 to 14).

2.4. Confrontation of the Supply and Demand for TSs

An assessment of STS´s supply vs. demand was necessary to detect the strengths and weaknesses posed to the structuring of the innovation system in the Londrina region. This assessment was based on partial results of the survey and also supported by data gathered from the literature review and the recent experience of Londrina in the implementation of its industrial incubator.

3 Relationship Between &t Institutions and Private Companies

The Londrina region has a number of S&T institutions that supply trained people and TSs to companies from several industrial sectors. Figure 2 presents the spatial distribution of S&T institutions and companies from the three studied sectors / complexes in the seven municipalities in which the regional innovation system is expected to be developed. A brief description of the S&T competencies and the studied industrial sectors follows:

3.1 Universities, Colleges and Research Centers

The Londrina region has 3 universities (UEL, UNOPAR, UNIFIL), 4 colleges (UMP, CEFET, FACCAR, FECEA), and 3 second grade technical schools (SENAI, IPOLON, Castaldi). Presently, UEL – the largest university at the regional level – has around 13,500 enrolled students (88% undergraduate; 12% graduate) and a staff of 1,606 professors. Over 400 professors hold a doctoral degree and around 600 hold a master's degree. UEL was ranked as one of the top Brazilian universities in a recent countrywide assessment of the student's level carried out by the federal government.

IAPAR and Embrapa are the two major research centers, but only the first one has labs that have played an important role in supplying TSs to agriculture related companies.

3.2 Food Sector

Companies that manufacture industrialized products, pre-processed and processed meat, beverages, pasta, biscuits, grains, and pet foods compose this sector. Soluble coffee, dairy products, pasta and biscuits are the main industrialized products manufactured in the Londrina region. Modern industrial plants with high potential to meet the market's needs and requirements are common in this sector. Partnerships with research centers and universities have been an R&D strategy sought by some of the largest companies, specially by those that are either certified in accordance to the requirements of ISO 9001 Standards or have implemented GMP (Good and Manufacturing Practices) and HACCP (Hazards Analysis and Critical Control Points).

Only one company that recently has incorporated two other smaller companies located in São Paulo State represents the pet food industry in the region. This company is a market leader in the Southern states and other regions of the country. Implementation of quality programs in its industrial plants is an important competition strategy of this company. Its TSs needs are met in its quality control labs.

The pre-processed and processed meat industry includes small cold storage houses where operations such as boning, dry meat preparation, and sausage manufacture are performed. Presently, this industry faces a strong recession because of the competition of huge conglomerates that are continuously displacing regional markets formerly occupied by small cold storage houses. TSs demanded from university labs were not observed in this industry.

The grain industry is represented by industrial plants with high wheat and corn processing capacity. Some companies that are leaders in both the regional and national markets are found in the Londrina region. In general, these companies are very organized and have

internalized GMP (Good and Manufacturing Practices) and HACCP (Hazards Analysis and Critical Control Points) in their working procedures. A closer interaction with UEL in the pursuit of partnerships to develop cooperative technological projects was observed in the corn processing companies.

The beverage industry consists of industrial plants with small production capacity and low technological level that produce soda at competitive costs. The companies interviewed have not implemented quality management systems, such as GMP and HACCP. At the regional level, companies are not familiar with the rules and regulations that they are supposed to follow.

Among the TSs suppliers it was detected that the UEL Department of Food Technology and Medicine is currently the only one institution offering these services. For more than fifteen years, the food lab of this department has been supplying an extensive amount of TSs to help companies from this industry meet the Standards of the Brazilian Health Ministry and market requirements. This lab was accredited by the Health Ministry and became a TSs supplier reference all over Northern Paraná. Other institutions with potential to supply TSs to this industry are IAPAR, EMBRAPA and private universities.

At the regional level, the amount of TSs externally demanded by food companies that are market leaders is very incipient because most of these services are carried out in their own labs. These TSs are necessary for raw material, production process, final product, and packing material control. The TSs demanded from universities and research centers are occasional and carried out in labs accredited by the Health Ministry from Curitiba, Maringá, São Paulo and Campinas.

3.3 Chemical, Pharmaceutics and Veterinarian Sectors

The major products manufactured by these sectors are presented in box 2, as follows:

SECTORS	PRODUCTS
Chemical	Agrochemical, paints, varnishes and covering for floors and roofs
Pharmaceutics	Cosmetics, deodorants, soaps, candles, cleaning materials, chemical solvents
Veterinarian	Vaccines, serums

Small companies dominate these sectors, except for Milênia Agrociências that is a multinational that manufactures agrochemicals. In general, when these small companies require TSs, they are carried out internally, in their own labs. Only very few companies mentioned that they intend to demand TSs from universities in the near future. The main factor that limits the TSs demanded by the small companies is the high price. Companies that deal with chemical solvents do not demand any type of TSs since they tend only to dilute products for sale. Milênia demands TSs for new product development, productive process control, and final product quality control, but all of them are carried out in its own labs.

UEL is presently the only one institution that supplies TSs to small companies that manufacture soaps, cleaning materials and candles. The Chemistry Department of this university also supplies TSs for fuel quality control that are needed by gas stations to meet the requirements of a federal regulation. This department has modern lab apparatuses (e.g. gas and liquid chromatography, atomic absorption) that could enable it to supply a wide range of TSs to the chemical industry.

3.4 Electrical, Electromechanical and Electronic Sectors

This sector is dominated by micro and small-sized companies that manufacture no-break, caller-ID, satellite receiver, voltage stabilizers, transformers, amplifiers, electrical wires, electrical panels, apparatuses for lab and the dairy industry, commercial and industrial refrigeration equipment, elevators, automotive batteries, hospital equipment and furniture, and components for industrial automation. Most of the TSs demanded as part of the production control processes by these companies are either carried out in their own labs or by raw-material suppliers. Only specific TSs whose demand is occasional (e.g. equipment calibration) are carried out in labs from Curitiba, São Paulo and Porto Alegre.

Just recently some graduate courses in technological areas such as electronics, electricity, telecommunications, mechanical, and information systems were created in universities and colleges located in the Londrina region. Interviews with the head of these institutions have revealed that only CEFET at Cornélio Procópio has some tradition in working with private companies in cooperative projects. This college has labs that supply TSs to companies that operate in both the electricity and electromechanical areas. A possible approximation UEL and Unopar from Londrina to companies from this sector to meet their demand for TSs and technological research needs are expected to happen in the coming years.

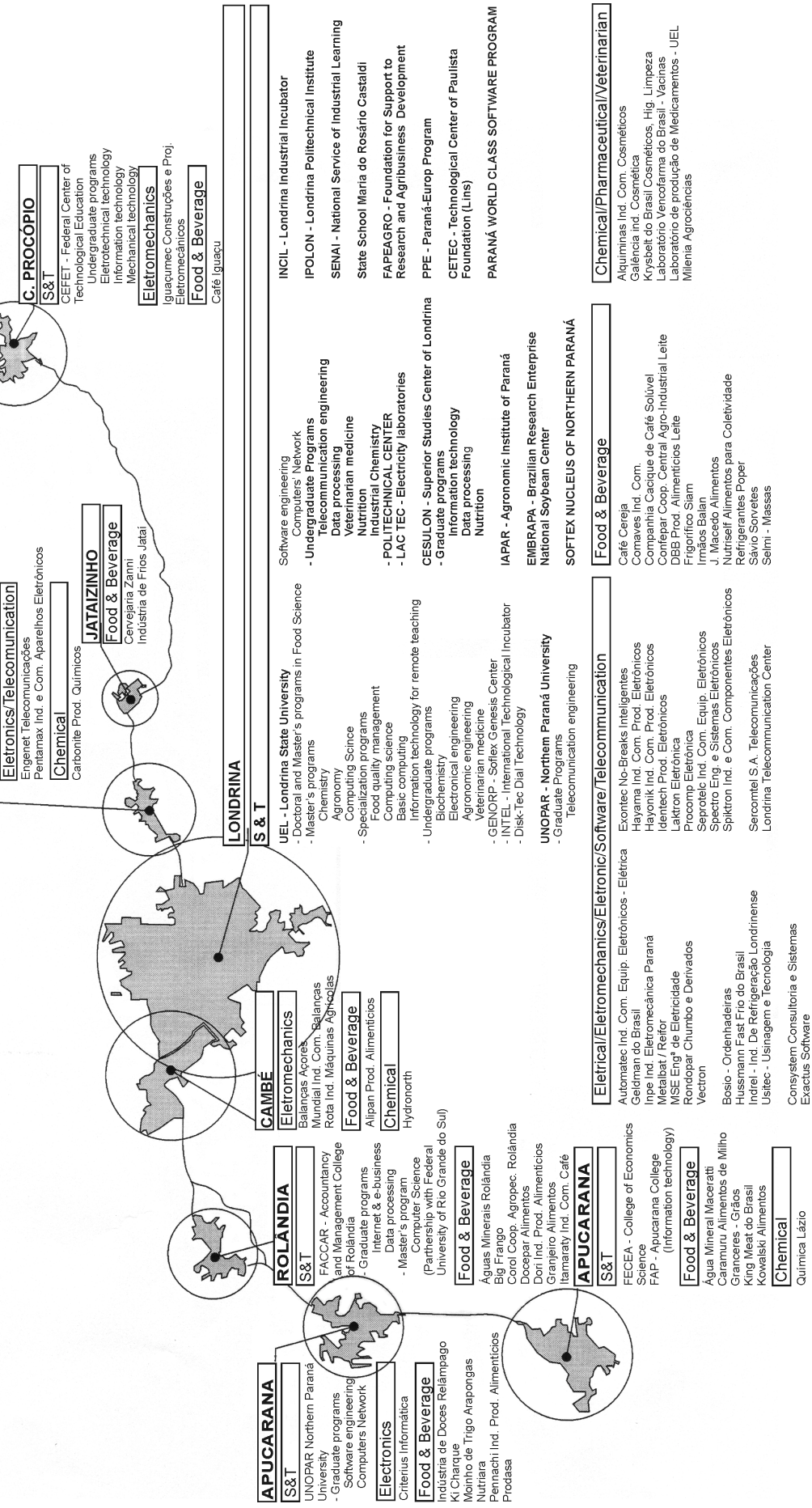

Figure 2 – S&T institutions and companies.

3.5 Software Sector

Around 80 small companies develop and commercialize a variety of software in the Londrina region. Most of these softwares are customized and only a few can be considered either shelf or customer requested products. The following are some examples of products developed by these companies:

– industrial and commercial management (material control, accounting, sales, billing);
– road transportation management;
– virtual reality (3 D reality);
– building construction management;
– insurance company management;
– mall management;
– educational (AIDS, health improvement);
– *edutainment* (leadership games);
– demographic census;
– car dealer management;
– dentist office management.

Due to the specific characteristics of this sector, TSs are not demanded during the software development process. In general, specialized consulting is the most commonly demanded service by software development companies.

Presently, two important technological projects to support both micro and small software enterprises – Genorp and Softex – are underway in the region. Genorp is supported by the federal government and Londrina State University (UEL) and aims to provide chances for talented students to become entrepreneurs in the software industry. Space for physical installation, computers, and funding opportunities are among the major opportunities offered to these students. This year, UEL also created a technological incubator for software development (INTUEL) that is expected to house the most qualified entrepreneurs for two years. Softex – a project supported by the federal government and ADETEC – aims to provide infrastructure to micro and small enterprises to help them to develop new software projects. Presently, 34 enterprises are affiliated to Softex, but only 3 are currently using the offices and computers provided by Lab Softex.

Concerning the human resource training for the software industry, the Londrina region has five institutions that offer undergraduate and graduate courses as presented in box 3.

3.6 Telecommunication Sector

Sercomtel and Global Telecom are the two major companies that operate in this arena in the Londrina region. Both are intensive users of scientific and technological knowledge and advanced technology products. Recently, a telecommunication center was installed at UNOPAR as a result of a partnership of this university with Sercomtel and Impisat. This center offers low cost data communication services. Specific TSs such as equipment gauging and calibration are the only types of TSs demanded occasionally by SERCOMTEL. In general, labs from Curitiba, São Paulo, Campinas and Rio de Janeiro supply this demand.

4 Optimistic Scenario

Scenario´ can be either defined as a possible configuration of a future situation or a number of paths that can be followed to reach specific goals toward the future (ÁVILA; SANTOS, 1989).

The optimistic scenario described in this paper is the result of a brainwriting session carried out with 7

INSTITUTION	CITY	PROGRAMS
UEL	Londrina	Computing science (undergraduate, specialization, master) Basic computing (specialization) Information technology applied to remote teaching (specialization)
UNOPAR	Londrina	Telecommunication engineering (undergraduate, graduate) Software engineering (graduate) Computers' network (graduate) Data processing (undergraduate)
	Arapongas	Software engineering (graduate) Computers' network (graduate)
UNIFIL	Londrina	Information system (undergraduate) Information system (graduate)
CEFET	Cornélio Procópio	Electricity technology (undergraduate) Information technology (undergraduate) Mechanical technology (undergraduate)
FACCAR	Rolândia	Internet and e-business (graduate) Data Processing (graduate) Computing science (graduate)
UMP	Londrina	Computing Science (undergraduate) Electrical engineering (undergraduate)

local professionals with some expertise in technological development.

In response to question 1 *(how do you envisage Londrina 10 years from now)*, referred to in item 3, the local experts pointed out that:

– local economic growth will follow the average economic growth of Paraná State that is expected to be 4% a year, from 2000 to 2015, resulting in a positive effect on income and quality of life.
– existence of an implemented municipal management system based on a participative process in which the local government's budget is openly discussed with society.
– commitment of local authorities and leaders to the promotion of a high level educational system, S&T diffusion and quality of life.
– national reference in the educational sector, mainly in technological areas with some potential for innovation, such as: electronics and software development.
– creation of an adequate environment for thriving of technological based-enterprises in both the software and electronics.
– continuous immersion in the global info-communication system.
– international recognition as a world class city with specialization in one or two industrial sectors (e.g. electronics, software).
– institution of an aggressive marketing policy focussed on strategic alliances with international companies and the attraction of new industrial investments in promising sectors such as electronics and software.
– effective land use planning based on the 21 Agenda guidelines (local level) to protect the property rights of citizens and companies.

The major answers to question 2, that refers to *innovation systems and technology transfer mechanisms that could promote the approximation of the university and research centers to the productive sector* include suggestion for the creation of 5 possible instruments summarized as follows:

– cooperative research centers involving the existing S&T institutions and technological based-enterprises from industrial sectors, such as electronics and software. These centers could be supplied with lab apparatus to be shared by its members to carry out TSs to meet the companies' demand at a regional level.
– condominiums of technology companies consisting of buildings shared by small and medium-sized firms.
– an information agency to organize and disseminate relevant data and information to promote and implement both regional and technological development. The supply and demand of TSs, local S&T institutions and private company marketing as well as funding opportunities for projects in the technological area are some information to be disseminated.
– S&T secretariats and specific funds for investments in technological projects at the local level in the major municipalities of the Londrina region.
– foundations in state and private universities to carry out TSs and cooperative lab researches with companies from the productive sector.

Question 3 inquired on *how to change the culture of private companies' managers and universities' professors in order to expand partnerships and cooperative researches between these two parts*. Also it asked the experts' opinion *on what should be changed for the approximation of these two parts*. A summary of the main experts' replies follows:

– opening of labs from universities and other research institutions for company manager visits; it was considered that the opposite – opening of the companies for professors and researchers' visits – would not be possible due to manager resistance to showing their productive processes to outsiders.
– organization of informal meetings involving open-minded professionals from private companies, researchers from public S&T institutions and private universities to discuss technological innovations and research trends in their areas of work and expertise;
– creation of some mechanisms to facilitate technological research, such as: (i) incentives to compensate researchers from S&T institutions that develop cooperative projects with the productive sector; (ii) fellowship programs in government agencies specific to unemployed professionals holding doctoral or master's degrees interested in developing cooperative projects involving universities, research centers and private companies; and (iii) internship programs and scholarships for undergraduate engineering students to carry out their final work in private companies.

5 Findings

Mayor findings from field interviews and desk research indicate that a culture of partnership and cooperation between universities / research centers and private companies from the three studied sectors / complexes is still missing.

From the universities / research centers' side, it was observed that:

– there is a lack of a technological and scientific development policy to guide both the research centers and universities' researches at the local and regional levels. UEL has recently published a book containing its areas of research to provide a basic reference for the development of its human resource internal policy, but it is still far from having a specific policy to guide its external relations with the private sector.
– there is a poor management of the existing knowledge and a lack of perception of the potential market for its diffusion, use and exploitation; these problems limit the supply of TSs by the existing universities and research institutions.
– there are situations in which department policies inhibit cooperative research and TSs suppy to meet

the industry demand; in general, some staff members tend to consider that the university is not supposed to focus its attention on anything else other than human resource formation.

– researchers and professors' degree of awareness is limited about the real importance of the transfer technology mechanisms (e.g. incubators, condominiums shared by technological companies, cooperative research centers) as possible mechanisms to promote successful technology diffusion.
– private universities such as UNOPAR, UNIFIL, FACCAR and FECEA do not have any tradition in conducting scientific and technological research, but they are growing in importance, at the regional level, and have the potential to carry out cooperative projects with private companies in the near future.
– major universities and research centers such as UEL and IAPAR have highly specialized staff and some labs with modern apparatus that, theoretically, enable them to expand the supply of TSs to industries such as food, chemical, pharmaceutical and veterinarian. However, it has been argued by a few researchers and professors that this would be possible only if there was an internal policy reform in these institutions.
– most research conducted at UEL is academic and disconnected from the real technological needs of the local industry.
– issues such as entrepreneurship, intellectual property rights, and marketing, that are important to new entrepreneurs and small companies, are not included in the university programs.

From the industry side, it was observed that:

– there is no explicit industrial development policy in the seven municipalities of the Londrina region to orient new investments.
– there is a potential demand for TSs in the food and chemical industries that can be supplied by universities and research centers' labs in the near future.
– there is a lack of proper information on funds provided by the government for technological research; also several informed companies did not show interest in federal programs (e.g. PADCT, RHAE) due to relationship problems with universities in former attempts to carry out cooperative projects.
– there are a few multinational companies from the chemical and electromechanical areas in the Londrina region; these companies do not demand any type of TSs from the local universities because their R&D is conducted abroad and/or they have their own labs where the TSs for production control are carried out.
– Most companies from the Londrina region are not used to pursue technological innovation; some incremental innovation has been frequent only in the software and electronics industries.

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