# *Chapter* 3

# Sub-national Initiatives for Regional Clusters and Innovation Systems

## Introduction

Mexico's lack of productivity growth is one of the primary barriers to country competitiveness. Unlike in many OECD countries, there are relatively few incentives provided by national policy in a range of policy families to promote the development of regional innovation systems and clusters as a vehicle for supporting productivity growth (see Chapter 2). Are Mexican states (and in some cases municipalities) able to fill the gap? Although in a federal country the expectation would be for states to take a lead role in supporting regional innovation systems, the high level of fiscal centralisation (see Chapter 4), along with the territorial concentration of innovation resources within the country (see Chapter 1), are among the barriers for states.

This chapter reviews the state level initiatives to support regional clusters and innovation systems. First it explores the different competitiveness approaches taken at the state level, which tend to be focused more on business environment conditions and indicators rather than from a holistic approach. It then reviews the state strategies for selecting and supporting sectors and clusters which are increasingly a focus of state policy but often for the same sectors across several states. It then analyzes support for the regional innovation systems, including the science and technology efforts at sub-national level (which are under-developed in most states) and utilisation of relevant national programmes, illustrating wide variations in state innovation assets, capacity and programmes. International good practices in these different fields are also discussed.

## State programmes for competitiveness

### *Overall approaches based on narrow definition of competitiveness*

Mexican states have made "competitiveness" a priority for state action. One of the main drivers for the state level approaches is the range of competitiveness ranking systems actively used in Mexico. As discussed in Chapter 1, the most commonly used are that of the *Instituto Mexicano para la Competividad* (IMCO) (for state and now city level) and the World Bank's *Doing Business* report, as well as Aregional.com and those produced by leading HEIs such as CIDE (Centre for Economics Teaching and Research), among others.

Several states use these indices as their diagnosis for a competitiveness plan or even hire one of these ranking organisations to provide consulting services aimed at improving competitiveness. The state of Mexico and Jalisco, for example, are working with one provider on action plans to improve their scores on certain indicators and implement

concrete policies. Not all the indicators in these indices are easily influenced by state policy, however states focus their attention on those indicators that have a stronger weight in the composite index in which they can have an impact. The challenge with these indices, in addition to the inability for an index to identify a state's unique characteristics, is that they tend to have few knowledge economy related indicators (see Chapter 1).

The competitiveness approaches tend to be focused on the relative position with other Mexican states, but not in a global context. Of course depending on the particular industry, states discuss international benchmarks, usually more oriented towards production costs, doing business conditions and FDI attraction. For example, in the software industry states often refer to their advantages relative to India given physical proximity to the US. An interesting example of a more global perspective was noted in the state of Chihuahua. They are working on a specific strategy for addressing competition with China. The state has an officer in Beijing to identify niches where they are not competing but are complementary and may work together effectively.

Many of the competitiveness statements seek to be long-term visions. The names of these strategies make allusion to this: Coahuila 2020, San Luis Potosi 2030, Chihuahua 2020, among others. A key point to ensure the success of these long-term strategies will be the creation of mechanisms that assure that policies and objectives are not negatively affected by political changes or programmes easily discontinued. In this sense, the involvement of non-government institutions, associations and the participation of civil society will play an important role. Coahuila has established civil committees in each of the state's regions, including HEIs and firms (and supported by government) seeking to address specific needs and demands in terms of competitiveness. The inclusion of the private sector may help induce greater durability and certainty of such committees. The governance of regional innovation systems could also take a more clear public-private partnership approach. Given rapid changes driven by global trends these strategies will require regular re-assessments.

Overall, Mexican states tend to view competitiveness first as a question of regulation and business environment. As attracting FDI is one of the top goals of Mexican states, the orientation for competitiveness is on attracting such firms with physical infrastructure and low regulatory burdens with respect to firm establishment and labour laws. There is also an effort to put together a training package that would meet the firm's needs. While some advantages in terms of human capital, education level and English proficiency are mentioned as selling points generally (albeit more so in the Northern states), innovation-related assets are discussed significantly less in promotional materials or public documents for most participating states.

Measures of labour productivity (or total factor productivity) are not typically part of the diagnosis of competitiveness challenges or used as an indicator of progress, in contrast to many other OECD regions. There is some discussion of capturing more value added in the value chain which addresses a need for greater productivity in part. Other strategies commonly being pursued include the integration of value chains, promoting an increased number of local suppliers (hence increasing local content) and moving towards high-tech "appealing" sectors. States tend to promote the size of a particular industry relative to other states within Mexico, which is important but not the only characteristics that may make investment in that industry in that state most relevant.

There is an opportunity for the federal government to set an example for states by taking a more holistic approach to competitiveness. Within the national Ministry of the Economy, the new Under Secretary for Normativity, Foreign Investment and International Commercial Practices is being referred to as the Under secretary for

Competitiveness and Normativity, indicating a potential shift in the role of this Under Secretariat. There is an opportunity for the national government to set a new tone for Mexican states with respect to the term competitiveness, whether through this Under Secretariat or more generally. The competitiveness approach could give greater weight to knowledge economy factors and measures to improve productivity in addition to general business environment factors. Furthermore, the spatial dimension of economic activities around the country could be taken into account to a greater extent for national competitiveness. Such an approach could support a long-term and more fundamental change.

While there exist different competitiveness strategies based on a state's level of development, there are interesting and successful examples even among lagging states. Often these examples involve technology upgrades and mobilising innovation resources to benefit more traditional sectors. Additionally, polices may be devised to ensure that lagging regions also benefit from new (higher-tech) sectors in more advanced states. For example, some of the declining industries suffering from international competition, like textiles and leather, are now supplying to the aerospace industry.

### *Public and private stakeholder roles in competitiveness strategies*

The process of developing a competitiveness strategy as well as its implementation is as important as the strategy itself. Successful regional strategies, whether for competitiveness or innovation, have proven to be those where there is a consensus about the problem (based on objective information), an agreed upon action plan to address the identified problem, and clear action steps for the different stakeholders. These stakeholders include not only different government departments but firms, educational institutions, research entities, and key civil society associations, among others (OECD, 2007k).

One important and highly positive trend is the increasing involvement of civil society actors in the development of these competitiveness strategies. Several states are now using public-private councils or initiatives to support their competitiveness approaches. Diversifying these private sector stakeholders beyond the top businessmen is important. For example, the process for developing Colima's competitiveness strategy involved many stakeholder interviews. The result of this dialogue and diagnosis was the development of a list of 82 strategic projects, and the lead of each project is a non-governmental entity. However, the funding for many of these projects is likely contingent upon future public budgets.

The greater involvement of civil society actors is a vehicle for ensuring the longevity of important strategies and gaining credibility with the business community. At all levels of government in Mexico, a change in administration can result in considerable turnover and a reinvention of many programmes. There is a strong risk of not building on prior successes. For example, in Nuevo Leon the current governor has made science and technology an important component in the state's development plan and competitiveness approach. In a future administration, there is always a possiblity that this strategy may not be maintained, therefore embedding the approach will help it survive political fluctuations for the long-term economic development benefit of the state.

Another positive trend is the cross-sectoral approach to public sector mobilisation behind the competitiveness strategies in several states, representing a more comprehensive approach. For example, in Puebla the secretariat charged with competitiveness is also responsible for labour issues, and therefore co-ordinates actively

with the economic development secretariat. The state of Mexico has several competitiveness working groups (in different topics) led by the Economic Development Secretary (through its Industry Department), but with many other secretariats, private sector representatives and members of HEIs participating in improving competitiveness and whose performance on indicators is tracked regularly. In Jalisco, the *Gran Alianza* for competitiveness is directly under the governor, and therefore can more easily co-ordinate across the different ministries. The state of Michoacan also had a very interesting cross-sectoral approach to addressing many important issues for competitiveness, in part due to the importance of the agricultural sector in the economy. The S&T councils were not typically actively involved in the public sector competitiveness groups, however in this respect Guanajuato stands out for the Council's very tight collaboration with economic development and a high level of linkage of relevant firms in most sectors in the state's regional networks (see later section on state S&T councils).

## Supporting sectors and clusters

### *Sectoral priorities common across many states*

Mexican states prioritise a series of sectors, often stated in their State Development Plans, however they tend to be broad and similar across most states (see Table 3.1). The popularity of certain sectors for regional plans is not unique to Mexico. Many OECD countries and regions seek to support the same sectors. For example, eight out of the nine English regions have given a priority to biotechnology or health sciences in their strategies. And while three-quarters of the US biotechnology industry is located in just five urban centres, 41 out of 50 US states have established significant funding programmes to spur development of the life sciences industry (Cortright and Mayer, 2002).

The criteria for state selection of these prioritised sectors appears to be a mix of those with the largest employment and in some cases a "strategic" higher-technology sector. Across OECD countries, sectors could be selected for public support for a range of reasons (dynamic growing sectors, exposed sectors experiencing job losses, sectors of strategic importance for a key technology, existing comparative advantages, historic specialisation or sectors of social importance to respond to specific needs). However, the states generally did not appear to have clearly defined criteria or indicators for such selection. The state of Baja California, while not a case study state, is reported to have strong cluster strategy development and selection mechanisms.

The prioritisation of sectors is not necessarily consistent across different sets of actors at state level. For example, a state economic development secretariat may target one list while the same state's S&T Council may target another list. While complete coherence is not necessarily advisable, there is a need to look across different national and state efforts to support particular sectors generally, and the needs of individual clusters in particular.

The specificities of each state with respect to these common sectors merits greater clarification, as well as the potential links among the different specialisations in the same state. Again, this is a problem for many OECD regions in terms of establishing their position in global value chains (OECD, 2007k). Within the automotive sector, one of the priority sectors for many Mexican states, there are trends in other OECD regions to better define their specificities. In Mexico, Chihuahua has specialised in certain design processes (especially in software, electronic and electric devices for automobiles – based on Delphi's Design Centre in Ciudad Juarez) and Michoacan (taking advantages of its

varied climatic conditions) specialised in vehicle testing. The state of Queretaro has been strategically consolidating the aerospace sector (which could potentially become a cluster) around its international airport (the "aerospace park") supported by two large investments in the state by MNEs.

**Table 3.1. Prioritised sectors in participating states**

| | Ags | Chi | Coa | Col | Gto | Jal | Mex | Mich | NL | Pue | Qro | SLP | Tam | Yuc | Zac |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Automotive | √ | √ | √ | | √ | | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| IT/Software | √ | √ | √ | √ | √ | √[3] | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Electronics (consumer and other) | √ | √ | | | | | | | √ | | √ | √ | √ | √ | √ |
| Textiles / leather and footwear | √ | | √ | | √ | √ | √ | √ | | √ | | | | √ | |
| Aeronautic | | √ | √ | | √ | | √ | | √ | | √ | √ | √ | √ | |
| Agro industrial/ food and beverage | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | | √ | √ | √ | √ |
| Wood and furniture | √ | √ | | | | √ | | | | | | | | | |
| Chemicals and pharmaceuticals | | | | | | √ | √ | | | √ | | | | | |
| Maquila | | √ | √ | | | | | | | | | | √ | | |
| Nano-tech | | √ | | | √ | | | | √ | | | | | | |
| Bio-tech | | | √ | √ | √ | | | | √ | | | | | | |
| Energy; incl. renewable | | | | √ | √ | | | | | | | √ | | √ | |
| Metals-mechanics | | | √ | | | | √ | √ | | | | √ | | | |
| Mining | | √ | √ | | √ | | | | | | | | | | √ |
| Logistics (includes ports) | | | | √ | | | | √ | | | √ | √ | | √ | |
| Services[1] | | | | | | | | | √ | | | | | √ | √ |
| Other[2] | √ | √ | | | | √ | | | | √ | √ | √ | | √ | |

*Notes*: 1) Jalisco (services related to manufacturing, tourism, education, finance), Nuevo Leon (medical servcices), Puebla (tourism), San Luis Potosi (ecotourism), Yucatan (education, health, tourism), Zacatecas (tourism). 2) Aguascalientes (robotics, commerce, transport), Chihuahua (building materials), Guanajuato (crafts, construction), Jalisco (machinery and equipment, plastics, commerce), Puebla (dairy products), Queretaro (telecommunications), San Luis Potosi (plastics, steel), Yucatan (crafts), 3) Althought not listed in the state's development plan, Jalisco does priortise IT.

*Source:* State documents or state officials.

A number of OECD examples illustrate this niche development within their priority sectors. For example, as production has transitioned to other countries, Gothenburg (Sweden) has specialised in car safety and climate testing, while the region of Piedmont (Italy) has sought a niche with respect to IT in the automotive sector. Shanghai has successfully built up its position in global value chains in biopharmaceuticals, specifically as a research hub. Other regions in China may be more specialised in biopharma production (OECD, 2007k).

In Mexico, several of the participating states have shown a particular interest in becoming a logistics hub based on the importance of existing ports. Michoacan and Colima host two of the most important ports on the Pacific coast (Lazaro Cardenas and Manzanillo), naturally making them an entry and distribution point in the country. Local governments have centred part of their sectoral approach in becoming true logistic centres

and in that sense upgrading their capabilities to increase productivity. Similarly, Yucatan has progressively positioned itself as a logistics centre for the highly touristic southeast region, in which the state port of Progreso plays a pivotal role.

### *Cluster support: achieving critical mass*

#### *Overview*

The emphasis on sectors in the different state approaches is increasingly nuanced with the concept of clusters. Moving beyond a sector focus is vital for identifying niches, understanding the kinds of actors in the particular location, and providing more tailored policy support. The academic literature on clusters presumes that the agglomeration effects and linkages will increase the productivity of the firms in the cluster, levels of employment in the cluster, or both.

There are different definitions of clusters used across OECD countries (OECD, 2007a). They generally, but not always, imply a spatial dimension, as relational proximity is often supported by geographical proximity. Definitions of clusters have also expanded to include not only firms but other key actors that can support the cluster, including specialised service providers (for example, intellectual property attorneys) and knowledge generators (such as research centres and Higher Education Institutions). For example, Chihuahua is supporting a targeted cluster through research centres with the goal of becoming one of the national leaders in terms of nanotechnology (Box 3.1).

#### Box 3.1. **Supporting nanotechnology through knowledge generators**

Although nanotechnology is still an incipient sector in Mexico, several states mention it within the framework of their economic development strategies as a priority given observed global trends. Several have highlighted the magnitude of this industry in terms of potential revenues and its accelerated rate of growth in the first decade of the century. Chihuahua is one of the states that has put a stronger emphasis on the importance of developing capabilities that could allow for increased activity in nanotechnology. The state was recently selected as the location for CONACYT's Research Centre in Advanced Materials (CIMAV), the first national lab for nanotechnology. The state of Chihuahua also created a Centre for Research in Applied S&T located within the Autonomous University of Ciudad Juarez. This centre was created with the objective of promoting development, innovations and transfers of advanced technology of Microsystems (MEMS) for this industry through the promotion of R&D projects that may help upgrade the region's industry and technology level.

*Source*: Based on information from the state of Chihuahua.

Some caution should be used with respect to the trend of *clusterización* in Mexico. A certain degree of duplication across states is inevitable; however the economic costs of the competing strategies could be monitored. If only the leading states in any particular sector are supported and reinforced with national funding flows, it is of course more difficult for certain lesser developed states to take risks that could change the path dependency of their regional trajectories. The term *clusterización* used by many states implies that there is a belief that clusters can be created by policy when critical mass does not already exist. There is a caution to supporting so-called "wishful thinking" clusters given the greater potential for inefficiency of public investment.

The lack of critical mass among many "clusters" that the states seek to support could be solved in part by creating a stronger links across states. In some states, a handful of firms or the presence of one large firm with a few suppliers was deemed a cluster by the state. There are a range of cluster footprints, and in many cases they crossed state lines. However, cluster support often did not seek to take into account these naturally occurring linkages. For example, one state had a number of suppliers to a neighbouring state's OEM (original equipment manufacturer). The state's strategy was not to build stronger linkages but rather to attract its own OEM. In addition, greater inter-state collaboration could help achieve economies of scope and scale.

Like at the national level, FDI attraction is at the top of state agendas and is seen as a key element for triggering economic development and creating jobs. However, there are some challenges related to FDI in Mexico: first, for many states, the flows of FDI are relatively small as a percentage of their economies and second, there seem to be insufficient science and technology spillovers from FDI firms (see Chapter 1). An additional problem seems to be a national framework that does not prevent or take into account regional flows, nor the "race to the bottom" approach undertaken by states (see Chapter 2). Furthermore, half or more of FDI flows in Mexico is not new investment but rather reinvested earnings and intra-company loans (OECD, 2007p).

In addition to (and in support of) FDI attraction, states may use a wide range of cluster development instruments:

- ***Engaging actors:*** this may include mapping/benchmarking analyzes, the use of brokers, incentives for firm networking, cluster awareness-raising events, and support of cluster initiatives.
- ***SME support:*** instruments may be targeted towards business development, supplier development and supply chain linkages, export networks, market intelligence, and technical standards/ISO certification support.
- ***Skilled labour force:*** often the development of a skilled labour force to meet cluster needs is supported by labour market information, specialised vocational and university training, and policies to attract students.

### *Engaging actors*

One of the first steps to supporting clusters is of course to identify that one exists. There are examples across the states to go beyond a basic sectoral analysis. A few states have engaged in cluster mapping studies. They are typically in the form of location quotient analysis (whether there is a disproportionate share of employment in one geographic region relative to a larger area like the nation). Puebla and Coahuila commissioned cluster studies performed by local consultants. Chihuahua's state government uses location quotient analysis by detailed industrial code, including by sub-region within the state. It is important to note that these kinds of mappings based on location quotients only indicate the potential for a cluster. The presence of a large number of firms in the same sector does not necessarily indicate that there are active links among the different firms and specialised service providers.[1] The diagnostic studies done by Jalisco and Guanajuato in the early 2000s to assess technological capabilities helped to identify the industrial-innovation potential, even if they were not specific cluster studies.

This regional/sectoral analysis to understand clusters is even more important in states that are polycentric. Many states participating in this review have a disproportionate share of economic activity centred around one core metropolitan area, such as Aguascalientes,

Nuevo Leon, Puebla and Queretaro. Other states have multiple economic hubs: Coahuila has three clear urban growth centres, Guanajuato six industrial districts, and there are several hubs in Tamaulipas and the state of Mexico. Jalisco, albeit with one clear leading metropolitan region around Guadalajara, has also encouraged the development of regional-sectoral plans to account for the specificities of different sub-regions within the state.

Zacatecas has taken an interesting approach that goes beyond a basic cluster mapping to make this information interactive. The state has created a type of "economic Google" which will be made publicly available. They have been mapping clusters and productive value chains within the state. They have also tried to gather information on different financing sources of benefit to the mapped clusters and value chains. While Zacatecas is one of the lesser developed participating states, it has taken this creative approach to increasing transparency on its clusters and the resources that could support them, while decreasing transaction costs for firms and other users.

Cluster initiatives are one vehicle for promoting greater interaction among relevant stakeholders and to better identify possible public and private action to support the cluster. Many OECD regions have supported the development of cluster initiatives through policy. Several OECD cluster programmes involve two phases of possible funding: one to put together a cluster initiative and a second to fund common projects. One of the main challenges for public support of cluster initiatives is the cultivation of sufficient private sector leadership so as to have an appropriate public sector support exit strategy. Studies of cluster initiatives have shown that those with a private sector leadership tend to be the most successful (Sölvell *et al.*, 2003).

Several Mexican states have recently begun encouraging the development of cluster initiatives. There are already examples of different business chambers, some with branches in different states throughout the country. For example, the state of Nuevo Leon has constituted civil councils in three of its eight strategic sectors (IT, automotive and specialised medical services) that include the participation of both HEIs and private firms. Three additional civil associations are in process (nanotechnology, biotechnology and consumer electronics). These cluster initiatives (such as in the IT industry) have performed an assessment of their needs to remain competitive and have developed a list of action items for the cluster. In Aguascalientes, a number of cluster initiatives have been created; they are recognised by the public sector and are currently co-ordinated by the state's Institute for Competitiveness.

The public sector can better orient its policies to address cluster needs, when there is a justified role for public action, through clear communications with cluster initiatives. Guanajuato, for example, has civil servants assigned to each of the targeted clusters. One interesting international example from the Basque Country (Spain) reveals an innovative way of not only supporting existing cluster initiatives, but also the common needs across cluster initiatives to ensure a transversal cluster approach (see Box 3.2).

One opportunity for firms organised in a cluster initiative is that they can then obtain adapted technical services. Furthermore, there is a need to develop intermediaries that can provide such quality services to meet firm demand. By providing technological services that are needed by member firms, such institutions can become self-sustainable. The cluster initiatives in Aguascalientes, for example, are seeking such a model.

### Box 3.2. **Basque Country (Spain) cluster support**

The Basque Country Competitiveness Programme offered a new approach to be used as a part of the region's industrial policy. It nevertheless was built on a prior tradition of firm co-operation. The region had already developed an infrastructure of sectoral support mechanisms through technology and business support centres. The idea for the explicit cluster approach came from a contact between a high level official in the Basque Government and Michael Porter. A 1991 study on the region's competitiveness issues included a statistical analysis and other competitiveness analysis criteria to select target clusters. The study prompted a public/private debate that led to the programme.

The Competitiveness Programme falls under the region's Department of Industry, Commerce and Tourism. A team of civil servants across different Divisions serve as liaisons with the cluster initiatives. Their duties are conceived in the context of an organisational matrix. They ensure that all the meetings of a cluster are attended by the same person, and that all the meetings on a particular horizontal common theme across clusters are attended by the same person (internationalisation, technology and quality/excellence in management). As a result, there is very active contact between the cluster initiatives and civil servants. While the Competitiveness Programme remains only one component of the industrial policy, it is thought to cover 80% of manufacturing GDP and 30-40% of overall GDP for region. The goal for the programme is to go deeper and wider by working with a few more clusters and strengthening the relationships with (and within) each cluster.

*Source*: OECD (2007), *Competitive Regional Clusters, National Policy Approaches*, OECD Publishing, Paris.

### *SME support*

As many of the cluster initiatives described above are focused on the model of a well known multinational anchor firm and suppliers, there is perhaps insufficient attention to incorporating SMEs into basic networks. This is even more important in some of the lesser developed states in Mexico. Denmark's network programme had an active approach to recruiting and training facilitators that was replicated around the world. The Danish programme trained brokers, including the development of a broker certification system, as well as used other "scouts" to identify opportunities for joint activities (see Box 3.3). Many US states replicated this approach in the early 1990s, especially for rural areas, in states such as North Carolina, Arkansas and Oregon (Rosenfeld, 2001). The concept of facilitator training and certification continues to be used today, including in the latest Oregon programme and the Czech Klastry programme (OECD, 2007a).

All states have programmes to support the development of SMEs generally, and some of these have a technology upgrade or cluster integration focus. Many of the state programmes are based on funding and guidelines from the national SME Fund (see Chapter 2) and PROSOFT in the case of firms related to the IT/software sector. While many of these programmes are generic business support, there are some interesting experiments at the state level either managed by the state itself or through an intermediary.

### Box 3.3. **Denmark's Network Programme: brokers and scouts**

Denmark's programme offered monetary incentives to promote co-operation among firms. Groups of at least three independent firms that sought to commit themselves contractually to a long-term relationship. Grants were provided for three different phases of network creation: feasibility studies to evaluate the potential for co-operation, planning grants to prepare an action plan or budget for a network, and start-up grants for operational costs in the first year.

**Network "brokers":** The Network broker was the key to the programme, serving as external facilitator, or systems integrator for network functions. In some instances, the brokers were consultants expecting to earn a living in this role but, in most cases, brokers worked for agencies that already served small and medium-sized enterprises (SMEs). Because the idea of working with groups of firms was uncommon, Denmark designed a training and certification program.

**Network multipliers:** These are people intimately familiar with the companies and able to detect and assess opportunities for collaboration that can be passed on to brokers. Sometimes referred to as "scouts," they include staff of chambers of commerce, trade associations, banks, accounting firms, law offices, trade centres, technical colleges, and technology extension services that serve SMEs.

**Incentives for rural networks:** Denmark offered sequenced incentives to compensate small firms for some of the costs of participating in activities with uncertain returns. The Danish program was based on the US Small Business Innovation Research program, with small 100% concept grants (up to USD 10 000), larger planning grants (up to USD 50 000), and larger still implementation grants (up to USD 500 000).

**Information campaigns:** Denmark also distributed information widely through the media, brochures, and newsletters on the potential value of networks and funding opportunities. They used distribution venues ranging from conferences to pubs.

**Institutional hubs:** This was not part of Denmark's official program but was part of those of most of its imitators. The sector centres in Emilia-Romagna (Italy) were viewed as essential parts of its co-operative structure, therefore many regions used specialised technical institutes, research centres, and councils for network formation and services.

*Source*: Rosenfeld, Stuart (2001) "Networks and Clusters: The Yin and Yang of Rural Development" in the conference proceedings *Exploring Policy Options for a New Rural America*, (Kansas City, Missouri: Federal Reserve Bank of Kansas City) pp. 103-120.

Basic SME support is not the focus of this study, however efforts to develop one-stop shops for SME support deserve attention. One national initiative to facilitate firm openings, SARE (by its Spanish acronym), seeks to reduce the regulatory burden for firms across the three levels of government. Beyond firm start-ups, states are trying to facilitate firm access to different public programmes given the complicated landscape with programmes provided for different services across multiple levels of government.

A number of state examples illustrate interesting approaches to SME support broadly. Michoacan, for example, has taken several initiatives to facilitate the environment for SMEs. The state has made one-stop shops a high priority, reflected by their high rankings in reducing firm-start burdens, and has developed an initiative to combine all the SME financing sources in the state into a common fund. Yucatan has also launched a clearinghouse entity that is seeking to serve as an information broker on the different publicly supported financing support programmes. Puebla's Institute for Productive

Competitiveness (IPPC for its Spanish acronym), whose board includes HEIs, members of the private sector and unions, has designed a programme to support SMEs that seeks to identify on a case-by-case basis factors that would have the most impact in such firms. An interesting approach of this programme is that it sets the clear objective of increasing the size of firms within a specific timeframe (*i.e.*, a small firm to become a medium-sized firm within two years) while having a control group of firms, facilitating periodic evaluations.

Supplier development is vital for Mexico as the local content of products is much lower than it could be, leaving many under-exploited opportunities for domestic SMEs. A national SME Fund strategic area is supplier development. A number of states have programmes of varying degrees of intensity for supplier development. Some states have followed international models, such as those proposed by the UNDP, which are often based on anchor firms.

At a minimum, states can develop registries of potential suppliers. At times it can be easier via internet to find a supplier outside of Mexico, even as far away as China, than inside of Mexico. Therefore, the development of state level registries, while valuable to public officials for FDI attraction strategies, could also be of general benefit to other firms and other states when considering where complementarities may exist. For example, Nuevo Leon developed a registry entitled Supply Hub. Similarly, Queretaro has developed a database by economic sector as a way to attract firms based on existing suppliers in the state. This online tool shows for each sector in the state the name of potential suppliers as well as their capabilities and their production processes. The challenge with such registries is that they are state specific and therefore when suppliers are working with purchasers in another state, which is frequently the case, the registries are less responsive.

Perhaps the most intensive form of supplier development programme was observed in San Luis Potosi. The Programme for Supplier Development to Large Industry (PDP for its Spanish acronym) works with a very limited number of firms. An intensive advisory service and support of these firms results in a very high per-firm investment for a limited number of firms (*Fundación IDEA*, 2007.) The aforementioned Supply Hub programme in Nuevo Leon is another example of a policy aimed at integrating SMEs into both domestic and global value chains. This programme links larger firms in the state with potential suppliers (registered in the Supply Hub) which could satisfy their specified needs. Chihuahua also has an important Centre for Supplier Development (CEDEP for its Spanish acronym), which seeks to achieve greater integration among local and national suppliers with the *maquiladora* industry through three strategic lines of action: a competitiveness intelligence department, a virtual business centre and a programme to promote entrepreneurs.

Efforts to support ISO certifications, bar code registrations and other standards could receive greater attention within the states. Furthermore, such certifications reinforce technical upgrading within the firms. They also increase their potential business supplier base, both domestic and international. Several states mentioned programmes along these lines, although they appear to receive perhaps insufficient attention in the general offer of SME-related services. There are also business chambers, such as CANACINTRA, that are supporting firm certification efforts. Some of the challenges for certification are that the cost is very high for the firm, and yet sometimes the payoff for higher quality is not recognised by purchasers who may still, in some fields, prefer the lower cost uncertified provider. The use of basic technologies, notably IT related, is also another minimum

technology support for the least developed firms. The state of Aguascalientes has an innovation support programme for SMEs (see Box 3.4).

### Box 3.4. **The Aguascalientes Innova Programme**

The main objectives of Aguascalientes Innova are: *i*) to develop innovation projects for participating SMEs; *ii*) to increase the chances of a higher income level among the owners of the participating firms and their employees; and *iii*) to develop a general awareness of the impact that innovation poses in a globalised business environment. The programme (currently in its pilot stage) has served 39 local SMEs and trained approximately 700 people on innovation. The programme is subsidised by the state's S&T Council. An outside contractor, iNovel Consulting, selects SMEs and invites their CEOs to trainings. The programme has triggered awareness of the impact of innovation within the small business community. Several firms have already developed, selected, and task-scheduled their own innovation projects. The programme rests upon three pillars: *i*) a methodology where SMEs can develop high-impact innovations; *ii*) a vision to select and pick the right innovative ideas among the many posted by participants; and *iii*) a task-scheduled process about the strategic sequence of activities of the implementation and launching of the innovation projects. So far, the firms are innovating in new product development, new business models, and technological and processes-upgradings. The programme has begun to raise awareness among SMEs about the fact that firm competitiveness is not only a question of costs, but often a matter of product differentiation and reinvention. *i.e.,* the kind of competitiveness that is sustainable over time.

*Source*: *www.innovacionregional.com.*

Several states have initiatied interesting programmes for certification, registrations and related instruments. In addition to financing intellectual property registration, as is done in other states such as Aguascalientes and the State of Mexico (see later section on science and technology), Zacatecas is helping to finance the registration of bar codes. For a firm wanting to sell to a large purchaser, whether domestic or international, this bar code registration is often necessary and can immediately open a much wider market to which micro enterprises and SMEs may sell their products. The state encourages the development of nutritional value labels required on many food products for wider distribution. The state also supports certification processes. One of the programmes is targeted at the mezcal sector whereby the programme helps finance the advisory services and process to get certified and the firm pays the certification registration.[2] In Michoacan, the office CEXPORTA (an export promotion bureau) helps SMEs to export Mexican food products to the Hispanic community in the US. The bureau funds the package design, labels and sanitary certifications, among other export support needs.

Another strategy that supports both niche strengths and is a form of intellectual property, is the support of recognised regional labels and branding for food products. This strategy can be used in any state, regardless of its level of development. In Yucatan, such initiatives have been observed for the habanero pepper and octopus sectors. In Zacatecas, there is a similar initiative with mezcal producers. In Michoacan, this was observed with several regional products making the state one of the national leaders in this type of registration. In Colima, a niche strategy for economic development is related to its lime production.

### *Specialised labour supply*

Similar to national level policy, state level higher education policy is limited in its mandate or actions to promote a specialised labour supply to meet local industrial needs. There are certain types of higher education institutions that are more closely linked to labour market needs given their mission and operating methods (see Table 2.11, Chapter 2). For example, the technological institutes and universities are both designed to have active engagement with the local industrial base to meet labour demands with student placement in firms as an integral part of the curriculum. Private sector universities that receive their funding mainly by tuition revenues must prove the relevance of their curriculum for graduate placement in order to attract students.

A State Commission for Higher Education Planning (COEPES) is the main state level entity to promote the regional engagement of HEIs. In existence since 1979, these councils were reinvigorated through reforms in 1997 to improve their performance, albeit not all states have a functioning commission (OECD, 2007e). They are charged with the task of ensuring that the range of HEIs in a state take into account the different lines embedded in the state's development plans and that there is some systematic revision of the curriculum. Membership includes representatives of different types of HEIs, as well as firms and other social partners. The focus of the committees is on the educational demand needs of the state broadly, but tends to be more labour market focused. Aguascalientes is an example in which the state government has taken an active role in better linking labour supply and demand. The state constituted a special committee to identify labour market needs and define priorities in terms of human capital formation, working together with different industry chambers to define regional needs in terms of HEI graduates.

State level labour ministries are also involved in ensuring an appropriate labour supply, but generally for relatively lower skilled qualifications. They tend to focus much more on basic level training for individuals not destined for higher education. They target the unemployed population and provide training on specific basic competencies in certain professions or trainings tailored to the needs of local firms. They also implement a national training programme that targets vocational training and high-school level programmes.

One of the often cited challenges across the participating states is the insufficient labour supply with technical skills. Statistics in most states reveal a cultural trend in Mexico whereby students favour law, business and social science curriculum. There are a few states that have achieved a higher rate of student enrolment in technology, engineering and science relative to the national average, including Tamaulipas, Chihuahua, Coahuila and Queretaro. [3] The state of Chihuahua has recently established the Training Centre for High Technology (CENALTEC for its acronym in Spanish) providing training directly linked with local industry. This centre works through a reverse engineering method in which regional firms define human capital requirements. Through 2008 this institution had provided services to more than 3 000 workers in the two main cities in the state, including relevant certifications.

In terms of human capital requirements, some of the clusters at the state level have done a mapping of their labour supply needs. They have found that the largest gaps are not necessarily in the highest skilled labour, although it is frequently mentioned that the overall number of engineers tend to be a limitation. In Northern states, Jalisco, the State of Mexico and other states with a strong presence of multinationals or with strong presence of highly integrated global sectors, English language skills of the labour supply were also frequently mentioned.

Attracting and retaining high quality students and graduates is a challenge for the lesser developed states. For example, Colima's HEIs produce graduates in IT that find few job opportunities in the area and migrate to nearby Guadalajara. The state is now seeking to develop a firm base with jobs that will help retain these skilled graduates in the state. This net deficit of specialised human resources undermines the innovation potential of such states while making transition to a more knowledge-based economy even more difficult, reinforcing existing cleavages.

## State level actions to support regional innovation systems

The concept of a regional innovation system is not yet integrated into the policy approach of most participating states. However, there is an increasing desire to change from a "made in Mexico" to a "created in Mexico" approach. And several states are beginning to use terms found in other OECD countries, like the "triple helix" of industry, government and research/higher education. The *maquiladora* industry has gone through four different generations with an increasing innovation approach. However, many of the existing *maquilas* may still be trapped in the earlier generations implying a lower level of innovation capacity and potential spillovers.[4] While not a major world R&D centre hub, there are a several design centres in the country that states seek to attract and capitalise on in their innovation systems.

A focus on innovation and technology in SME programmes and other strategies is relatively new for most states, dating back no more than ten years. The relationships across firms, HEIs, and research centres have also evolved due to a number of systematic drivers at national level (see Chapter 2) and through different bottom-up initiatives from the states. Still, there is a broad consensus on the lack of a collaboration culture between knowledge generators and the private sector, and the need to build more communication channels and confidence on both sides.

Studies of regional innovation systems within Mexico are rare. There are state profiles produced by CONACYT that show state utilisation of their programmes ranging from scholarships to R&D tax credits, however this is more of a listing than an analysis. Many of the common problems for the national innovation system are observed across states including disincentives and cultural barriers for collaboration between firms and HEIs/PRCs (but with a positive trend) and a lack of intermediary institutions to support firm technology and research needs. An isolated example of a study of a particular dimension of the RIS approach was elaborated in San Luis Potosi where determinants, barriers and types of collaboration between firms and knowledge generators were mapped.

States are beginning to think in a systemic way about regional innovation systems and to encourage greater linkages across actors in the system. Coahuila mentions regional innovation systems in their Economic Development Secretary working plan. Yucatan's state government decreed a State System for Research, Innovation and Technological Development in June of 2008. Puebla has a similar approach of increasing linkages among members of the researcher community. And Guanajuato has a very thoughtful approach to supporting sectoral innovation networks within the state, including different RIS actors (see Box 3.5). In addition, other actors are seeking to strengthen regional innovation systems through joint action in several states, such as with the ARCO Alliance (see Box 3.6).

### Box 3.5. **Guanajuato Networks of Innovation**

The Networks of Innovation are a relatively low cost mechanism of promoting innovation that also has the virtue of linking actors, with government serving merely as a facilitator. The networks are constituted as groups of businessmen, academics and other researchers related to certain topics, economic activities or sectors. In place since 2005, the start-up of these networks (11 initially and now up to 15) is funded by the state government with a relatively small amount of resources (MXN 1 million approximately) through the state's S&T council. The idea is for these networks to be self-sustainable through joint or collaborative projects between industry and knowledge generators. In this sense, all projects originated in the network are required to have at least one partner from the private sector, but may be in either basic or applied science.

The sectors of the networks are defined by the state government. Researchers and firms in the sector (usually through their Chief Operations Officers) are called upon to participate and discuss potential problems and projects. If profitable collaboration is deemed possible, the network is constituted with a leader from the private sector. Within these networks, government is invited as an observer with the possibility of expressing opinions, showing the state's offer in terms of available programmes and making recommendations, but with no voting rights. After a one-time start-up grant, projects for the network are pursued and finalised through the network itself (both firms and researchers are members) which serves as a broker. The networks are constituted as civil associations and may seek researchers outside of their own network or even beyond state boundaries if specific knowledge needs are identified as unavailable. Most firms engaging in this kind of consortia are SMEs.

*Source*: Based on information from the state of Guanajuato, Secretary of Economic Development.

### Box 3.6. **Coalitions for regional innovation system support: ARCO**

ARCO is a non-incorporated alliance between three national organisations which share the mission of promoting a sustainable development for states and regions of Mexico through innovation. The aim of ARCO is to launch and strengthen as many regional innovation systems as possible. Participants in ARCO are: ADIAT (National Association of Directors on Applied Research and Technologies Development), REDNACECYT (National Network of State Councils and Organisations for Science and Technology) and COFUPRO (Co-ordinator of PRODUCE Foundations; these Foundations group most agro-related producers from every state in the country).

The specific mission of ARCO is to advise Mexican states and regions on the design and implementation of an RIS based on a guide Model which considers six core processes and four enabling processes plus a dedicated effort to trigger a major social change in the region. The six core processes are: Strategic Mapping, Strategy and Vision, Indicators and Goals, Brokers for Connectivity, Project Portfolio and Policies at all levels of government. The four enabling processes are Technology Transfer, Project Management, Governance Structures and Financial Structures. Workshops on major features of the ARCO Model have been carried out in six states from the end of 2007 through 2008 with participation of potential leaders of each state for the establishment of a RIS. States already covered include: San Luis Potosi, Guanajuato, Nayarit, Chiapas, Coahuila and Jalisco. Future projects with EU funds may seek to support projects in several states.

*Source:* Information provided by ARCO.

### *Science and technology plans*

While the states do not have a regional innovation strategy per se, many have a science and technology plan that is supported by an S&T council. As part of the 2001 national science and technology programme (PECYT), and to support S&T in different regions of the country, a system of state S&T councils was created. The role of the diverse S&T councils has been crucial not only for their contribution to the combined actions along with CONACYT, but also for the attainment of specific programs in such fields as scientific knowledge diffusion, awards to scientists, the development of links between universities and enterprises or the promotion of innovation by means of networks, consortia and clusters in strategic industries. The Law of S&T and other policy changes established the commitment of the states to elaborate their respective S&T laws and commissions, and to create S&T councils as well as develop S&T plans or programmes.

Not all the 32 states are equally advanced in the execution of their state level science and technology commitments. There are 30 laws and state councils, but only 18 S&T state plans. Marked inequalities are also manifested by the available budgetary amounts (in absolute values and as a percent of the economy), and therefore in the capacity to generate specific actions in favour of S&T&I or the ability to complement and co-fund national instruments and programmes. Some state Councils only implement programmes in co-ordination with CONAYCT, mainly the Mixed Funds (FOMIX) while others have been able to offer additional instruments to strengthen the state's scientific and innovation capabilities.

The framework for state level action is inscribed in each state's science and technology law, which varies from being a brief paragraph to several pages. The benefit of a more general text is that this leaves greater flexibility for policy initiatives, however that flexibility means that the long-term goals may not be supported with a government change. Even if a law exists with very specific goals, it may not be respected. For example, similarly to what happens at the national level, a state law may determine that there should be a certain percentage of expenditure relative to the size of the total economy (such as 1% of its GDP) in science and technology; however, if this goal is reached (or not), there are no accountability mechanisms.

Of the 15 participating states, nine have developed a formal S&T plan (see Table 3.2). The plans pick up, as a frame of reference, the structure of the federal law (PECYT). They start from the dictates of the S&T state law and from the considerations of the State Development Plan (PED for its Spanish acronym) regarding science, technology and innovation. In this context, the general structure of an S&T plan contains, more or less, the following common chapters: *i*) diagnosis or context; *ii*) vision, aims and objectives; *iii*) strategies and/or action lines; *iv*) specific instruments or programs; and v) operation, assessment, and monitoring. For the states without a plan, several are in progress.[5]

**Table 3.2. Elements of state S&T plans**

| | GJ | JAL | Mich. | Coah | Puebla | SLP | N Leon | Zac | Tamps |
|---|---|---|---|---|---|---|---|---|---|
| Year of Plan | 99 (1) 05 (2) | 01 (1) 08 (2) | 05 | 02 | 05 | 03 | 04 | 04 | 05 |
| Ex Ante Evaluation | | | | | | | | | |
| Productive activities | 1 | 1 | 1 | | | | 1 | | |
| Sectoral activities | 1 | 1 | 1 | | | | | | |
| Scientific capabilities | 1 | 1 | 1 | 1 | 1 | | 1 | | 1 |
| Vision, goals and objectives | | | | | | | | | |
| Scientific research | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Human Resources | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Technol. Development & innovation | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Science dissemination | 1 | 1 | | | | 1 | 1 | | |
| Science-Industry relations | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| International co-operation | | | | 1 | | 1 | | | |
| Solutions for State problems | 1 | 1 | 1 | 1 | 1 | | 1 | | 1 |
| Strateges and actions | | | | | | | | | |
| Support for Scientific research | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 |
| Support for Hum. Resources | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 |
| Support for Technol. Development & innovation | 1 | 1 | 1 | 1 | 1 | | 1 | | 1 |
| Suppport for Science dissemination | 1 | | 1 | 1 | | 1 | 1 | 1 | 1 |
| Support for Science-Industry relations | 1 | 1 | 1 | 1 | 1 | 1 | | | 1 |
| International co-op. agreements | | 1 | | | | | 1 | | |
| Solutions for state problems | 1 | 1 | 1 | 1 | 1 | 1 | | | 1 |
| Policy programmes and instruments | | | | | | | | | |
| Scientific research | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | |
| posgraduate progr. | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | |
| Technol. Development & innovation | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | |
| Dissemination of science | 1 | | | 1 | 1 | 1 | | 1 | |
| Science-Industry relations. | 1 | 1 | 1 | | 1 | | | 1 | |
| Internacional co-op. Agreements | | | | | | 1 | | 1 | |
| Solutions for state problems | 1 | 1 | 1 | 1 | 1 | | | | |
| Monitoring, evaluation of performance | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| Number of elements | 22 | 21 | 20 | 19 | 17 | 16 | 13 | 12 | 11 |

*Source:* Based on analysis by Villaviciencio *et al.* for the OECD.

Consistent with the tradition of different ministry or government-wide plans, the S&T plans tend to be more ideals or lists of action items rather than overall strategies. While the competitiveness visions appear to include an increasing participation of stakeholders in problem definition and solutions (see previous section), it is not clear that these more administratively produced S&T plans have prominence or wide stakeholder participation. Again, the process of defining a regional innovation strategy has been noted as being very important for the success of a region in adapting to global trends (Benneworth, 2007).

Observations regarding the overall plans include:

- ***The form (chapters and structure) is very similar among state level and federal plans***. This is explained by the characteristics of the federal and state S&T laws that define the frame of the activities and the areas of priority for S&T public policy. In the case of Guanajuato, Nuevo Leon or Jalisco, the state plans actually surpass the federal plan in the design of some instruments.

- ***Lack of coherence within a plan.*** Some of the plans show lack of coherence between priorities or detected problems, aims/strategies definition, programme design and, finally, their implementation. Either there are no programmes and instruments to address the stated problem or there are programmes that do not respond to a stated aim or strategy. Some plans do have a diagnosis and an orientation of instruments towards some or all of those priority sectors, such as in the plans of Jalisco, Guanajuato, Michoacan, Coahuila and Nuevo Leon.
- ***Challenges for continuity***. The uncertainty expressed by the six-year change of government, as well as the desire to change with every six-year development plan, have prevented the development of long term S&T public policies. The problem is exacerbated by the annual budget negotiation which can, in some circumstances, limit resources or cancel specific programmes.[6] In this sense, some states (Jalisco, Guanajuato and soon Michoacan) have updated their plans with the aim of improving previous instruments. The continuity of policies with the objective of contributing to the construction of S&T state systems in the medium and long term in these cases has shown positive results.
- ***Insufficient commitments to effect desired change.*** The resources and actions outlined in the plans usually fall far short of the stated goals. Some non-targeted actions are supported (such as scholarships to increase human capital) while others may be very specific, such as a one-time reward for industrial innovation. In some cases these programs replicate the federal ones, handled at a smaller scale (*i.e.*, fewer funds). In this sense, evaluations of these actions at national level are very important since the same types of programmes are often replicated at the state level. There is also a need for greater understanding with regards to the strategic, as opposed to generic, objectives for state S&T plans.
- ***Different areas of best practice noted across state plans.*** *Guanajuato's* plan, which has a long history, has a number of novel instruments in it relative to other states, including the creation of an energy information system, a state observatory and innovation networks related to strategic productive sectors. *Jalisco*'s plan is based on more sophisticated background research to diagnose the problem, including direct surveys to firms (the only participating state where this kind of research was performed, and based on Oslo Manual definitions). The plan includes some innovative institutions, like the Jalisco Institute for Information Technologies, the Jalisco Centre of Biotechnology and the programme PROVEMUS to encourage links between universities and firms. *Michoacan* has avoided the tendency to be too focused on "fashionable" high-tech industries and (beginning with a sectoral diagnosis) focuses on the benefits of science and technology for other areas like the environment and natural resources, as well as the diversification of existing traditional industries like foods and textiles.

Support for the effective development of state plans would be of benefit across Mexico. As discussed in Chapter 2, this is an issue that national governments within the OECD view as important. They are providing resources to support plan development, such as the national level initiatives in the UK and France for regional innovation system strategy support.

### *Science and technology councils: variations in models and budgets*

The prominence and effectiveness of the S&T councils varies widely across states, and is not always correlated with the state's level of development. A council's relative importance is the result of governance differences across states as well as the leadership of particular S&T council directors and other public officials. It is also strongly related to the focus of the S&T strategy and its linkages with the different business sectors. Budgetary considerations are also likely to be an important (but not exclusive) determinant.

There are a number of challenges for the councils from an operational standpoint. They tend to be very small in terms of staffing, often just a handful of individuals. In addition to small operating budgets, they also in most cases have small but usually increasing programme spending. As an order of magnitude, these budgets range from approximately MXN 10 million to over MXN 300 million (approx. USD 730 000 to 22 million). That upper bound is unusual, as most of the budgets are very low relative to the size of state economies and their needs. Furthermore, the mobility of government staff has implications for the stability of state councils. While some directors have gone beyond a six-year period (equivalent to the length of a governor's term) such as Jalisco or Guanajuato, others have changed during the last one, two or three years (Michoacan, Coahuila, Tamaulipas, Zacatecas) or in the extreme case, Aguascalientes, with four different directors since 2004.

The ministry or entity to which the S&T councils report (where they are "sectorised") can play a role in its perception within the state and the focus of the policies it will implement. While there are some associated with an education secretariat, there is a greater likelihood that those councils are more oriented to basic research and academic activities. Several other S&T councils report to an economic development secretariat. In general, those councils tend to be more oriented towards an industry linkage approach.

Some councils are now under the direct administration of a governor's office, hence gaining in terms of flexibility and autonomy. For example, the S&T council for the State of Mexico has been using this strategy of seeking to be "desectorised" to become more prominent in the state and leverage more funds. In recent years, the council's budget has quadrupled from approximately MXN 20 to 80 million (and final figures for 2008 are expected to be considerably larger). Guanajuato is one of the most active in terms of promoting science and technology as part of the state's economic development strategy, and its council is directly under the governor's office, giving it more flexibility and contributing to the state's disproportionately high share of resources from national S&T funds.

Colima and San Luis Potosi also illustrate how the S&T council can serve the needs across government sectors. Colima's S&T council is new but the approach within the state is interesting. The Governor asks all state-level ministries to submit their S&T needs and an accompanying budget such that the council has a list of priorities for projects in service of the state across different secretariats. All the different secretariats are on the board of the S&T council even if the operations of the council sit within the culture secretariat. In the case of San Luis Potosi, although the state council is formally under the education secretariat, several other secretariats of the state government (including economic development) are part of the council's board of directors.

## *State level science and technology programmes and federal programme use*

### *Building capacity and linkages*

States have taken very different strategies in terms of the kinds of programmes they have created. At a minimum, states implement the national FOMIX programme for research projects. In evaluations of that programme nationwide, it has been found that in some states this is the only S&T support programme. Other states have helped local firms, HEIs and PRCs access a wider range of national S&T programme funds. Above and beyond these national programmes, they have created new programmes themselves. State-initiated programmes include exchange visits and scholarships to visit foreign firms or study in foreign universities, support for intellectual property registration, technology transfer and innovation network support (including the creation of new intermediaries) and even technology parks.

Some state councils are trying to support an intellectual property culture. For example, the states of Mexico, Zacatecas, Tamaulipas, Guanajuato and Aguascalientes help finance patent searches and registrations. Many of the states co-ordinate with the regional offices of IMPI to further promote an intellectual property culture, and in some cases systematically disseminate information on intellectual property issues. Tamaulipas specificies in its S&T plan that a key objective is to promote intellectual property. The state has established a centre of advisory services for such purpose with the objective of increasing patents in the state. In addition to working with firms, states also need to consider greater efforts to work with HEIs on intellectual property issues.

The number of firms, HEIs and other actors that could potentially use national S&T funds is limited to those in the national S&T registry, RENIECYT. This has been noted as a barrier in particular for SMEs. States can therefore play an important role in increasing the number of potential national fund programme recipients by awareness raising and assistance to firms to increase the number of potential beneficiaries of national funds. For example, the state of Aguascalientes has a service to advise firms on registration in RENIECYT. Other states would also benefit from doing a similar programme.

For sustainability and to diversify the landscape of intermediaries, states can support the development of non-university research and technology institutes. For example, the Jalisco Institute for Information Technologies is a separate institution outside of the council to support initiatives in the IT sector. Guanajuato has created a state innovation observatory as well as innovation networks linked to the state's strategic sector priorities. A somewhat different but interesting programme is found in Queretaro developed by two external institutions (ADIAT and CIDESI) that trains firms in innovation processes, while also subsidising innovation seminars or granting financial resources for firms seeking to attend innovation-related events. [7] Spain has a long history of technology centres that play a vital role in different regional innovation systems (see Box 3.7).

### Box 3.7. **Spain's Technology Centres**

Technology Centres are private non-profit research bodies that use their own material and human resources to carry out activities both for generating technological knowledge and facilitating its exploitation, either by existing companies or by generating start-ups. They function as a support platform for companies, generating and facilitating the use of technological knowledge, providing local companies with research, development and innovation services. Their success is measured by the competitive improvement of companies and their contribution to the economic development of their environment. The important role played by these Centres in Spain as instruments for making new technologies available to SMEs was already highlighted in the *OECD Economic Surveys: Spain* (2007).

Founded in 1996, Fedit is the Spanish Federation representing Technology Centres. The Federation is composed up of 67 Technology Centres, with a total workforce of more than 5 500 and providing services for around 30 000 companies a year. These figures make Fedit one of the most active agents in the Spanish Innovation System.

The Ministry of Industry, Tourism and Trade recognises Fedit as an expert body in R&D and innovation, and as a privileged partner in the Spanish Innovation System. This involves participation in the industrial observatories, in which Fedit working groups take an active part. At the same time Fedit belongs to a number of international associations and bodies in which it represents the interests of Spanish Technology Centres. Among them, it is part of the Executive Committee of the European Association of Research and Technology Organisations (EARTO), and it is also a founding member of the Executive Committee of the International Network for Small and Medium-Sized Enterprises (INSME).

The combined revenue of Fedit Technology Centres in 2007 totalled EUR 520 million. This was a 19% increase over 2006, which in turn was 20% higher than 2005. Technology Centres have doubled their revenue in the last five years. The main activity is R&D projects, accounting for EUR 340 million in 2007, half of which were in-house projects and the other half were contract projects for more than 3 400 customer companies. Next were technology services, with around EUR 112 million, followed by training and diffusion activities, totalling EUR 39 million. Another interesting outcome of Fedit is the creation of new technology-based companies, at a rate of about 20 per year.

The current funding of the activities of Fedit is 57% private, via contracts and fees of the associated companies, and the remaining 43% public: 26% from local and regional administrations, 11% from the Spanish government and 6% from abroad (mainly EU funds).

*Source: www.fedit.es.*

## *Technology parks*

Across OECD regions, there has been a long history of the development of technology and science parks. Unlike a basic industrial park, which has more of a spatial planning and infrastructure focus, these other types of parks imply the presence of research facilities (including specialised research centres and HEIs) or other service providers that could be accessed by firms. In many cases, science parks are co-located with a university. The results of these projects, which often involve significant infrastructure investments (buildings, IT and other technology-related investments) are mixed across OECD regions (OECD, 2005a). For example, it took the now successful Sophia Antipolis technology park in southern France many years to be fully operational

as a technology park. In its early stages, it was merely a location for several multinational firm offices.

A notable trend among strategic state projects to support their RIS is the development of technology parks. The Ministry of Economy announced in 2007 it planned to invest MXN 240 million (MXN 140 million for infrastructure and MXN 100 million to support firms being established within the park) in funds aimed at building some 33 technology parks. These parks seek to set the conditions for firm development in a context of better technology infrastructure, while bringing together HEIs, PRCs, and firms. Many of these parks are expected to house business accelerators and incubators that can support high-growth SMEs and start-up firms. ITESM is a private university that has played an active role in the development of the concept in Mexico, while participating in great number of these projects through their campuses in different states. One of the most prominent examples is the PIIT in Nuevo Leon that is part of the City of Knowledge initiative (see Box 3.8). Many other states are now trying to replicate the concept. One of the challenges in ensuring the success of these massive investments to support regional innovation systems is the potential lack of focus and specialisation of the park.

### Box 3.8. **Monterrey International City of Knowledge and the PIIT**

Since 2004, the state government in Nuevo Leon set as one of its main pillars for economic development the strategic project Monterrey International City of Knowledge, which is based on an alliance between government, HEIs and industry to promote growth through innovation. Some of the first initiatives undertaken were bringing the Universal Forum of Cultures to Monterrey and the creation of the Institute for Innovation and Technological Transfer (I2T2). In the beginning, the project followed some basic strategies which included revising educational contents and methods, the incorporation of technology specialists for industry, increasing the number of researchers and PRCs, promoting business incubators, and strengthening the city's infrastructure. To make the alliance stronger, several clusters were initiated in sectors including auto, IT, medical services, life sciences, agro, nanotech and biotech, accompanied by Centres for Innovation and Intellectual Capital by sector. For the creation of new enterprises, the government launched the programme INVITE in 2005 helping researchers and local entrepreneurs license and register their knowledge while promoting the creation of new knowledge-based firms. Additionally the I2T2 started two funds with seed money and resources from private investors to help firm start-ups as well as high-growth SMEs.

In order to further enhance the RIS (predominantly centred around its main city Monterrey), the state invested in the Research and Innovation Technology Park (PIIT). The objective of the park is to strengthen innovation endeavours and technological developments while facilitating technology transfers to the private sector. The park hosts HEIs and specialised business incubators as well as public and private research centres. For this purpose, the state government invested USD 90 million, providing land and other needed infrastructure, reserving the majority of the space for firms and knowledge generators.

*Source* : Information provided by the state of Nuevo Leon.

### *Capitalising on higher education institutions*

HEIs play several important roles in regional innovation systems. In addition to developing a specialised labour supply to meet regional needs (see previous section), HEIs can be the source of potentially commercialiseable research and provide a range of services to firms including contract research or consulting (see Chapter 2). Additionally,

they may engage with firms in joint projects or be the source of new SMEs through business incubators. There are numerous examples across the states of HEI involvement in incipient regional innovation systems through different forms of support (see Box 3.9).

### Box 3.9. **Higher education institution engagement: examples**

The following examples show that local conditions and differing funding sources have been driving factors in the establishment and development of linkages between universities and firms while underpinning the different regional innovation systems. Cultural problems nevertheless remain and confidence by the private sector is still deemed insufficient.

In **Puebla**, the presence of subsidiaries of multinational firms and competitive domestic firms has increased the demand for highly trained personnel thus making the provision of training among local private universities highly profitable. Selling services through industrial liaison offices has not only been a source of income but has also contributed to establishing a pool of business consultant experts and developing an entrepreneurial attitude among universities. The *Benemerita Universidad Autonoma de Puebla* (BUAP) now has a liaison office (*vinculation* department), but most of the research contracts with the business sector have been signed with large and often public companies such as PEMEX. UAP received the national award for university-industry linkages. It has launched an entrepreneurship program and provides services to companies all over Mexico (reflected in the BUAP *mapa de servicios*). The Technological University of Puebla (TUP) performs audits on companies upon demand from the private sector including Volkswagen. Some universities have a regional vision (UPAEP) but they do not collaborate with other HEIs. Some have alumni programmes but their main focus is business incubation (30 companies in the TUP incubator).

In **Tamaulipas**, UAT (*Universidad Autonoma de Tamaulipas*) devotes 12 to 15% of its budget to technological development. Collaboration with business is in general limited, but the situation is changing. For example the *Instituto Nacional Polytechnico* (INP) has signed 168 *convenios* with firms (mainly heavy industries). In private universities, the possibility to link with business for students is greater (85% are involved at one level or another with firms). 32% of students enrolled in HEIs are born in the state. INP is looking for highly skilled researchers and encourages professors to follow education programs in other states. In Tamaulipas, universities are not allowed to patent research result for their own benefit, thus providing an incentive for researchers to patent their own work. But infrastructure for research is lacking.

*Source*: Alliance for International Higher Education Policy studies (2005), *Determinants of University-Industry Collaboration: the Cases of Four States in Mexico*, AIHEPS Research Study. http://steinhardt.nyu.edu/iesp.olde/aiheps/downloads/finalreports/June%202005/University-Industry%20Collaboration%20(Mexico).pdf and OECD.

With a lack of a national intellectual property culture, HEIs in Mexico need support in this respect and states can play an active role. As the skills to identify commercialisation opportunities for HEI-generated research are generally lacking, and not always available within a given HEI, there is an even greater need for capacity building support. There are also economies of scale to supporting several higher education institutions in the same region in their efforts to increase commercialisation prospects. For example, in the four provinces of Atlantic Canada, the national government through the regional development agency has supported the creation of Springboard Atlantic as a vehicle for improving the quality of such offices and their effectiveness with respect to intellectual property in member HEIs. In the trans-national (Denmark and Sweden) Øresund Science region, the universities are linked in a joint network with a range of different cluster-specific platforms (see Box 3.10).

### Box 3.10. **Networks across HEIs to support commercialisation**

Established in 2004, ***Springboard Atlantic Inc.*** is a network of university technology transfer/industrial liaison offices that supports the commercialisation of university research in Atlantic Canada. Fourteen universities and the four provincial community colleges comprise the nework. It is funded by the national government via the Regional Development Agency (Atlantic Canada Opportunities Agency) and its Atlantic Innovation Fund, the Natural Sciences and Engineering Research Council's Intellectual Property Mobilisation (IPM) Programme, and the member higher education institutions.

The network offers services and resources to its member universities including; *i*) delivering educational programmes (*e.g.,* on intellectual property); *ii*) hosting network events for researchers and business people; *iii*) facilitating industry sponsored research; *iv*) assessing discoveries; and *v*) developing proof of concept projects marketing technologies. Springboard's *Interns in Innovation* training program provides professional development, mentoring and job shadowing opportunities for new and existing staff in members' technology commercialisation offices. The programme seeks to create an unprecedented cohort of highly qualified technology professionals who can accelerate innovation and commercialisation in the Atlantic region.

The ***Øresund Science Region*** is a platform that seeks to link 14 higher education institutions which participate in the cross-national Øresund University. There are nine networks or platforms linked to specific industry/service areas spread across two countries (Denmark and Sweden).* The platforms are thus organised around core competencies in the region. Each platform has built a database of the relevant regional businesses and organisations into its respective core competences, which creates the possibility of directing specific knowledge streams from HEIs to the targeted areas of development. For example, Diginet Øresund, Øresund food network and Øresund IT academy are key sector areas for generating regional development outcomes as they are mainly made up of small firms. Having different platforms under the umbrella of one single organisation also increases potential benefits from the economies of scale and scope. Learning advantages and cross fertilisation between different platforms of the Øresund Science Region can be exploited. For example the Øresund Food Network is linked to the Medicon Valley platform and the Diginet Øresund to the Øresund IT Academy.

*Øresund Science Region Platforms: Medicon Valley Academy, Øresund IT Academy, Øresund Environment Academy, Øresund Design, Øresund Logistics, Øresund Food Network, Diginet Øresund, Nano Øresund, The Humanities Platform.

*Source*: *www.springboardatlantic.ca*; OECD (2007), *Higher Education and Regions: Globally Competitive, Locally Engaged*, OECD Publishing, Paris.

## *Use of national S&T programmes*

Given the lack of data at sub-national level, one area for analysis with respect to state access to innovation resources is the utilisation of national innovation/technology and scientific research programmes. As eligibility for receiving national S&T funds from CONACYT is restricted to actors who are in the national registry RENIECYT, the number of firms or other institutions registered serves in part as a proxy for potential capacity to absorb federal funds. However, it does not necessarily represent true state capacity. As discussed in Chapter 1, the state receipt of national programme funds illustrates that some states benefit from a greater share of public funds relative to their GDP (even if overall levels are universally low). Such states include Guanajuato, Zacatecas or even Chiapas. Several of the largest states access a much lower share as a percent of their GDP, in part given their much larger GDP (see Figure 1.34, Chapter 1).

With respect to participation in innovation and technological development programmes and incentives, the most active states are among those with a strong and highly developed industrial base (Table 3.3). Among the most prominent are Nuevo Leon and Jalisco. Some important industrial states might not benefit from as many projects due to a lack of mobilisation for capturing national resources as opposed to a lack of capacity per se, such as the state of Chihuahua. The average project size per fund per state was not readily available for a finer analysis of programme utilisation. Project sizes vary considerably based on the purpose and industrial branch, ranging from USD 10 000 to USD 2 million with a maximum 50% co-financing from CONACYT.

Different states have shown greater success in capturing scientific research funds (Table 3.4). Some states have a higher number of research centres and higher education institutions in the RENIECYT, implying a greater stock of such reources and greater mobilisation of knowledge generators. Some states have a long history of using national programmes. Tamaulipas has had a large number of project calls for its state S&T fund through FOMIX, due in part to the longer programme history. While again, further information on per project size would add greater clarification, some general conclusions may be derived from this data:

- ***Use of national programmes is not always correlated with the scientific capacity*** of a state (as defined by the number of CONACYT eligible entities registered in the RENIECYT, the number of high quality advanced degree programmes, or the number of nationally accredited researchers). There are also examples of states that outperform with respect to the fundamental research fund even if there is lower scientific capacity per these variables. However with such low levels of national funding and minimal, if any, state-level funded programmes, it is essential to promote within the scientific community a larger participation in the federal programmes that finance scientific and technological activities. Potential for scientific research is undervalued in several states that appear to have resources but are accessing fewer projects.
- ***For FOMIX, the number of projects is more related to administrative issues.*** Looking at the projects financed from FOMIX outside of the industrial development category, those states with the greatest number of projects had organised more calls for proposals. Again, performance is not necessarily linked with capacity in terms of scientific resources. Some states have put a greater share of FOMIX towards industrial development projects rather than basic research.
- ***There are 14 sectoral funds, some accessed by only a few states,*** but open to a wider range of actors than the RENEICYT registry. For agriculture, low levels are observed even in states with a strong agricultural vocation. Agriculture is an area that could benefit from a regional innovation system but is not usually recognised or included in competitiveness strategies to the same degree.

**Table 3.3. State participation in select innovation and technological development programmes**

| | Number | | | Granted projects | | | | |
|---|---|---|---|---|---|---|---|---|
| State | RENIECYT[1] # of firms / total registered | CONACYT public research centers[2] | *Estímulos Fiscales* (R&D tax credit) (2001-2006)[3] | Avance (2003-2006) | *Fondo Economia*[4] (2002-2006) | *Fondo Innovación* (2007-2008) | FOMIX (2002-2006)[5] (Industrial development area) | PROSOFT (2004-2008) |
| Aguascalientes | 53 / 78 | 2 | 33 | 1 | 10 | 1 | 38 | 42 |
| Chihuahua | 127 / 171 | 4 | 68 | 7 | 5 | 7 | 3 | 12 |
| Coahuila | 123/ 164 | 2 | 71 | 8 | 10 | 8 | 65 | 39 |
| Colima | 19 / 26 | 0 | 4 | 0 | 9 | 0 | 0 | 30 |
| Mexico | 264 / 356 | 0 | 189 | 18 | 26 | 9 | 3 | 9 |
| Guanajuato | 329 / 425 | 3 | 84 | 8 | 32 | 4 | 55 | 31 |
| Jalisco | 345 / 424 | 2 | 269 | 19 | 56 | 15 | 25 | 200 |
| Michoacan | 84 / 109 | 1 | 19 | 0 | 0 | 4 | 2 | 7 |
| Nuevo Leon | 343 / 386 | 0 | 348 | 16 | 45 | 19 | 57 | 197 |
| Puebla | 86 / 136 | 1 | 44 | 2 | 9 | 5 | 54 | 52 |
| Queretaro | 81 / 116 | 3 | 87 | 11 | 25 | 2 | 24 | 48 |
| San Luis Potosi | 54 / 67 | 3 | 26 | 1 | 1 | 1 | 95 | 2 |
| Tamaulipas | 47 / 77 | 0 | 29 | 0 | 1 | 1 | 3 | 33 |
| Yucatan | 26 / 59 | 2 | 7 | 2 | 0 | 0 | 9 | 20[6] |
| Zacatecas | 11 / 26 | 0 | 4 | 1 | 0 | 0 | 56 | 24 |

*Notes*: The information is not homogenous for all programs and states. The main reason is the different cycles of management for each program (call, evaluation, contracts, etc.). 1) This information is for December 2008. It changes every month since membership is only for three years and has to be renewed. 2) This concerns the technological and scientific research centers linked to CONACYT. There do exist other public and private research centers but there is no centralised listing. 3) The *Estímulos Fiscales* statistics may double count the same firm that received the incentive in multiple years within the period, which is a frequent occurrence. 4) This program became Fondo Innovación in 2007. 5) Information after 2006 was not available for all states. Some states did not begin their FOMIX programme until after 2004. 6) The state of Yucatan reports 23 and not 20 grant projects.

*Source:* Based on data from CONACYT and the Ministry of the Economy, Mexico.

**Table 3.4. State participation in select scientific research programmes**

Number or granted projects

| | Number of universities[1] (public & private) | RENIECYT[2] Universities & Research Centers/ total | High Quality[3] Advanced Degree Programs (PNP) | SNI[4] Researchers | Fundamental Research Fund[5] 2002-2006 (% of total) | FOMIX[6] (2002-2006) | | Sagarpa Fund (2002-2006) | Semarnat Fund (2002-2006) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Projects | Calls | | |
| Aguascalientes | 28 | 6 / 78 | 6 | 78 | 11(0.3%) | 29 | 6 | 8 | 3 |
| Chihuahua | 74 | 1 / 171 | 17 | 186 | 39 (1.1%) | 26 | 4 | 9 | 2 |
| Coahuila | 86 | 16 / 164 | 29 | 199 | 76 (2.2%) | 43 | 4 | 18 | 6 |
| Colima | 25 | 1 / 26 | 7 | 112 | 28 (0.8%) | 18 | 2 | 0 | 3 |
| Mexico | 228 | 34 / 356 | 58 | 878 | 115 (3.4%) | 15 | 2 | 29 | 15 |
| Guanajuato | 148 | 20 / 425 | 34 | 466 | 176 (5.2%) | 161 | 11 | 20 | 4 |
| Jalisco | 200 | 19 / 424 | 53 | 776 | 104 (3.0%) | 20 | 8 | 15 | 5 |
| Michoacan | 69 | 11 / 109 | 33 | 424 | 111 (3.3%) | 56 | 6 | 10 | 9 |
| Nuevo Leon | 100 | 8 / 386 | 68 | 511 | 108 (3.2%) | 20 | 8 | 15 | 16 |
| Puebla | 209 | 24 / 136 | 52 | 561 | 181 (5.3%) | 18 | 2 | 3 | 4 |
| Queretaro | 56 | 17 / 116 | 14 | 312 | 108 (3.2%) | 42 | 4 | 16 | 6 |
| San Luis Potosi | 87 | 6 / 67 | 33 | 288 | 123 (3.6%) | 69 | 4 | 7 | 12 |
| Tamaulipas | 108 | 12 / 77 | 8 | 125 | 17 (0.5%) | 168 | 12 | 15 | 2 |
| Yucatan | 64 | 14 / 59 | 23 | 308 | 106 (3.1%) | 96[7] | 6 | 18 | 8 |
| Zacatecas | 31 | 7 / 26 | 4 | 111 | 13 (0.4%) | 56 | 6 | 3 | 0 |

*Notes:* 1) Information taken from the CONACYT state profiles in 2007, from ANUIES (2009) and the Ministry of Education. In almost all states, directories can also consider Arts and Universities performing teaching studies (*Escuelas Normales*). 2) Information as of December 2008. It changes every month since membership is only for three years and has to be renewed. 3) This information is as of February 2008. It changes every year since the designation is valid only for three years and has to be renewed. 4) Information is as of December 2008. Designation as a SNI is for three or four years depending on the category (junior, senior). Evaluations take place for renewal and new members, thus the exact numbers change anually. 5)The total projects granted by this program during the analysed period are 3 411. 6) This excludes projects for the industrial development area. Information after 2006 was not available for all states. Some states did not begin their FOMIX programme until after 2004. 7) The state of Yucatan reports a significantly higher figure.

*Source:* Based on data from CONACYT, ANUIES, and some state S&T councils.

### *Regional innovation systems (RIS): typologies*

There are different types of regional innovation systems across OECD regions. Overall performance on innovation inputs, linkages and outputs gives a sense of rankings across Mexican states on these parameters (see Chapter 1). However, it is the combination of these variables that helps categorise different types of existing or potential regional innovation systems. And what is perhaps more important, and more difficult to measure, is the effectiveness of different systems relative to their assets. Unfortunately, due to a lack of sub-national data, Mexican states can't be as easily compared quantitatively with other OECD regions in terms of regional innovation. The state of Jalisco stands out for its measurements of R&D using OECD definitions (based on the Oslo Manual) and using international comparisons of its S&T performance on a couple of key indicators. Beyond the data (which is particularly limited for Mexico), other forms of diagnosis can help determine which actors are important in the RIS.

One possible RIS categorisation for OECD regions is based on the lead generators of knowledge in a region. The share of R&D expenditure (as a percent of GDP) by actor can be used as a proxy for this. Some regions have a strong public research driver, due to the location of key national centres. Other regions may have particularly active higher education institutions. Finally, a system with a very high share of business sector R&D indicates a firm-driven regional system with R&D likely to be more oriented to industrial needs.

There are several types of potential regional innovation systems across Mexican states based on their industrial and scientific innovation-related assets. As R&D expense by actor is not available, use of some national programmes by type is used as a rough proxy. Other factors include the state's industrial base, scientific research capacity and the strength of local S&T and innovation support institutions. Table 3.5 illustrates one possible characterisation; however there are many possible groupings that could be used in the conception of RIS policy support mechanisms. A more refined categorisation for the entire country could be used to inform national S&T, industrial and regional development policy approaches that currently do not account for such regional differences. An example of a categorisation of regions in Europe with respect to their regional innovation system characteristics and the corresponding policy recommendations can be found in Table 3.A1.1 in Annex 3.A1.

**Table 3.5. Categorisation of states by type of innovation assets**

| Category | States | Description |
|---|---|---|
| Intensive and diversified S&T&I | Guanajuato | Strong scientific profile with qualified human resources, prestigious public and private universities and postgraduate programmes as well as CONACYT research centres, diversified industry in mature and high-tech sectors, strong relationship between Council and other public entities, high participation in most CONACYT programmes. |
| Industry intensive, innovation | Chihuahua<br>State of Mexico<br>Jalisco<br>Nuevo Leon | Strong industrial activity, high utilisation of innovation-related programmes, some important universities but few Public Research Centres. |
| Rising scientific and technological capabilities | Aguascalientes<br>Coahuila<br>Puebla<br>Queretaro<br>San Luis Potosi | Presence of CONACYT Research Centres and active S&T Councils, lower participation in innovation-related as opposed to scientific-related national funds. |
| Strong scientific capabilities, lesser innovation performance | Michoacan<br>Yucatan | Strong scientific community with high number of recognised researchers (the SNI designation) but lesser application of this research to economic needs (in these states more agricultural than some others), success in FOMIX calls and projects from national Fundamental Research funds |
| Unexploited S&T/innovation potential | Colima<br>Tamaulipas<br>Zacatecas | These states do not have as many basic science resources and have captured less national resources in both innovation and science funds, in part due to the newness of the Councils in several of the states. |

# Notes

1. ADIAT and ARCO are cultivating a network of suppliers who can develop mapping tools for regional innovation systems, that includes business clusters, so as to identify and analyse linkages across regional actors.

2. Another interesting programme in Zacatecas is the 4x1 programme similar to the 3x1 found at the national level (see Chapter 2). Given the particularly high migration rates to the US, this programme uses resources sent by migrants and multiplies them by four (federal government, state government, municipal government and a local firm) which are then invested in productive projects decided by the migrant, including SME support and scholarships.

3. As per the ANUIES classification, science includes only natural and exact sciences.

4. The example of the high-tech *maquila* industry in Ciudad Juarez (Chihuahua) and Tijuana (Baja California) shows the importance of this industry in bringing together training institutions, brokers, and other intermediate organisations to build a more competitive "milieu" for this industry, as mentioned in Villavicencio D., (Ed.) (2006), *La emergencia de dinámicas institucionales de apoyo a la industria maquiladora en México*, M.A Porrúa/UAM, México.

5. *Aguascalientes*: Its S&T plan is in process of elaboration and it should be approved by the state instances soon. *Chihuahua*: The S&T state council was created by official ordinance at the end of 2007; therefore a plan is in process. However, the State Development Plan 2004-2010 does not make an explicit reference to the S&T topic. *Colima:* The S&T state council was officially created in 2007, it must soon proceed to the elaboration of the Plan. *State of Mexico:* The state Law of Science and Technology since 2004 mentions that the S&T plan should be created, which has yet to occur. *Queretaro:* Although the state Law of S&T has been approved since 2004, the state does not have yet a plan. *Yucatan:* The state government decreed the State System of Research, Innovation and Technological Development in June of 2008; its implementation should be enshrined in the strategies which the S&T plan will present. This plan will be elaborated soon.

6. According to the law, each new federal and state government should elaborate its Development Plan and, thereby, its sectoral plans or programs. In this sense, every six years state governments redesign strategies and public policies. In the best case, a new government can give continuity to some of the existing programs which show success and are popular with the electorate and, in the worst case, programs are re-invented every six years. Furthermore, these Plans for any sector, at federal and state levels, are only indicative as they are subject to annual Finance Department budgetary allocations, a state's Congress and on the priority each state government assigns to it.

7. CIDESI is the Spanish acronym for the Centre of Engineering and Industrial Development.

# Annex 3.A1

## Table 3.A1.1. Policy recommendations by type of RIS: European regions

| Broad category | Sub-categories | Description and regions | Key strategic messages | Potential focus of EU Structural Fund support |
|---|---|---|---|---|
| Global consolidation | Nordic high-tech learning; Science and service centre | These regions are on the top rung of the ladder of European innovative regions and include: Copenhagen, Ile-de-France, London, Prague, Stockholm and Vienna, etc. These regions are clearly well above the average for all factors as well as GDP/capita with the exception of the private technology factor where they are close to the EU average. | --Becoming or maintaining position as international innovation and knowledge hubs<br>--Enhance strengths in cutting edge pervasive technologies (ICT, nano-micro, materials, life sciences, renewable energy) | --Developing clusters in emerging strategic areas, such as creative industry, life sciences, eco-industries, etc.<br>--Competence centre type projects to increase networking of universities and smaller firms<br>--Major projects to test/develop new technologies for urban/public services, etc.<br>--Regions as lead partners of inter-regional networks in advanced technologies |
| Sustaining competitive advantage | Learning; Centro techno; High techno | Sustaining competitive advantage regions (strong industrial and learning Regions, *e.g.*, Baden-Württemberg, Flanders, Ireland, Piemonte, Rhône-Alpes, Salzburg and Scotland, etc.) are relatively strong on private technology (reflecting the industrial tissue and heritage of these regions) and on learning families but much weaker in public knowledge and urban services (suggesting a difficulty to restructure towards more knowledge-based services). | --Consolidate competitive advantage in high value-added manufacturing activities<br>--Maintain higher value added activities (research, marketing, etc.) within value chains<br>--Diversify the economic structure into knowledge intensive services | --Competitiveness/ innovation poles in core or emerging regional sectors<br>--Promotion of science and engineering careers and research-industry and international mobility<br>--Mentoring, innovation management tools, etc. for boosting entrepreneurship<br>--Regions as lead partners in EU level sectoral innovation networks (automotive, electronics, etc.) |
| Boosting entre-preneurial knowledge | Local science and services; Aging academia | This category includes second-tier capitals and regions with strong public research *e.g.*, Athens, Berlin, Bratislava, Catalunya, Lisbon, Midi-Pyrénées, Warsaw, and Wallonia, etc. that are strong on public knowledge and relatively competitive in terms of urban services but need to boost private technology and in particular Learning family drivers of their knowledge economies. | --Encourage and support science-business co-operation<br>--Support traditional industries to diversify through the uptake of persuasive technologies<br>--Develop current niches (public and private) into competitiveness poles<br>--Strengthen regional innovation system and improve governance of regional innovation policies | --Focus on systematic instruments such as competence centres, industry-academic joint R&D, etc.<br>--Support to universities propensity to engage in entrepreneurial activities<br>--Mentoring, innovation management tools, etc. for boosting entrepreneurship<br>--Support for internationalisation of regional clusters/poles in inter-regional projects |
| Entering knowledge economy | Southern cohesion; Rural industries; Eastern cohesion; Low-tech government | The Entering knowledge economy regions (broadly similar to the Structural Fund convergence regions) lie on the southern and eastern rims of the EU. This group includes most of Greece, southern Spain, Poland except Warsaw, Estonia, Lithuania, Portugal except Lisbon, the Mezzogiorno, etc.). These regions are broadly speaking users rather than producers of technology. | --Develop operational innovation policy frameworks based on regional partnership<br>--Develop new specialisation areas by combining local advantages in traditional industries with knowledge intensive activities<br>--Restructure agricultural areas through multi-functional rural activities<br>--Develop new trajectory for tourism industry by linking it to other high value added activities and provision of advanced logistics and ICT for the personalisation of services<br>--Exploit untapped potential in renewable energy and tackle environmental degradation by introducing clean technologies | --Renew regional innovation strategies focusing on specific technologies and sectors<br>--Support innovative initiatives based on the actual regional potential (*e.g.*, in traditional low-tech sectors)<br>--Productivity/technology grant for SMEs<br>--Profile human resources according to the needs of economy (*e.g.*, placement schemes)<br>--Creation of cross-border research or innovation networks to create critical mass |

*Source:* Adapted from Technopolis *et al.* (2006) *Strategic Evaluation on Innovation and the knowledge based economy in relation to the Structural and Cohesion Funds, for the programming period 2007-2013: Synthesis Report.* A report to the European Commission, Directorate General Regional Policy, Evaluation and Additionality, 23 October 2006.

# *Table of Contents*

**List of Acronyms** ..... **11**

**Assessment and Recommendations** ..... **15**

Introduction ..... 15
The economic and innovation challenges in Mexico ..... 16
How can national policy help? ..... 18
What should states do? ..... 27
What governance tools support the policy objectives? ..... 30

**Methodological Introduction** ..... **35**

**Part I: Synthesis Report** ..... **37**

**Chapter 1: Mexico's Regional Economic and Innovation Performance** ..... **39**

Introduction ..... 39
The national context ..... 39
Macroeconomic stability but insufficient growth ..... 39
Several factors limiting economic growth ..... 42
The regional perspective: a tale of different "Mexicos" ..... 57
Regional economic performance ..... 57
Territorial disparities ..... 59
Poverty and inequalities ..... 61
Sources of persisting GVA per capita differences ..... 63
The regional innovation dimension ..... 88
Inputs for innovation ..... 90
Linkages and interactions for innovation ..... 95
Output indicators ..... 99

Annex 1.A1 ..... 106

Manufacturing industry specialisation ..... 106
Manufacturing specialisation index ..... 109
A regional perspective on FDI in Mexico ..... 110

**Chapter 2: National Policies to Support Regional Clusters and Innovation Systems** ..... **127**

Introduction ..... 127
Trends in OECD countries ..... 128
Regional development policy: need for national approach with competitiveness focus ..... 129
Enterprise policies ..... 134

Sectoral policies: place-blind and place-based examples ..... 134
FDI policy: need to seek regional spillovers ..... 137
SME policy: general support and networking ..... 142
Science and technology policy: increasingly supporting a "regional" approach ..... 151
Higher education policy: incentives and disincentives ..... 160

**Chapter 3: Sub-national Initiatives for Regional Clusters and Innovation Systems ..... 171**

Introduction ..... 171
State programmes for competitiveness ..... 171
Public and private stakeholder roles in competitiveness strategies ..... 173
Supporting sectors and clusters ..... 174
Sectoral priorities common across many states ..... 174
Cluster support: achieving critical mass ..... 176
State level actions to support regional innovation systems ..... 184
Science and technology plans ..... 186
Science and technology councils: variations in models and budgets ..... 189
State level science and technology programmes and federal programme use ..... 190

Annex 3.A1 ..... 200

**Chapter 4: Multi-level Governance to Promote Regional Competiviness and Innovation systems ..... 201**

Introduction ..... 201
Responsibilities for regional competitiveness and innovation systems ..... 201
Municipal level ..... 202
State and federal role sharing to support innovation ..... 204
Continuity challenges at all levels of government ..... 205
Cross-sectoral co-ordination and "gatekeeper" roles ..... 206
National level ..... 206
State level ..... 209
Centralisation and impacts on competitiveness ..... 209
Fiscal centralisation ..... 209
Strategies to capture economic benefits of decentralisation-type mechanisms ..... 214
Tools for national and sub-national responsibility sharing and alignment ..... 217
Monitoring performance: transparency, trust-building and programme effectiveness ..... 220

Annex 4.A1 ..... 223

**Part II: State Profiles ..... 225**

**Chapter 5: Aguascalientes ..... 227**

**Chapter 6: Chihuahua ..... 239**

**Chapter 7: Coahuila ..... 251**

**Chapter 8: Colima ..... 263**

**Chapter 9: Guanajuato ..... 275**

**Chapter 10: Jalisco** ..... **287**

**Chapter 11: Mexico** ..... **299**

**Chapter 12: Michoacan** ..... **311**

**Chapter 13: Nuevo Leon** ..... **323**

**Chapter 14: Puebla** ..... **335**

**Chapter 15: Queretaro** ..... **347**

**Chapter 16: San Luis Potosi** ..... **359**

**Chapter 17: Tamaulipas** ..... **371**

**Chapter 18: Yucatan** ..... **383**

**Chapter 19: Zacatecas** ..... **395**

**Bibliography** ..... **407**

## Tables

Table 0.1. Policy trends supporting clusters and regional innovation systems ..... 19
Table 0.2. Policy priorities by type of RIS ..... 27
Table 1.1. Educational attainment of the adult population ..... 54
Table 1.2. Classification of OECD and Mexico regions ..... 58
Table 1.3. Poverty, inequality and human development in regions ..... 62
Table 1.4. FDI by region (1994-2007) ..... 79
Table 1.5. FDI/GDP by region ..... 79
Table 1.6. Regional competitiveness indices ..... 85
Table 1.7. State rankings on regional competitiveness indices ..... 87
Table 1.8. Industries, technology and innovation ..... 101
Table 1.9. Gross value added by technology level ..... 102
Table 2.1. Policy trends supporting clusters and regional innovation systems ..... 129
Table 2.2. Rationale for pan-regional RIS collaboration ..... 132
Table 2.3. New regional development policy frameworks: regional competitiveness ..... 134
Table 2.4. Sectoral support programmes ..... 136
Table 2.5. FDI spillover channels ..... 138
Table 2.6. Policy measures to create and deepen MNE-SME linkages ..... 142
Table 2.7. Budget for SME Fund programmes ..... 144
Table 2.8. Business incubators and enterprises ..... 146
Table 2.9. CONACYT budget ..... 155
Table 2.10. Utilisation of R&D tax incentive ..... 156
Table 2.11. Types of higher education institutions ..... 162
Table 2.12. CONACYT centres by region ..... 164
Table 2.13. Scholarships, SNI researchers and basic science support by state ..... 165

Table 3.1. Prioritised sectors in participating states ..... 175
Table 3.2. Elements of state S&T plans ..... 187
Table 3.3. State participation in select innovation and technological development programmes ..... 196
Table 3.4. State participation in select scientific research programmes ..... 197
Table 3.5. Categorisation of states by type of innovation assets ..... 198
Table 4.1. Governance sharing for competitiveness ..... 202
Table 4.2. Municipalities: number and population distribution by state ..... 203
Table 4.3. National-regional responsibility sharing for innovation policy ..... 204
Table 4.4. Examples of co-ordination bodies for place-based approaches ..... 206
Table 4.5. Empirical results on the effects of decentralisation on economic growth ..... 216

**Figures**

Figure 0.1. Participating states ..... 16
Figure I.1. Basis for regional competitiveness ..... 35
Figure I.2. Participating states ..... 36
Figure 1.1. Mexico's growth performance in comparison ..... 41
Figure 1.2. The sources of persisting real income differences ..... 43
Figure 1.3. GDP per hour worked and growth in productivity ..... 44
Figure 1.4. Gross foreign direct investment in comparison ..... 46
Figure 1.5. Factors contributing to differences in output ..... 47
Figure 1.6. R&D intensity and evolution of gross domestic expenditure on R&D ..... 49
Figure 1.7. Researchers, 2005 ..... 51
Figure 1.8. Triadic patent families per million population ..... 52
Figure 1.9. Scientific articles per million population ..... 53
Figure 1.10. Top performers in the PISA science assessment and country research intensity ..... 55
Figure 1.11. Student performance and spending per student ..... 55
Figure 1.12. Population with tertiary attainment, 2005 ..... 56
Figure 1.13. OECD regional classification by income levels and growth rates ..... 58
Figure 1.14. GDP, GDP per capita and growth rates ..... 59
Figure 1.15. Marginalisation levels, 2005 ..... 61
Figure 1.16. Factors contributing to differences in regional GVA per head ..... 64
Figure 1.17. Evolution of GDP per worker ..... 65
Figure 1.18. Gini index of inequality of GDP per worker ..... 65
Figure 1.19. Regional dispersion in GDP per worker ..... 66
Figure 1.20. Percentage of workers in regions with GDP per worker below the national average ..... 67
Figure 1.21. PISA results and average schooling years ..... 68
Figure 1.22. GDP per worker and tertiary attainment ..... 69
Figure 1.23. Distribution of state GDP per capita by main economic sector ..... 71
Figure 1.24. Specialisation in specific low-tech manufacturing industries ..... 73
Figure 1.25. Specialisation in specific mid-low tech manufacturing industries ..... 73
Figure 1.26. Specialisation in specific mid-high tech manufacturing industries ..... 74
Figure 1.27. Specialisation in specific high-tech manufacturing industries ..... 74
Figure 1.28. Regional specialisation ..... 76

Figure 1.29. Changes in regional specialisation....76
Figure 1.30. Specialisation and labour productivity....77
Figure 1.31. Big manufacturing firms by FDI share....80
Figure 1.32. Informality and unemployment rates....82
Figure 1.33. Innovation indicators....90
Figure 1.34. Regional expenditure of national S&T&I programmes....91
Figure 1.35. Access to credit by state....92
Figure 1.36. Tertiary education....93
Figure 1.37. Enrolment at tertiary level....93
Figure 1.38. SNI researchers by state....95
Figure 1.39. Collaboration in innovative projects....96
Figure 1.40. Firm collaboration in innovative projects with external institutions....97
Figure 1.41. External sources for innovation....98
Figure 1.42. Co-patenting in Mexican regions....98
Figure 1.43. Regional concentration of national patent applications....99
Figure 1.44. Tacit innovation outputs....100
Figure 1.45. Percent of firms that invest in process technological R&D....103
Figure 2.1. Meso-regions in Mexico....131
Figure 2.2. Location of IT cluster initiatives....137
Figure 2.3. National innovation system actors....154
Figure 2.4. Undergraduate enrolment in engineering, technology and sciences....163
Figure 4.1. Sub-national shares of revenues and expenditures....210
Figure 4.2. Tax revenue by level of government....211
Figure 4.3. State revenue sources, 1989-2007....211
Figure 4.4. Contracting approaches for regional development....219
Figure 4.5. Linking indicators and programme objectives....221

**Boxes**

Box 1.1. Obstacles for innovation in Mexico....48
Box 1.2. Regional disparities and economic growth....60
Box 1.3. FDI and a systemic approach....78
Box 1.4. The informal economy in Mexico: multiple issues....81
Box 1.5. Innovation's spatial dimension....88
Box 2.1. FDI policy evolution in Mexico....139
Box 2.2. Certification of EU business innovation centres....146
Box 2.3. Endeavor and Visionaria: supporting high-growth SMEs....149
Box 2.4. Business Support Simplification Programme, UK....150
Box 2.5. The Mexican SME Network (*Red PyME*)....151
Box 2.6. Evolution of science and technology policy....153
Box 2.7. Supporting R&D capacity in less advanced US states....158
Box 2.8. Networks of Competence in Germany....160
Box 2.9. Mexican Association of Small Business Development Centers....167
Box 2.10. Higher Education Innovation Fund: England....168
Box 3.1. Supporting nanotechnology through knowledge generators....176
Box 3.2. Basque Country (Spain) cluster support....179
Box 3.3. Denmark's Network Programme: brokers and scouts....180
Box 3.4. The Aguascalientes Innova Programme....182

Box 3.5. Guanajuato Networks of Innovation ..... 185
Box 3.6. Coalitions for regional innovation system support: ARCO ..... 185
Box 3.7. Spain's Technology Centres ..... 191
Box 3.8. Monterrey International City of Knowledge and the PIIT ..... 192
Box 3.9. Higher education institution engagement: examples ..... 193
Box 3.10. Networks across HEIs to support commercialisation ..... 194
Box 4.1. The DIACT/CIACT in France: an inter-ministerial committee for regional competitiveness ..... 208
Box 4.2. Linking taxpayers with services provided: the state payroll tax ..... 212
Box 4.3. Is there always an efficiency *versus* equity trade-off? ..... 213
Box 4.4. Decentralisation and economic competitiveness ..... 215
Box 4.5. Association of Mexican Economic Development Secretaries ..... 218