CONCYTEQ

Tec
de Monterrey
CAMPUS QUERÉTARO

El **S**istema de **I**nnovación

de **Q**uerétaro

El Sistema de Innovación de Querétaro

Cooperación Regional Gotenburgo (Suecia)-Querétaro (México)

Participantes

Dr. Sverker Alänge. *Coordinador en Gotenburgo. Chalmers University. Suecia*
Lic. Alejandro Ardila. *Coordinador en Querétaro. Instituto Tecnológico y de Estudios Superiores, Campus Querétaro*
Lic. María Concepción Bernal. *Consejo de Ciencia y Tecnología del Estado de Querétaro*
Lic. Cecilia Bustamante. *Secretaría de Desarrollo Sustentable*
Dr. Manuel Espinoza. *Instituto Tecnológico y de Estudios Superiores de Monterrey, Campus Querétaro*
Dr. Roberto de Holanda. *Instituto Tecnológico y de Estudios Superiores de Monterrey, Campus Querétaro*
Dr. Alejandro Lozano Guzmán. *Consejo de Ciencia y Tecnología del Estado de Querétaro*
Ing. Gilberto Muñoz Arango. *Consejo de Ciencia y Tecnología del Estado de Querétaro*
Dr. Sari Scheinberg. *Gestalt Academy of Scandinavia. Suecia*

Reporte 1

GOBIERNO DEL ESTADO DE QUERÉTARO

Ing. Ignacio Loyola Vera
GOBERNADOR CONSTITUCIONAL

Dr. Gabriel Siade Barquet
SECRETARIO DE EDUCACIÓN

CONSEJO DE CIENCIA Y TECNOLOGÍA DEL ESTADO DE QUERÉTARO

Dr. Alejandro Lozano Guzmán
DIRECTOR GENERAL

D.G. Alicia Arriaga Ramírez
DIFUSIÓN

Indice

Resumen

El Sistema de Innovación de Querétaro:

Un estudio piloto en el marco del programa de investigación que compara los sistemas de innovación regional entre México y Suecia.

I. Introducción

De manera cada vez más amplia se reconoce que el sistema de investigación y desarrollo tecnológico en la industria en México, no tiene el mismo grado de avance que el de los países europeos. El caso de México muestra una economía "bivalente"; esto es, por un lado, se encuentran las grandes compañías que dependen de manera fundamental de tecnología importada, y por el otro, las pequeñas y micro empresas que atienden mercados locales, y que tienen problemas de sobrevivencia. No obstante la gran diferencia entre ambos tipos de empresas y estos sectores industriales, sí poseen, al menos, una cuestión en común: tienen contactos muy limitados con las Instituciones de Educación Superior y los Institutos de Investigación.

En este marco, el sistema de investigación local muestra signos de baja conectividad y poca cooperación en la materia, y ello se refleja en una incidencia muy limitada del aparato de Investigación y Desarrollo (ID) dentro de la industria en México. Un resultado de dicha situación, es el número limitado de productos desarrollados localmente y la buena marcha del proceso de investigación.

En numerosos seminarios, investigadores mexicanos y suecos han expresado su interés de llevar a cabo una investigación que permita dilucidar por qué ese impacto limitado de la ID en México en la industria local, comparándolo con el programa de innovación, tan amplio, que existe en Suecia.

Como primera etapa para el presente estudio, se planeó hacer 26 entrevistas a ejecutivos de empresas líderes en Querétaro.

Objetivo

El objetivo de este reporte es el de presentar de manera general, el sistema de innovación en Querétaro. Para lograrlo, se identifica a los participantes en su carácter de empresas, universidades, institutos de investigación e instituciones financieras y gubernamentales. En cada caso, se presenta su participación en el desarrollo de nuevos productos y procesos. Con lo anterior se pretende localizar patrones de innovación y ubicar las fortalezas y debilidades del proceso de innovación en Querétaro, a fin de estudiarlos posteriormente con más detalle.

Reporte

En la primera parte del reporte, se resaltan las secciones y conclusiones de la versión completa, en inglés, misma que se presenta en la segunda sección del mismo.

II. Sistemas de Innovación e Investigación Local

Si bien los países constituyen una unidad natural para formar un sistema de innovación, éstos, de manera recurrente, se presentan como un sistema multinacional abierto. Lo importante, ahora, es identificar cuál es el interés básico que impulsa la cooperación hacia el interior de los sistemas de innovación.

En los países desarrollados la cooperación, dentro del sistema de innovación, se ha establecido de manera dinámica. En general, el proceso de creación y generación de conocimiento innovador se da en las universidades y centros de investigación, siendo la industria la que desarrolla y comercializa este conocimiento a través de nuevos productos y procesos, sin faltar el componente gubernamental que regula esta actividad a través de la creación de leyes e incentivos.

Tal modelo no está presente en las economías emergentes, pues están menormente integradas y son más dependientes del conocimiento desarrollado en otros países, en cuanto a producción de tecnología se refiere, produciéndose así lo que se ha denominado "economía bivalente".

Este es precisamente el caso de México, pues según la "OCDE" México, desde hace mucho tiempo, se mueve en una economía bivalente, caracterizada por empresas multinacionales orientadas a la exportación, y pequeñas empresas de baja tecnología que no tienen acceso al conocimiento tecnológico en los ámbitos nacional o internacional."

Ese problema ya fue detectado por el gobierno mexicano, por las Instituciones de Educación Superior, Centros de investigación y, en menor medida, por la industria. En México se han intentado acciones, con resultados positivos en otros países. Entre ellas, desarrollar instituciones de educación e investigación de excelencia, establecer incubadoras de empresas, el avance de las comunicaciones y la creación de foros tendientes a vincular a la academia, la industria y el gobierno. Aun cuando lo anterior se ha impulsado tanto al nivel local como nacional, en Querétaro no se han obtenido los resultados esperados.

III. Método de Investigación y Cuestionarios

Con el objetivo de identificar la problemática local, en este estudio se recabó información entre diferentes actores del sistema de innovación. Se diseñó un cuestionario donde se pregunta cómo participan los encuestados dentro del sistema de innovación, y se aplicó a ejecutivos de empresas multinacionales, de empresas mexicanas consideradas como innovadoras, a personal de empresas en crecimiento y a micro empresarios.

Se hizo lo mismo entre directivos e investigadores de universidades, institutos de investigación, bancos y dependencias gubernamentales relacionadas con el establecimiento de políticas industriales, de fomento y de apoyo al desarrollo de proyectos de innovación. Así pues, se realizaron 26 entrevistas, de las cuales 14 se llevaron a cabo en industrias, 2 en universidades, 4 en institutos de investigación, 2 en bancos (de desarrollo) y 3 en dependencias gubernamentales.

Las entrevistas se basaron en un cuestionario diseñado por el Grupo Binacional de Investigadores; fueron personalizadas y posteriormente se analizó la información recabada.

IV. Resultados

A) ¿Qué está pasando en el sistema de innovación e investigación en Querétaro?

Con base en el trabajo realizado, se presentan algunas observaciones preliminares sobre lo que sucede en el sistema de innovación en Querétaro.

1.   Industria. Una primera observación va dirigida hacia las enormes diferencias existentes en el sistema de innovación, dependiendo del tipo de empresa. Las compañías multinacionales obtienen su tecnología de productos y procesos del exterior, normalmente. Se detectó que en algunas de estas empresas multinacionales hay la iniciativa de poseer unidades de diseño y desarrollo del producto. No obstante, estos desarrollos se llevan a cabo de manera desvinculada a las universidades e institutos de investigación, los cuales se emplean sólo para servicios. A las universidades solamente se les mira como proveedoras de personal.

Se detectaron igualmente algunas empresas nacionales innovadoras que están desarrollando sus productos y procesos localmente. En este caso, se observa que ninguna de éstas cuenta con egresados de doctorado para el desarrollo de su trabajo.

Otro grupo de empresas medianas y pequeñas, que presentan como factor común problemas financieros, tratan de hacer desarrollos tecnológicos locales. Sin embargo, muchas sólo desempeñan labor de maquila, por lo que son muy vulnerables a las variaciones del contexto internacional.

Por lo que respecta a las microempresas, están en una situación económica y tecnológica difícil. No cuentan con recursos económicos y la idea del desarrollo de productos en el largo plazo se encuentra fuera de su alcance.

2.   Institutos de investigación. Actualmente tienen la encomienda del gobierno federal para orientar su trabajo más hacia las necesidades del mercado. No obstante, la mayoría de los industriales entrevistados opinaron que el tiempo de respuesta de los centros de investigación es muy largo.

Se encontró poca cooperación entre universidades públicas privadas y en ambos casos con los institutos de investigación.

3.   Universidades. En lo que a las universidades privadas se refiere, ellas se perciben como proveedoras de personal y, en algunos casos, como centros de educación continua, sin mantener una relación de cooperación investigación aplicada a problemas de la industria.

Prácticamente toda la investigación en México se desarrolla en las universidades públicas, con recursos públicos. Sin embargo, debido a la estructura de incentivos académicos en el ámbito de la investigación, la mayor parte de la actividad se centra en reportes académicos y a la publicación de trabajos en revistas y ponencias en congresos, etcétera.

En general, como resultado de las entrevistas se detectó el comentario de que las universidades "necesitan hacer más para acercarse a la industria".

4.   Bancos de desarrollo. Si bien se detectó que existen iniciativas gubernamentales tendientes a apoyar esquemas que promuevan el desarrollo, éstos son arcaicos. En general, el crédito que ofrecen las instituciones de banca de fomento es costoso y, bajo las circunstancias económicas actuales, las pequeñas empresas no consideran a tales instituciones bancarias viables para financiar su desarrollo y crecimiento.

5.   Organizaciones Gubernamentales. Por lo que respecta a las organizaciones gubernamentales consultadas, se detectó una queja con respecto a la baja participación de la industria en los programas que estructura. Algunas de las razones argumentadas para esa escasa participación, son la falta de información, lo inadecuado de los productos ofertados o simplemente temor a trabajar con funcionarios gubernamentales.

En este marco, también se detectaron gran cantidad de traslapes entre los apoyos ofrecidos por las instituciones. De las consultas efectuadas puede establecerse que parece haber mayor promoción por parte de instituciones federales que de las estatales en el proceso de innovación.

6.   El Sistema de Innovación en Querétaro. Se puede afirmar que la característica del sistema de innovación en Querétaro es la falta de confianza en el proceso mismo. Una posible explicación a tal situación, es el conocimiento tan limitado que existe de las actividades de los participantes con respecto a lo que los demás están haciendo. Existe desconfianza de la industria hacia las universidades, ya que los tiempos de respuesta de la universidad no están acordes con los que requiere la industria. Ciertamente juega un papel importante, a fin de disminuir dicha desconfianza, el que la industria se dé cuenta del potencial que representan las universidades y los institutos de investigación.

Hay signos de que la situación está cambiando. Actualmente está más difundida la idea de que las universidades en el área de Querétaro no son solo proveedoras de mano de obra barata para la industria automotriz, sino que pueden llegar a ser el sustento tecnológico para una región con capacidad para producir ingenieros y lideres empresariales altamente calificados. Ejemplo de esto es el hecho que varias empresas están estableciendo laboratorios de investigación localmente. Ciertamente a esto contribuye la percepción de que Querétaro es un buen lugar para vivir.

Del trabajo realizado, se detectó que enfoques más elaborados de colaboración tales como compartir la propiedad industrial y el arranque de nuevas empresas a partir de proyectos de investigación, ya están siendo considerados en algunos sectores industriales.

B) Temas para investigaciones futuras

Ciertamente, los comentarios presentados anteriormente requieren un estudio más amplio, especialmente a la luz de los siguientes puntos:

1. La muestra de instituciones participantes en el proceso de innovación, empleada en este estudio, fue muy pequeña y limitada.
2. Se tiene información fragmentada.
3. El análisis presentado se logró sin datos del detalle operativo de las organizaciones encuestadas.
4. Se requeriría información adicional sobre las fortalezas existentes y con potencial de desarrollo entre las instituciones participantes. Asimismo, se requiere de más información sobre el número de empresas de base tecnológica que operan en la región, así como su estructura y relaciones con el resto del aparato productivo.

Un aspecto importante, que se considera innovador en este estudio, es la introducción, en el conjunto de interrelaciones mencionadas, de los aspectos "cultura" e "idiosincrasia local". En varias de las entrevistas se mencionó que una de las razones porque no se establecen vínculos entre la academia y la industria, obedece a diferencias culturales. Ello afecta percepciones, como que las iniciativas deben venir "desde arriba", o que "no se puede trabajar en grupo". Esto último nos da la pauta para conocer a detalle la interacción entre los diversos grupos sociales y aun las relaciones intrafamiliares en el marco del proceso de innovación.

V. Conclusiones

1.- El presente estudio piloto, ofrece una primera vista general del sistema de innovación en Querétaro.

2.- El sistema de innovación varía radicalmente, según el tipo de empresa.

3.- Algunas empresas grandes han iniciado relaciones con universidades e institutos de investigación, si bien sólo como proveedores de personal, entrenamiento de estudiantes y en menor grado educación continua.

4.- Las empresas medianas y micro se encuentran en una posición difícil con respecto al proceso de innovación, y en general están desconectadas de las unidades de investigación y desarrollo de tecnología.

5.- Se detectó falta de confianza y una especie de "todos contra todos" para llevar a cabo el proceso de innovación.

6.- Es clara la necesidad de ahondar en cada uno de los temas e instituciones que se abordaron en este estudio.

The Querétaro Innovation System:
A pilot study within the research program on comparative analyses of regional innovation systems in México and Sweden

Sverker Alänge[1], Alejandro Ardila[2], Concepción Bernal[3], Cecilia Bustamante[4], Manuel Espinosa[5], Roberto de Holanda[6], Gilberto Muñoz[7], Sari Scheinberg[8]

I. Introduction[9]

In Mexico, it has increasingly been recognized that the indigenous knowledge production in terms of research and development (R&D) in industry is not of the same magnitude as in comparative Western European economies.[10] Mexico shows characteristics of a "dual economy"[11] with one sector of the economy, primarily representing larger firms heavily dependent on technology import from abroad, and another sector, primarily representing small and micro size firms with local markets and a focus on short term survival. Regardless of their vast difference, both of these sectors have at least one thing in common, they both have limited contacts to research at Mexican universities and research institutes.[12] Hence, the local innovation systems show signs of low connectivity and limited research cooperation, contributing to the limited amount of R&D in Mexican industry which in turn results in limited local product and process innovation.

In connection with the 2nd seminar on academic cooperation between México and Sweden[13], arranged by SEP[14] and STINT[15], at Chalmers University of Technology, Göteborg in September 2000, Mexican participants expressed an interest in developing research cooperation to deal with the issue of limited R&D in Mexican industry and low

---

connectivity between industry and university research. As a first step to understanding of the problem area, a representative for Chalmers University of Technology was invited to Mexico in February 2001 and took the opportunity to meet with a number of the local university representatives, and to visit a few research institutes and one large firm. As a result of this first initiative, the Swedish and the Mexican representatives[16] agreed that it would be worthwhile to design a joint research study for the purpose of developing an in-depth understanding of this issue.

However, it was not possible to design and develop a study from a system of innovation perspective unless more information was collected. As a result, it was decided that two Swedish researchers would visit Querétaro for 2 weeks in July 2001. Together with a team of six Mexican researchers, they conducted 26 interviews with the various stakeholders representing different aspects in the innovation system within Querétaro city[17] and region.[18] On the basis of this initial study, key issues were identified and the foundation of a more comprehensive study was designed to research the functioning and development of regional innovation systems. This paper provides a first explorative report based on these interviews.

The purpose

The aim of this paper is to provide a broad description of the local innovation system of Querétaro in Mexico. It presents an overview of different types of stakeholders such as firms, universities, public research institutes, banks and government organizations in order to explore their participation in the development of new products and processes. The aim is to identify innovation patterns and to explore barriers/facilitators to innovation in order to identify issues for further research.

This report

There are 5 sections in this report. In the following section 2, a brief overview of the theoretical underpinnings for the importance of innovation and entrepreneurship for the economic development of a country, is presented. It also points to the importance of not only considering the development of individual firms, but that firms develop in relationship to other firms, universities, financial organization and in a context regulated by laws and culture, i.e. in what conceptually can be described as an innovation system. In section 3, the research methodology and research questions that drove the pilot study are outlined in more detail. Section 4 presents the findings of our initial work. This report concludes by addressing what we have learned from this preliminary study and by a review of what is needed to develop a more thorough understanding about. Finally, in section 5, the conclusions are presented.

---

[16] Sweden: Sverker Alänge, Chalmers University of Technology, and México: Alejandro Ardila, ITESM (Instituto Tecnológico y de Estudios Superiores de Monterrey) - Campus Querétaro and Alejandro Lozano, CONCYTEQ, Querétaro
[17] Santiago de Querétaro
[18] Querétaro State is part of the Bajío region located north of México City.

II   Innovation Systems and Local Research

A characteristic of developed industrial nations is the capacity to innovate and create new products, new production processes, and new ways of organizing operations and distribution. The importance of innovation for economic development and job creation has long been recognized and in this context, the specific role of the entrepreneurs and the start-up of new companies have been emphasized (Schumpeter 1911 and 1934). The first half of the 20th century saw the gradual development of in-house research capabilities in the large corporations and the R&D laboratories of large firms assumed an important complementary role in the creation of knowledge needed for innovations (Schumpeter 1942).[19] However, firms typically develop in relationships with other firms and organizations, including universities and research centers: this has been expressed in terms of concepts such as "development blocs" (Dahmén 1950), clusters, networks or systems. Specifically, the concept of "innovation system" has been used when studying the participants and their environment, including the regulatory mechanisms (institutions such as laws and culture), involved in creating new technology and innovations. Innovation systems have mainly been studied on a national level[20], but they can also be of a more local level, as well as transcend national borders.

While the national system is a natural unit of analysis, providing an identical context in terms of rules for economic activity, innovations are often created through interplay of participants from different nations. Hence, innovations are developed in open systems, and there is a need of considering the inputs to and outputs from the system when analyzing an innovation system, as the system borders have always been set through an arbitrary process, based on what makes sense for the aim of the analysis. Correspondingly, a regional open innovation system often has considerable contacts outside the region, but typically the focus of analysis is on the vitality of the cooperation among the participants inside the system.

As mentioned above, a characteristic for developed industrialized nations is the existence of an innovation system where different actors co-operate to create new innovations. This co-operation consists in a dynamic interplay between knowledge creating organizations, such as universities and research centers, industry developing and commercializing the knowledge into new products and processes, and the governing structures, including the creation of laws and incentive structures. However, this is not typically a characteristic for economies striving to catch-up. Rather, these economies show less signs of integrated innovation systems, more dependency on the external world for knowledge production and technology, and many times a more fractional national system, sometimes expressed in terms of a "dual economy". This is also the case of Mexico, and according to a recent OECD (1999) publication:

---

[19] Mansfield (1968) suggested that there is a considerable advantage in a diversity of firm sizes in an economy and later he also emphasized the synergetic cooperation between small start-up companies creating new technology and large firms with superior marketing and distribution capabilities.

[20] Freeman (1987), Lundvall (1992), Nelson (1993), Carlsson (1997) and Edquist (1997)

> "México has long grappled with a dual economy, characterized by export-oriented multinationals and inward-oriented, low-technology small firms which lack links to international and national sources of knowledge and technology." (p.74)

It has been shown that "history matters" in such a way that the development process of local industry and institutions is "path dependent", which means that inertia makes radical changes harder.[21] However, in México there is a growing awareness of the limited connectivity between the local science production, in universities and research centers, and local industry, and this has resulted in different policy measures to improve the functioning of the innovation system.

> "New measures now aim to strengthen the Science and Technology (S&T) infrastructure. These include the establishment of an R&D tax credit, the lowering of import duties for research materials, and support for a government-funded but privately managed venture capital scheme. The CONACYT's 20 research centres are being reorganized with a view to gradually reducing public support while increasing funding from industry. Knowledge and Innovation is a new programme planned to foster networking, technology diffusion, and the development of new markets for technological services. México is also using technology foresight studies to better focus research and policy actions." (OECD 1999, p.74)

These are measures at a national level – but put into a regional context, there are many examples of local growth areas, often built around a specific technology area, including local knowledge production and innovation. The dynamic interplay between university research, entrepreneurship and company formation has been emphasized[22], e.g. in Silicon Valley[23] or in a new "emergent" form of cooperation in México[24], or in the close cooperation between different small companies, e.g. in industrial districts in Italy[25] or in the Swedish "Småland" small scale industry intensive area[26]. This kind of dynamic cooperation contributes to the creation of employment and to an increased attractiveness of the local region, both for the location of new companies and for established units to remain and expand. Among measures on local level can be mentioned: the development of excellent educational institutions and research institutions[27], the establishment of incubators for new company creation, the development of communications, the provision of land and facilities. Of specific importance is the creation of meeting places for communication and interchange between industry, academia and government, contributing to the establishment of a culture of innovations. It has to be emphasized that these local growth areas are never totally self-sustained - the contacts outside the local system can be of immense importance for its continued development[28] - i.e. an open system. Rather, the connectivity locally is the base, i.e. a good information and knowledge

---

[21] Arthur (1989), Ehrnberg & Jacobsson (1997)

[22] Lundqvist (2001)

[23] Rogers and Larsen (1984), Saxenian (1994)

[24] Casas and Luna eds. (1999)

[25] Pyke et al. (1990)

[26] Johannisson (1985)

[27] Casas et al. (2000) points at the importance of regional research institutes for the development of "knowledge spaces" in Mexico.

[28] Also contacts that are less frequent can be important, e.g. weak-ties (Granovetter 1973)

4

flow between local actors, but it is as important that some actors have connections outside the system with excellent research units, suppliers of technology, or market competence. These links outside, which typically can be international, can in a well functioning local innovation system be essential for the development of many companies and local economic activity, provided that there are local arenas or meeting places.[29]

III   Research Questions and Method

3.1 The Research Questions

There were 5 main questions that were driving the pilot study, they were:
1. What types of innovations take place in the various stakeholder groups within the Querétaro State today, e.g. product, process and organization?
2. What activities are followed and resources allocated to support the innovation process (research and development) in the various stakeholder groups in the Querétaro State?
3. What types of links exist between the various stakeholders to the innovation process?
4. What obstacles hinder the links between the stakeholders and interfere with the innovation process and what supports, mechanisms or resources exist that support these links between the stakeholders?
5. What are the future opportunities and trends regarding innovation and stakeholder cooperation in the Querétaro State?

3.2 Defining the Sample

The first step in examining the innovation process from a stakeholders' perspective, was to define those parties that would be included as stakeholders. As a result of a critical examination of the players in México, the following stakeholder groups were identified as being part of the innovation process:
1. Industry
    a. Multinational companies (companies that belonged to an international group and had headquarters abroad.)
    b. National advanced group (large Mexican companies)
    c. National intermediate group (small and medium sized Mexican companies)
    d. Micro Firms
2. Public Research Institutes
3. Universities
4. Banks
5. Government Agencies
    a. Setting policy for innovation
    b. Practically supporting innovation
    c. Funding innovation

---

[29] Alänge (1987)

Once these groups were identified, it was agreed that at least 2 representatives from each of the stakeholder groups listed above, be selected from the Querétaro region for participation in this pilot study. Based upon existing lists of organizations located in Querétaro region, the first list of potential organizations in each of the stakeholder categories was created. Then, for each stakeholder group, the Mexican members of the team tried to obtain appointments in those companies with which he or she had a good or previous relationship. Each organization was called, and presented with the opportunity to participate in this study. As a result of these calls, various stakeholders agreed to participate, and a number could not participate. At the final round, 26 interviews were scheduled and conducted. This final sample consisted of 14 industries, 2 universities, 4 public research institutes, 2 banks, and 3 Government institutions (see appendix "Summary of Stakeholder Organizations Interviewed in Pilot Study).

3.3 The Questionnaire

The study was designed to collect data using 2 methods. The first method selected for data collection was the interview. In most cases, the leader of the organization was requested and agreed to participate in the study. It was determined that in-depth interviews with the leader of each of the stakeholder organizations would support that the study be thorough and flexible. The second method selected, was to review existing documents and studies conducted on innovation activities and processes.

It was determined that each interview would lasts approximately, 2 to 3 hours. Most time during the visit, would be allocated to conducting an in-depth interview. While some time would also be allocated to walking around the organization, in order to observe some aspects of the innovation or production process.

To facilitate that similar interviews were conducted in each of the organizations, a series of 3 questionnaires were developed. One interview guide was developed for private organizations, another for universities and research institutes and the third for government agencies and funding organizations.

Each questionnaire was designed with two main sections:
In Section 1, the ***Current working situation*** was explored. For example, questions were developed to explore the way work, cooperation and innovation was taking place today.
In section 2, ***Future cooperation*** was explored. For example, questions were developed to explore how each stakeholder would like to work with innovation and the various stakeholders in the future.

For both sections on current and future innovations, the stakeholders were asked additional questions, including:
  a) to explain the process of innovation.
  b) to describe their relations with the stakeholders, i.e. industry, universities, research institutes, and Government.
  c) to describe trends in the business environment.
  d) to present barriers and opportunities to cooperation and innovation.

e) to make recommendations to the other stakeholders that could strengthen the cooperation.

The questionnaire was developed in stages. First, the two Swedish researchers developed a draft of a questionnaire. This was presented to the Mexican partners, who reviewed the questions and format. After some small adjustments, a model questionnaire was designed. This model then served as the basis for the development of the 3 versions of the questionnaire for each of the stakeholder groups.

3.4 The Interview Process

The Mexican-Swedish Team consisted of 2 researchers from Sweden (Chalmers University of Technology and Gestalt Academy of Scandinavia), and six Mexican researchers (3 representatives from ITESM, 2 representatives from CONCYTEQ and 1 representative from SEDESU). The team decided that they should be subdivided into 2 subgroups for the interview process. And the creation of each group should follow the following criteria for the selection process:
1. to have one Swedish researcher
2. to have one ITESM representative
3. to have one local Government organization representative

As the sample of organizations to interview was greater than the amount of time allocated for the interviews, it was necessary to create a 3rd subgroup for a few of the interviews.

Each interview was led by a leader, who asked most of the questions, and supported by a sub-leader, who asked supplementary questions. The remaining team members were responsible for taking notes and to observe the process. After each interview, the team spent at least 30 minutes to reflect on the interview and to summarize their main impressions. And finally, one person was chosen from each team to type up a draft version of the notes in English, which would then be reviewed and approved by the other team participants.[30]

A summary report for each company or institution, included the following aspects from the interviews:
a) Goals and facts about the organization
b) Innovation process – innovations and evaluation of process.
c) Links between the actors.
d) Barriers to cooperation between actors.
e) Recommendations for a better cooperation between actors.
f) Environmental trends.
g) Needs

---

[30] The note typing was, in fact, an important bottleneck. It was difficult for the Mexican team to make interviews during the day and to type the drafts in English in the same evening. After the two working weeks, some of the drafts were still incomplete and a few were in Spanish. Hence, in a few cases the initial analysis was based also on supplementary data from hand-written notes.

3.5 The Analysis Process

A four-step strategy was defined for analyzing the interviews.

The first step was to review the reports that were written, simply in order to get familiar with the various interviews, in order to have an overview of the key issues discovered in each of the aspects, defined above. As a result, a review included evaluating the characteristics of the companies or institutions, type and process of innovations being conducted, level and quality of cooperation with other stakeholders, perceived barriers to cooperate with other stakeholders, awards received, level of internationalization (imports and/or exports), views and needs of the future, etc.

The second step was to draw a stakeholders diagram for each organization. In this way, a map was developed for each organization illustrating the current relations between them and the other stakeholder groups. Each of these maps was analyzed to identify which links existed (to which stakeholders), what types of links were used and not used (e.g. types of cooperation) and what mechanisms supported these links (e.g. resources, contacts and laws).

The third step was to combine each of the above aspects for each stakeholder group. In this way, an analysis could be conducted to explore the patterns and properties affecting each stakeholder group. Hence an overview was created and portrayed for each of the stakeholder groups.

The fourth and final step focused on defining the main conclusions that can be drawn from this pilot study. In addition the team also tried to determine what information they were still missing, and what the limitations were for this study. A sketch of the final report was prepared and each member of the research team was responsible for the writing a specific part of it (in Mexico and Sweden). The integration of the final report was carried out by e-mail between Sweden and Mexico, and also by means of a series of coordinating meetings conducted in Mexico in connection with the SEP/STINT seminar in October 2001, held in Querétaro.

IV   Findings

A. What is happening today in innovation and research?

Some preliminary findings on what is taking place in the Querétaro innovation system will be presented below. It is based on the 26 interviews conducted with stakeholders in the Querétaro State in July 2001, supplemented by first hand data from within the research group as well as by some secondary data. These findings, based on a relatively limited set of empirical data, should primarily be seen as an explorative starting point for continued research. The aim of this explorative study is to generate or improve the research questions for further investigation and confirmation.

1. Industry

A first observation is that there are large differences in the way innovations are being developed and introduced depending on company type. We found it useful to divide the firms in four different groups, representing some broad common characteristics. The decisive variables used are ownership and size and we decided to use the following groupings: multinational companies, national advanced large companies, national small and medium sized companies, and local micro companies.

The multinational companies in México are 51% owned by a foreign multinational corporation, while Mexican owned firms can be from 51% (with 49% foreign capital) to 100% Mexican owned. All in all, we interviewed 8 multinational, 3 large advanced local firms, 3 medium sized, and one micro firm.

According to our findings, the *multinational firms* get their new technology and product/process innovations from abroad, and they have a big advantage in being able to finance their investments internationally. In some of the multinational corporations there is a recent tendency that the Mexican units get the responsibility to do local product design and product development. This is visible in the form of a locally developed product range being sold at both the Mexican market and for export, or in the establishment of local research laboratories. However, the multinational firms are not strongly linked to local research resources. Rather they use the public research institutions for simple testing assignments, because of their modern equipment, and they use the universities as suppliers of trained labor and in a few cases for continued training.

In contrast to the multinational firms, the *large advanced national corporations* were found to be the integrators who connect different actors in the local innovation system. They all have in-house resources for product and process development. But among these firms are also the pioneers who commission research projects by universities, and they use the public research institutions not only for testing purposes, but also to do joint projects or for specified product development assignments. They also use university resources, professors and students, and public research institutions in order to develop their production processes. However, the main cooperation with universities is still focused on their role as suppliers of trained labor, engineers and technicians. A very recent step has been to include the possibility for employees to do their PhD in a program managed by one of the research institutions. In general, however, these large advanced local firms do not yet hire PhDs for their development work.

There is a group of *relatively advanced local small and medium-sized firms* (SMEs) who at present are in a difficult situation, being squeezed by demands from their customers and the difficulty of arranging competitive financing on the local Mexican market. These firms are active on the export market as suppliers and subcontractors, or are directly feeling the competition from imported products after the lowering of import duties. Some of these firms have had a "maquiladora" position, which now is being threatened because there are other countries where the wage level is considerably lower than in Mexico, and

hence, their customers are leaving. Among this group of companies are some who have contacts with universities, but the majority, they are working in an independent way without linking up to universities, government or industry associations.

The *local micro firms* are in a very difficult situation mainly trying to survive from day to day. The thought of product development requiring substantial development time is far beyond their reality. Capital is very expensive on the Mexican market (2-3 times more expensive than at the international market during last years) and these small firms have very limited possibilities to obtain any kind of loans. There are still some minor programs for product/process development from the Federal Government or Development banks - but these programs are not known to most of the firms in this group. The micro firms are not well connected to universities. There are a few examples of programs geared towards this group from both the private universities and from the public universities, but it is very limited in comparison to the contacts with the larger local firms.

2. Public Research Institutes

According to the Public Research Institutes (PRI) interviewed in this study, they claim that their financing, which has historically been financed by the Federal Government, is now shifting towards private sources. This is a direct effect of a Government decision to gradually cut the federal financing in order to make the research institutes more market oriented. It remains to be seen if this new market focus will lead to short-term problem solving rather than more long-term joint research. From all of our interviews, both with industry and the research institutes themselves, one PRI stood out as already now being more market oriented. They have been able to focus and finance 98% of their projects based on expressed needs by industry. However, in general, industry representatives were not satisfied with the PRIs response time, and most projects financed, are short term oriented.

Upon reviewing the PRIs cooperation with universities, there has been virtually no cooperation with private universities, and relatively limited cooperation with public universities. One reason found was that Government funding does not normally go to private universities (in strong contrast to the government financing received by the PRIs). A second reason found was that the research institutes can issue PhDs by their own right, as they are entities directly under the Ministry of Education, and hence do not need to cooperate with universities around PhD education and pure research activities.

3. Universities

Private universities are seen by industry primarily as training facilities and suppliers of trained labor force. The cooperation with industry limits itself to the supply of labor, courses for continued education, and different kinds of training assignments for students on industry sites. Research cooperation between universities and industry is virtually non-existent. The result has been that private universities excel in training activities while their

research activities are very limited. This has been further reinforced by the traditional Governmental policy of not making research funds available for private universities.

Public universities, on the other hand, receive more Governmental funding for research and hence, there is a certain volume of research going on. However, due to the specific incentive structure in academic world, most activity is still inwardly focused on academic achievement and publication in scientific journals. This inward focus is often condemning any outside oriented focus, where working with industry and solving their problems as applied research is involved. However, we saw some interesting examples of applied research projects directly designed to solve problems for small agricultural and industrial entities. The university unit responsible for these applied projects even saw it as a natural step to form university spin-off companies.

In summary, there have not been many initiatives, from either private or public universities, to establish research cooperation with industries or research institutes. In our interviews it was an almost uniform view expressed by all interviewees, that universities have to do more, to go out and visit Mexican industry, in order to developing an in-depth understanding of the conditions and problems facing industry today in Querétaro.

4. Development Banks

There are some Government initiatives geared towards SMEs, but general credit schemes to promote their development seem to belong to history. In general, credits to SMEs are expensive, and in the present economic situation many small and micro companies do not consider loans as a viable means towards development and growth. One of the development banks interviewed, today plays a very limited role, as it has no direct access to funds for providing loans, but instead functions as an intermediary to other funding institutions.

5. Government Organizations

According to our findings, Government organizations complained about the lack of industry participation in most of the programs they are organizing (e.g. training, consulting, promotion, productivity and quality certification). This lack of industry participation has been defined as being due to a number of factors, including: lack of information, lack of interest, lack of promotion, inadequacy of products offered, inappropriate portfolio of products and activities being offered, or fear of working with Government officials. In addition, Querétaro, with both federal and state agencies dedicated for development, runs a risk of having non-coordinated efforts to promote industry development. There appears to be a large overlap in the services being offered by the various agencies. And it was hard for these agencies to differentiate themselves and their profile from the other agencies.

However, an interesting example of the activity of a state level agency was found, where it worked to promote the contacts between micro companies and existing federal support funds. It was also found that Federal government institutions are more concerned with innovation than state agencies, but both federal and state institutions have scarce resources for innovation. In addition, there is a general lack of both state and national policies, which promote the development of innovation systems and which consider innovation as a vital component for the creation economic development.

According to traditional Government policy in México, national development programs and public funding have been directed towards solely supporting national companies. Hence, the 51% foreign ownership rule, which defines a non-Mexican company, also puts an end to the participation of this kind of firms in national development programs. However, this rule might also have a detrimental effect on national company development, as it might form a barrier towards a needed increase in cooperation and connectivity in the local innovation system, where foreign owned companies could be a vital component.

6. The Querétaro Innovation System

A characteristic of the Querétaro innovation system is the missing trust between most of the stakeholders. Part of an explanation can be found in that the participants, with some exceptions, typically have a very limited knowledge and understanding of what the other parties are doing and could be offering. In addition, there is a deep mistrust of universities by industry, mainly because of the time conflict expressed by industry's "we want it done yesterday" in comparison to university's need of time for the development of new knowledge. This has been further aggravated by earlier experiences of universities' long vacations as well as labor disputes resulting in frequent strikes at public universities.
Hence, the Querétaro innovation system is characterized by a low connectivity and mistrust between the potential cooperation partners. The driving force to connect has been limited as there has been a limited understanding of the value of research among the business community, at the same time as the academic representatives, both at research institutes and universities, have been motivated primarily by incentive systems promoting an inward looking focus on academic publications.

However, there are clear signs of a qualitative shift in the perception of Querétaro as a source for future research and industrial development. The region's traditional strength of being a cheap producer and quality supplier primarily for the automotive industry is quickly fading. In its place is an increased awareness of the critical mass of world-class business leaders and engineers that now exists in Querétaro. Hence, Querétaro region is now perceived as able to offer qualified engineering capability. For example, large companies are now in the process of establishing software laboratories in Querétaro. And at our visits to the larger companies, both the foreign owned and the Mexican, we saw many examples of local product innovation and process improvement. Furthermore, this engineering resource in the region is growing as a result of the substantial number of local universities and public research institutes. This is further enhanced by the fact that

Querétaro is seen by professionals as a healthy place to live in and therefore attracts many people to move there.

In an innovation system, the way knowledge is being appropriated plays a key role. However, as of now, proprietary knowledge and patents have not been a primary question on the agenda for most of the potential partners, but they will need to address it in the near future. Another important issue that is barely visible in Querétaro while very prevalent in most industrialized economies is their understanding of the critical role of new company start-ups and university spin-offs. This can be seen as a complimentary road for university research to become commercialized and to contribute to the vitalization of the economy.

B. Issues identified for further research

1. Sample too small and limited

As noted earlier, this explorative study is based on a relatively limited number of interviews with stakeholders in the local innovation system. For example, only a few micro and small firms were interviewed and among these firms no professional service providers or consultants were included, considering the fact that this kind of firms typically are important providers of applied knowledge. There are five major universities in the area, but the findings presented above are based on a limited number of interviews only at two of these universities. We conducted interviews with federal level representatives in the State (Secretaría de Economía, NAFIN, BANCOMEXT and CONACYT) taking into account that decisions and actions at this level have a major impact on the local innovation system. Hence, there is an obvious need of supplementary data collection from these categories.

Given the limitations provided by the data collection, we still believe that the findings presented provide a starting picture of the local innovation system. However, the aim of this initial study was also to explore the area in order to identify issues which could impact the innovation system, and where further studies could be useful.

2. Missing information

One way of understanding what blocks the development of innovations is to ask local companies for what they need in order to enhance product and process innovation. This was something emphasized by many of the interviewees, both from industry and from other organizations. In addition, they noted that industrial firms require assistance in identifying their needs. We have learned in our study that identifying the needs are critical and that these needs are very different depending on type of industry and stakeholder group. Therefore, in the future it would be necessary to understand the needs more clearly, e.g.:

- What is the present view or awareness of the need for product and process innovation among Mexican company owners, leaders and among representatives of the other stakeholders?
- What are the needs of industry to enhance product and process innovation?
- To what extent are local organizations able to supply the needed knowledge and other resources?

3. Deeper Analysis

In this pre-study, we have chosen to develop relationship maps for each individual stakeholder organization interviewed. These relationship maps describe the specific activities that form the basis of the relationships: product and process development projects, technical services, training, consultancy and student projects. And then based upon these maps, it is easier to identify the cooperation partners of each individual firm or organization interviewed. These maps also provide an initial understanding of the type and quality of the relationships as they are existing today, as well as provide some hints as to why certain links have not been established. However, in order to develop a deeper understanding, there is a need of a more systematic analysis of specific innovation processes.

- How are innovations being developed in practice and over time? This question may impose the need of selecting a limited number of innovations for deeper case studies.[31]
- How does the knowledge network change over time? What is the importance of weak ties relative to more frequent exchange relationships in the value chain, during different phases of the creation of new knowledge leading to realized product and process innovations?
- What is the character of the local knowledge being used in innovations in comparison to the knowledge coming from the national and the global innovation systems?
- Are there local 'competent' buyers – e.g. advanced firms or government procurement?
- What is the present awareness and use of intellectual property rights, e.g. patents? How and to what extent does PRI (Public Research Institutes) influence the innovation processes?

4. Additional information

4.1 Existing and potential strongholds

Local innovation systems are often built around certain local specialties, e.g. a specific technology. And one measure of the strength of such a system is how well connected the different system participants are. Casas et al. (2000) identified a number of emerging "knowledge spaces" in the wider Bajío region (where the Querétaro is one of the States), where the local PRIs played an important role, e.g. in material sciences. Hence, it is

---

[31] Comparative data (and findings) from industry studies by two of our research partners can also be used to develop a deeper understanding of innovation processes in adjacent Mexican regions, e.g. de Gortari and Santos 2000.

essential to identify existing and potential local strongholds in the Querétaro region, and focus the analysis on them.

- Which are the present and potential "strongholds" in the Querétaro region?
- Are there specific innovation areas that have local advantages, i.e. which are more local/special or have more tacit components? For example, in our interviews, water saving and reuse of industrial waste were spontaneously mentioned by some of the interviewees.

4.2 Technology-based business development

As mentioned earlier, a characteristic of dynamic innovation systems is that new technology-based companies are started in order to commercialize the technology. This is, however, not a typical characteristic for the Querétaro region. In our interviews different reasons were brought forward, including the financial system and the focus among capital owners on very short pay back time. It was also pointed out that earlier or existing programs to promote entrepreneurship at universities or in incubators initiated on state level, have recorded very limited success. However, in the most recent Government plan for Science & Technology[32] it has been very clearly spelled out the importance of new technology-based business development, which indicates a shift in policy towards new company start-ups.

- What is the actual number of technology or science-based company start-ups in the region?
- What is the experience of these "successful" company start-ups and what is the experience of those entrepreneurs that have tried but did not succeed in launching a start-up company.
- What are the experiences of previous programs to promote entrepreneurship and company start-ups in the region?
- What has been seen as the primary factors hindering or facilitating the formation of new technology-based companies?

4.3 Structures and connectivity

One measure being used to describe an innovation system is its connectivity, i.e. how well different stakeholders within the system are linked. An indication of a low connectivity came from our interviews, where it strongly came out a lack of trust between different stakeholder groups. As is reflected in the federal-state-community structure, a characteristic of the Mexican society is that local or state level organizations are linked to strong centers, typically "México City", in what can be described as a pyramid structure. Hence, as was brought up in the interviews, this has a tendency of leading to a structure where the contacts across different local organizations are less well developed. In addition, there is always a risk that the connections across different system levels, here federal-state-community, can be distorted or one-sided. Hence, it is of interest to study to

---

[32] Mexican Government Plan 2001

what extent these characteristics of the structure of the Mexican society affects the local innovation system.

- How does the "vertical structure" of the Mexican society affect the development of local innovation systems?
- To what extent do formal institutions (rules and regulations) including incentive systems, on different system levels, affect the development of local innovation systems?
- What is the federal role, e.g. policies, priorities and funding and what is the interplay between different levels (federal, state, local)?
- What are all the instruments and mechanisms existing to promote or hinder innovation? (including social, cultural, political, economic, legal and administrative factors)

4.4 Culture influence

There were several instances at our interviews where the reasons for actions taken or lack of action was referred to as being cultural. In a more general sense, the lack of innovation and the lack of relationships and cooperation in developing new knowledge, was blamed on "culture" or "our habits". Other research has shown that culture can have an importance for business formation as well as for what is possible to change in an existing firm.[33] However, this general reference to culture has to be further substantiated.

- While it was clear from our interviews that there commonly is a belief in public institutions that all policies, improvements and support programs must come from the "top", it has to be further investigated to what extent this belief influences the way decisions are made and actions are taken.
- Several interviewees pointed out that the Mexican work force lack the ability to work in teams in the way required by many multinational companies working according to some form of TQM approach. At the same time, the role of social groups, e.g. the family, has been emphasized. Hence, there is a need to further clarify the role and relative importance of different social groups, including teams and family groups, in the innovation process.
- The willingness or rather lack of interest among Mexican company leaders to cooperate and share experiences has been interpreted as a cultural phenomenon. Also the perception among company representatives of research, and then specifically university research has as well been described in cultural terms during our interviews. This is yet another area where there is a need of further analysis.

Hence, we have found many references to the value system in México or traditions, but a thorough analysis of the role of these soft institutions in relation to the influence of hard institutions such as laws and regulations, remains to be made. The methodology for data collection in this matter has to be further elaborated upon. One possible avenue is to

---

[33] Scheinberg (1989), Miconnet (2001)

combine the interview and document-based enquiry with an in-depth study of a more anthropological character.

V   Conclusions

This explorative pilot study provides a first picture of the Querétaro region innovation system. The way in which innovations are being developed and introduced seem to vary considerably across different company categories. Multinational companies have an advantage in their supply of technology and financing from a global base, but are poorly connected to the Mexican university and research institute system. Larger advanced Mexican firms are beginning to create R&D links with Mexican universities and research institutes, although the major part of their relationships still takes place in terms of supply of trained labor, student assignments and continued education. Medium sized firms, as well as micro firms, are in difficult positions as regards innovation and long-term investment, and as a general pattern, most of these firms are poorly connected to local research and development units. A general impression is that the connections between university research and industry innovation is relatively limited and one major reason mentioned by representatives from different stakeholder groups is the lack of trust.

However, a main purpose of this explorative study was to identify areas where further research is needed on the way innovations are being conceived, developed, introduced and diffused in the Querétaro innovation system. There is an obvious need of in-depth analyses involving prime stakeholders in the innovation process. These stakeholders include *local and international firms* (both as customers of innovations and of the output of innovations, and as suppliers of inputs in terms of materials, components and knowledge), *knowledge and training producing organizations* (such as local and international research institutes and universities) as well as *financial institutions* and *policy/regulating institutions* (both local and international). These in-depth analyses include the way innovations are being blocked or promoted by various factors seen from different system levels.

This explorative study also identified a number of areas where there is a need of deeper understanding. Among these areas were:
1. What is the present view or awareness among Mexican Company leaders and other stakeholders of the need for product, process and organizational innovations?
2. What are the present and potential strengths of the Querétaro region?
3. What is the role of technology-based company start-ups?
4. Is there a need for research activities inside universities in order to develop local innovations?
5. What is the present and potential importance of intellectual property rights?
6. What is the role of government on different levels, federal, state and city?
7. What is the role of culture and habits, not the least contrasted to the concept of path dependency?

References

Alänge, Sverker (1987): *Acquisition of Capabilities through International Technology Transfer*, Dept. of Industrial Management, Chalmers Univ. of Technology, Göteborg

Arthur, Brian (1989): "Competing technologies, increasing returns, and lock-in by historical events", *Economic Journal*, 99, pp. 116-131

Carlsson, Bo ed. (1997): *Technological Systems and Industrial Dynamics*, Kluwer Academic Publ., Boston

Casas, Rosalba and Matilde Luna eds. (1999): *Gobierno, Academia y Empresas en México: Hacia una nueva configuración de relaciones, 2nd ed.*, Editoral Plaza y Valdés, México City

Casas, Rosalba, Rebeca de Gortari and Ma. Josefa Santos (2000): "The building of knowledge spaces in Mexico: a regional approach to networking", *Research Policy*, 29, pp. 225-241

Club de Industriales de Querétaro (1999): *30 Años - La industria de Querétaro - sus orígenes, actualidad y proyección,* Club de Industriales de Querétaro, Santiago de Querétaro, Qro.

Dahmén, Erik (1950): *Svensk industriell företagarverksamhet*, Industriens Utredningsinstitut, Stockholm (in English in 1970 translated by Axel Leijonhufvud "*xxxx*")

Edquist, Charles ed. (1997): *Systems of Innovation: Technologies, Institutions and Organizations*, Pinter, London and Washington

Ehrnberg, Ellinor and Staffan Jacobsson (1997): "Technological Discontinuities and Incumbents' Performance: An Analytical Framework", chapter 14 in Edquist ed. (1997)

Freeman, Christopher (1987): *Technology Policy and Economic Performance: Lessons from Japan*, Pinter Publications, London

Gobierno del Estado de Querétaro (2000): *Querétaro México 2000 - Economic Yearbook,* Secretaria de Desarrollo Sustentable, Gobierno del Estado de Querétaro, Qro.

De Gortari, Rebeca and Maria Josefa Santos (2000): Knowledge Flows in Big Mexican and Multinational Firms: A comparative analysis of technological trajectories of firms in order to distinguish different strategies in the process of acquisition, integration and accumulation of technological capacities", *Research project No. IN309601*, Institute of Social Studies, UNAM (Universidad Nacional Autónoma de México)

Granovetter, Mark (1973): "The Strength of Weak Ties", *American Journal of Sociology*, 78 (6), pp. 1360-1380

Johannisson, Bengt (1985): "Business and Local Community - Swedish experiences in bottom-up planning for local industrial development", *Report 1985:4*, University of Östersund, Östersund

Lundqvist, Mats (2001): "Chalmers innovationssystem: att utveckla det entreprenöriella universitetet" (The innovation system of Chalmers: to develop the entrepreneurial university), School of Technology Management and Economics, Chalmers University of Technology, Göteborg (mimeo)

Lundvall, Bengt-Åke ed. (1992): *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, Pinter, London

Mansfield, Edvin (1968): *The Economics of Technological Change,* W.W. Norton & Co, New York

Minconnet, Pascal (2001): *A Socio-Cultural Perspective on the Implementation of Management Models inside Firms*, Dept. of Industrial Dynamics, Chalmers University of Technology, Göteborg

Muñoz Arango, Gilberto, Alejandro Lozano Guzmán and María Concepción Bernal Salas (2001): *Problemática para Establecer la Relación Academia-Industria*, Concyteq, Santiago de Querétaro, Qro.

Nelson, Richard ed. (1993): *National Innovation Systems - A comparative analysis*, Oxford University Press, New York

OECD (1999): *Managing National Innovation Systems*, Organisation for Economic Co-operation and Development,

Perrusquía, Gustavo ed. (2000): *2nd Seminar on Academic Cooperation: Sweden – Mexico, Proceedings*, 25-26 September 2000, Chalmers university of technology, Göteborg, Sweden

Pyke, F., G. Becattini and S. Sengenberger (1990): *Industrial Districts and Inter-Firm Cooperation in Italy*, ILO, Geneva

Rogers, Everett and Judith Larsen (1984): *Silicon Valley Fever - Growth of High-Technology Culture*, Basic Books, New York

Saxenian, AnnaLee (1994): *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Harvard University Press, Cambridge, MA

Scheinberg, Sari (1989): *The Entrepreneurial Start-Up Process: A Cross-Cultural Comparison in 11 Countries*, The Fielding Institute, Santa Barbara, CA

Schumpeter, Joseph (1934): *The Theory of Economic Development*, Harvard University Press, Cambridge, MA (first German edition in 1911: *Theorie der virtschaftlichen entwicklung*)

Schumpeter, Joseph (1942): *Capitalism, Socialism and Democracy*, George Allen & Unwin, London (paper back version published in 1976)

Wagner, Cynthia K. (1998): "Biotechnology in Mexico: placing science in the service of business", *Technology in Society*, vol.20, pp. 61-73

Appendix: Summary of Stakeholder Organizations Interviewed in Pilot Study

Type Of Stakeholder	Name of Organization
Universities	1. ITESM 2. UAQ
Public Research Institutes	1. CIDESI 2. CENAM 3. IMT 4. CINVESTAV
Multinational Firms	1. Construlita 2. Valeo 3. New Holland 4. Johnson Mattey 5. Kostal 6. Tetrapac 7. TRW
National Advanced Firms	1. Velcon 2. Tremec 3. Condumex
National Intermediate Firms	1. Manufacturas Nieto 2. EXPOHORT 3. Maquinados Numéricos
Micro Firms	1. Galvelec 2. Government sources
Government Agencies	1. SEDESU 2. Secretaría de Economía 3. CONACYT
Development Banks	1. NAFIN 2. BANCOMEXT

**CONSEJO DE CIENCIA Y TECNOLOGIA
DEL ESTADO DE QUERETARO**