

OECD Review of Higher Education in Regional and
City Development

Paso del Norte, United States of America and Mexico



Assessment and recommendations

The Paso del Norte Region: moving from low wages towards a knowledge based economy

With a population of 2.4 million, the metropolitan area of Paso del Norte is one of the largest international cross border regions in the world and the largest metropolitan area on the border between the United States and Mexico. This region is also a major economic centre with three important urban areas: the City of El Paso in Texas, the City of Las Cruces in New Mexico and Ciudad Juárez in Chihuahua. The region provides a “preview” of the future for the United States: the Hispanic population in the US is projected to grow from 15% to approximately 30% by 2050.

The Paso del Norte Region features considerable intra-regional differences in its industrial make-up. 60% of the Ciudad Juárez labour force is employed in manufacturing, and the city constitutes one of the largest manufacturing centres in the world. Other sectors of the economy, including business services, trade, and transportation, support the dominant manufacturing sector. On the US side, the El Paso economy is more diversified, with a relatively large public sector. El Paso’s hospitality sector, trade and business services are interconnected with the manufacturing strength of Ciudad Juárez. There are also supplier linkages between the manufacturing industries in the two cities. Las Cruces in New Mexico is smaller in size but has a higher proportion of knowledge workers because of government defence and research facilities in Doña Ana and Otero Counties.

Since the implementation of the North American Free Trade Agreement (NAFTA), and in connection with the recent recession, the Paso del Norte Region has experienced fast population growth. The total population increased from 1 568 571 in 1990, to 2 385 695 in 2008, a growth rate of 52%. On the Mexican side the growth has been spectacular –73% compared to 37% for the US side. In large part, this growth reflects population migration in search of employment. Because of the influx of a low skilled

population, the Paso del Norte Region continues to be characterised by structural weaknesses and remains primarily in a low skills equilibrium. The economic performance on both sides of the border region is considerably below the OECD averages. Poverty remains a widespread problem both on the Mexican and US sides of the border and is a drag on the region's competitiveness. Health problems related to a low-income population, environmental degradation, and continuing violence jeopardise the long-term competitiveness of the region.

The major challenge for the Paso del Norte Region and its higher education institutions is to develop effective human capital development and innovation systems that can operate across the bi-national, tri-state region. The two larger cities, Ciudad Juárez and El Paso, are building the resources and institutions that can form the basis of future growth and development. However, to date, the regional innovation and human capital development system remains under-developed. The current drug-related violence on the Mexican side and the US focus on border security undermine the impetus to build a cohesive bi-national region.

The current extent of regionally relevant activities by higher education institutions in the Paso del Norte Region, including industry collaboration, widening access initiatives and entrepreneurship activities, are limited to sub-regional levels and not fully reflected at the regional cross border level. There are also gaps in important areas such as lifelong learning, entrepreneurship education and support for small and medium-sized enterprises. In this context, the key challenges for the Paso del Norte Region and its higher education institutions are the following:

- How to improve the overall educational attainment levels and increase the flexibility of the population to face rapid changes in the labour market?
- How to develop the HE knowledge base and collaboration within and between institutions that promote regional development?
- How to promote new business formation?
- How to leverage the current economic base and focus on a few world class competencies?
- How to address the considerable health and environmental challenges in the cross border region?

To address these challenges, the Paso del Norte Region needs more concerted efforts on cross border regional development, including a master plan with vision, goals, milestones, co-ordination measures and a robust evidence base. A more enabling environment needs to be created for new

business formation and for upgrading the current low skilled economy. The good practice examples currently seen within the region – in widening access to higher education and educational retention as well and industry-university collaboration – should be disseminated, extended and scaled up. Enhanced employability, job creation and access to employment opportunities should be seen as the primary goals of innovation and human capital development. In addition, higher education institutions should view the region as a “laboratory” for challenge-driven research and community outreach.

Human capital development in the Paso del Norte Region

The ability to fuel local growth by cultivating relevant skills is the best guarantee that the region will thrive in future. A region that wants to be globally competitive needs to have a highly skilled workforce and knowledge-based economy In order to break out of the low wage equilibrium The Paso del Norte Region needs to improve the educational attainment levels and widen access to higher education ...

There are considerable disparities across the Paso del Norte Region, which may narrow over time with the wages in El Paso levelling out or decreasing and the wages on the Mexican side increasing. On the US side the tendency in the past has been to attract low skill/low-wage jobs that do not do enough to diversify the region’s job skills level. The low skill/low wage propensity is, however, a self-defeating strategy not only to El Paso and Las Cruces, but also to the entire cross border region.

However, educational attainment levels limit the region’s ability to develop and attract high value economic opportunities. On the US side of the border the higher education attainment levels (associates degree and above) lag behind that of New Mexico (33.5%), Texas (31.7% and the United States 35.5%) as only 27.5% of the region’s population (aged 25 years and older) have an associates degree or higher in 2008. In the State of Chihuahua and Ciudad Juárez in Mexico, educational attainment levels are improving rapidly, and while higher than in many Mexican states, remain considerably below that of the US side of the region. Tertiary education attainment rates in Mexico are generally low: in 2007, only 15.9% of the population aged 25-64 had completed post-secondary education compared to the OECD average of 27.5% (OECD, 2009a).

... the El Paso Collaborative for Academic Excellence has achieved measureable improvements in school retention and widening access. This model of long-term multi-stakeholder collaboration needs to be underpinned with sustainable funding and extended across the region ...

The El Paso Collaborative for Academic Excellence has brought together educational institutions and the public and private sector stakeholders in a long-term concerted effort to improve retention and widen access in El Paso. The collaborative has made systematic changes in educational policy and curriculum to decrease the achievement gap across ethnic and socioeconomic groups. It has embraced all the twelve El Paso School Districts and produced measurable improvements in the performance of Hispanic students that make up 89% of the student population in El Paso. As a result, the educational attainment of the regional workforce significantly improved between 2000 and 2009. The proportion of the population with a high school (secondary) degree increased from 66% to 72% of the population and the proportion of the population with a bachelor's degree or higher increased from 17% to 20%. While this progress is commendable, higher education attainment still remains below the national average and also that of the States of Texas and New Mexico. There is a need to scale up the efforts of the Collaborative and support them up with sustainable funding to ensure long term impact. Programmes to widen access to higher education are also present in Las Cruces and at New Mexico State University (NMSU) but they play a less prominent role than in El Paso.

On the Mexican side of the border, higher education institutions have a more limited approach to widening access. For example the leading higher education institution, the Autonomous University of Ciudad Juárez (UACJ), maintains that its capacity to move forward in this area is limited by space constraints. Increasing and widening access to higher education in Ciudad Juárez is, however, necessary in order to make improvements in the local and regional economy. They are also necessary to enhance the flexibility of the population to adjust to changes in the labour market. Strong efforts should be made to extend the existing good practice examples in the region across the border.

...Despite the progress made, the region continues to lose educated workforce, particularly engineers and scientist. Strong

efforts should be made to link students with the local industry and to improve entrepreneurship education...

The Paso del Norte Region faces difficulties in retaining an educated workforce. El Paso is a net exporter of educated workers, particularly in the fields of engineering and computer sciences. A large number of the graduates of the University of Texas at El Paso (UTEP) in science, technology, engineering and mathematics are recruited by national and international companies outside the region. Renowned for its ability to educate Hispanic engineers, 75% of UTEP engineering graduates leave the region. Similarly the graduates of the New Mexico State University (NMSU) are recruited by business across the world. Ciudad Juárez is experiencing a significant brain drain as graduates are finding employment outside the region.

To improve graduate retention and the quality and attractiveness of local jobs, the region should consider better alignment of their educational programmes with the regional needs. Stronger efforts should be made to establish programmes to link all students, graduates and post-graduates with the local industry. Creating stronger ties between students and regional employers through internships and co-operative programmes should be made a priority. Higher education institutions have established various forms of work-based learning opportunities and entrepreneurship training for their students. However, only a portion of the students have exposure to this type of learning opportunities.

Las Cruces has a strong focus on industry skill development. The approach to human capital development in the higher education institutions in New Mexico has focused specifically on training for knowledge intensive jobs influenced in part by the labour demand in near-by defence establishments such as The White Sands Missile Range. The Arrowhead Center focuses on building new firms related to industry strengths in the region and provides a wide the range of services available to entrepreneurs and small firms. The Doña Ana Community College (DACC), adjacent to the New Mexico State University campus, provides technical training in skills related to industries in the region including automotive technology, digital graphics technology, electronics technology and welding. This industry skill development orientation is unusual in the US context and reflects both the high demand for medium-skilled labour in the defence facilities and suppliers in the Las Cruces area and a cooperative approach between employers and technical training providers.

On the Mexican side, the Chihuahua State has invested in “triple helix” collaboration bringing together the government, academia and industry. It

has also developed a range of mechanisms to improve human capital development in the state, including the establishment of training institutions. For example COVAP, an industry-academia liaison council helps match the supply and demand for highly skilled labour in selected enabling industries. CENALTEC focuses on sector-based skilled workforce training and provides process improvements in small businesses. It responds directly to the demand for more skilled workers in the *maquila* sector and in the regional economy. It contributes to localised learning and overall human capital development in the region and exemplifies best practice in skilled workforce training because it is organised around specifically defined industry skill needs and engages firms and trade groups directly and over time to ensure that training programmes change as firm skill needs change. Both CENALTEC and the Autonomous University of Ciudad Juárez are involved in “triple helix” type sectoral strategies in which a higher education institution and technical training institutes work in close interaction with industry to provide a technically skilled workforce and continuous improvements in productivity.

While the focus on continuous skills development in Ciudad Juárez for the benefit of the industry is commendable, too narrow skills development will not serve the population and the region in the long run. Stronger emphasis needs to be placed on general competencies that will allow people to adjust to rapid changes in the labour market and have the capacity for lifelong learning. Considerable efforts should be made by the state and local government and educational institutions to raise the levels of education attainment. There is a need for comprehensive long-term efforts to increase completion rates in secondary education and the preparation of both youth and adult population for further education. Widening access to higher education will require multi-stakeholder collaboration between higher education institutions, schools and government.

The following measures would promote human capital development in the Paso del Norte Region:

- A wider portfolio of robust data related to the regional context and the situation of individual higher education institutions should be developed in the Paso del Norte Region to support evidence-based decision making and targeted efforts to address human capital development needs. The most effective region-wide graduate labour market systems are based on the collection of comprehensive labour market intelligence, on-line publication of the data in a single place to improve students’ ability to make rational choices about their studies and to help graduates and employers come together and

move students into employment. Efficient systems also use data strategically to identify regional priorities and at an institutional level, to respond to the data in terms of course provision and the provision of employer specified skills.

- The Paso del Norte Group, higher education institutions, other educational institutions and key stakeholders of the economy and society should work together to establish a Strategic Plan for Regional Human Capital Development which outlines region-wide goals, policies and priorities extending from primary to tertiary education and beyond. To form the basis for regional comparative advantage this strategy should build on the strengths of the higher education institutions *i.e.* the widening access agenda in El Paso, industry skill development in Las Cruces and “triple helix” collaboration to improve productivity in industry in Ciudad Juárez. Regional policy makers should draw on the experiences from each “model” and identify ways to extend these activities to the region as a whole. The challenge is to selectively build on these strengths in order to disseminate the knowledge they represent across the region and to select projects for cooperative efforts that take advantage of the strengths of the higher education institutions, while recognising limits and barriers inherent in different institutional contexts. As part of this strategic plan, a higher education coordinating body should be established to define goals, policies and priorities.
- Higher education institutions should continue and expand efforts to increase the enrolment and success of first generation students. These efforts should build upon existing successful models of widening access, effective support services for students, including both academic and social supports and learner-centred teaching methods. Higher education institutions and governments on both sides of the border should increase financial assistance to low income students, including both institutional aid and state aid. The Paso del Norte Region should replicate the El Paso model for improving performance and widening access to higher education throughout the region. Higher education institutions’ lifelong learning activities should be strengthened and they should improve their capacity to provide up-skilling and re-skilling for the adult population who combine work and study or are unemployed.
- Ciudad Juárez needs to develop a comprehensive long-term strategy to increase completion rates in secondary education and the preparation of both youth and adult population for further education. Widening access to higher education will require multi-stakeholder

collaboration between higher education institutions, primary and secondary schools and government. Stronger emphasis needs to be placed on general competencies that will allow people to adjust to rapid changes in the labour market and have the capacity for lifelong learning.

- Significant multi-stakeholder public-private efforts should be made to boost entrepreneurship, business formation and business development. Higher education institutions should focus on strengthening the regional employability and entrepreneurial skills of all graduates. Creating ties between students in fields of critical importance to the region and regional employers through internships and co-op programmes should be made a priority. Experiential, work- and problem-based learning methods embedded in learning programmes to build entrepreneurship skills should be developed to improve graduate retention in the region. Similarly, efforts in dual language learning should be stepped up to assist the region in its internationalisation efforts.
- Incentive structures could be strengthened to encourage higher education institutions and their staff to engage in activities benefiting regional and local development and entrepreneurship activities. Discretionary funds should be established for supporting projects of various kinds of teaching-related activities that include interaction between the higher education system and the community.
- The industry or sectoral orientation should be extended to human capital development in order to galvanise technical training in Ciudad Juárez, El Paso and Las Cruces around cluster-based manufacturing and manufacturing services. The workforce development system should be adapted to the needs of small firms and to the development of companies in place. The Workforce Investment Board Report for El Paso (2008) focuses on cluster development, for example, an approach that when applied to human capital development is consistent with the sectoral approach being undertaken in Ciudad Juárez through CENALTEC. The Arrowhead Center appears to have made the most progress in working on an industry-based, small firm-oriented human capital development strategy.

Innovation in the Paso del Norte Region

... The United States provides favourable framework conditions for business formation, innovation and small business development. Faced with global financial crisis, the government has taken on a stronger role to support innovation ...

The universities in the Paso del Norte region have both advantages and challenges arising from the national context in which they operate and the character of their national innovation systems. The United States has led the way in developing pro-innovation policies and small business development. It was the first country in the world to offer companies a R&D tax credit and, through the 1980 Bayh-Dole Act, the first to allow universities to patent products originating from federal R&D funds. The technology licensing offices of the Massachusetts Institute of Technology (MIT) and Stanford University are global leaders in commercialising university research. The totemic examples of the Silicon Valley or Route 128 continue to inspire many regions and their higher education institutions worldwide.

Despite the favourable conditions, most US university technology licensing/transfer offices generate less licensing revenue for the university than the cost of their operations. Many universities have focused on technology transfer or developing revenue streams from products that have limited or no relation to the regional economy. As a result, most second-tier universities have not been successful in building regional clusters and innovation systems.

The US federal government's role in innovation has until recently been limited to funding basic research, subsidising the education of scientists and engineers and maintaining a system of intellectual property law. In 2009, the government assumed a more active role and declared its aim to transform the United States into an "Innovation Economy" that would support innovation for sustainable growth and quality jobs. The goal is to restore the US leadership in fundamental research, to build world-class workforce, to develop a physical infrastructure. The goal is to form the basis for innovation that will promote competitive markets able to spur productive entrepreneurship and catalyse breakthrough discoveries for national priorities, for example, in clean energy, health care and advanced vehicle technologies.

While many US state and local governments have established technology-based economic development programmes to promote innovation, these programmes often remain focused on the same high-technology industries regardless of whether they are suited to the regional and local economies (Wial, 2009). The Texas Emerging Technology Fund (ETF) provides financial support that boosts innovation for example through industry-university partnerships. The regional economic development agencies on the US side of the Paso del Norte Region – the El Paso Regional Economic Development Corporation (REDCo) and the Mesilla Valley Economic Development Alliance (MVEDA) – see their main role as attracting inward investment and serving industry that is relocating or expanding in their respective sub-regions.

In Mexico, national policies do not yet sufficiently support regional innovation systems or clusters. While programmes are in place to improve knowledge transfer and university-industry collaboration, there is a need for co-ordinated regional development policy approach ...

In Mexico, current efforts for regional development focus on poverty and infrastructure rather than competitiveness. Only a few enterprise-related policies take regional specificities into account while most sectoral programmes are place-blind, that is they do not build on comparative advantage. Although Science, Technology and Innovation (STI) Policy is increasingly recognising the importance of regional innovation systems, the concentration of resources in the capital slows down capacity building at the state and sub-national levels. The National Science and Technology Council (CONACYT) has taken measures to foster knowledge transfer and university-industry collaboration through different programmes, including the Mixed Funds Programme (Fondos Mixtos), Alliances and Innovation Networks for Competitiveness (AERIs), the Institutional Fund for Regional Development (FORDECYT) and a programme with the Mexican Institute for Intellectual Property (IMPI) to support technology transfer offices. In the State of Chihuahua, the Chihuahua Council for Economic Development (Consejo de Desarrollo Económico de Chihuahua), CODECH, leads the “triple helix” collaboration between academia, government and private sector.

The United States has a strong focus on small business development and effective programmes such as the Small Business Innovation Research Program. Mexico is also building its capacity in business development through support programmes...

Entrepreneurship plays an important role in generating innovation and stimulating growth. The US Small Business Development Centers (SBDCs) have a 30-year track record as an SME service network, with 1 100 centres located in higher education institutions, which annually serve 750 000 SMEs. The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programmes award USD 2 billion to small high-tech businesses every year. Established in 1982, SBIR is today the largest US innovation partnership and benefits from a stable budget: 2.5% of federal agencies' R&D budget has been set aside for grants or contracts with small businesses. It has helped new firms cross the "valley of death" and created a "demand pull" within SMEs by encouraging them to evaluate the commercial potential of research results. In El Paso, the Small Business Development Center is administered by the El Paso Community College.

Compared to the United States, new business formation in Mexico faces more difficult challenges. The Mexican Small and Medium-sized Enterprise Policy includes programmes that encourage university-industry collaboration and innovation, for example through the Fondo PYME (SME Fund) and the Programme for Innovation and Technology Development that funds business accelerators and innovation laboratories, often housed in higher education institutions. The State of Chihuahua has launched the Applied Research and Technological Development Program for Small Businesses (PIADET) to promote collaboration between small businesses and local or national research institutes and higher education institutions. Following the US model, Small Business Development Centers (SBDCs) have been created in Mexico. Currently there are no SBDCs belonging to the Mexican Association of Small Business Development Centres' network in Ciudad Juárez whereas the City of Chihuahua has four.

Despite favourable framework conditions, particularly on the US side, the innovation outcomes in the Paso del Norte Region remain modest...

The Paso del Norte Region combines many of the characteristics of peripheral and old industrial regions, which have been identified as being less innovative when compared with more central and agglomerated regions. The key challenges are a lack of dynamic clusters, a low level of R&D and innovation, and small and medium-sized enterprises (SMEs) in traditional sectors and/or branch plants with limited absorptive capacity. There is also a low level of networking and idea circulation and the innovation support institutions have limited infrastructure and capacity.

The US side of the region is a home to a number of defence-oriented organisations that could potentially play an important role in the regional innovation system by generating or using R&D and offering employment opportunities to high skilled personnel. While Fort Bliss has taken steps to reach out to the community, the economic impact of military related activities remains low due to the limited interaction with the regional community. In addition, the projected mix of military forces at Fort Bliss, increase in combat troops and decrease in the number of officers, makes it harder to attract more highly educated people to the region.

The research programmes in the US universities of the Paso del Norte Region support the defence and border security industry, but also have a wider emphasis, embracing border health and environmental sustainability. The universities have defined research fields that facilitate multidisciplinary work, respond to the regional needs and provide advantages in seeking state or federal funding. There is considerable overlap and potential for synergies. For example while the New Mexico State University (NMSU) has defined five research clusters, including biosciences; information sciences and security systems; natural resources sustainability and renewal; the Southwest border region's health, education, culture; and the development of 21st century aerospace, the University of Texas at El Paso (UTEP) has a focus on the environment, particularly air and water quality, Hispanic health disparities, border security and immigration, transportation and community health. In the future it will be important to enhance the regional focus of NMSU and UTEP research and mobilise the universities' collaborative efforts for regional development.

Currently, the universities have a tendency to measure success in innovation by the amount of (public) investment made, not the amount of commercial return generated or jobs created. This could be remedied by constructing efficiency/performance indicators for public agencies including

higher education institutions, such as time to process project applications and administrative costs for the programmes.

The development in the US side of the Paso del Norte Region is increasingly dependent on the investments from federal government on border security, defence, health and environment. The large public role in the regional innovation system could move the idea of innovation away from “commercially useful knowledge” towards a broader definition of generating “new knowledge.” Special consideration should be given to ensure that publicly-driven innovation system will not negatively impact entrepreneurship attitudes and delay the emergence of private sources of capital for innovation. Until recently El Paso was one of the few cities of its size in the United States without a venture capital group. The launch of Cottonwood in November 2009 is particularly welcome as it bridges the “valley of death” for innovative start ups by focusing on seed money in the range of USD 500 000 to USD 1 million.

Broadening the sectoral orientation and the disciplines that underpin engagement could be beneficial for large and growing clusters in the service sector. At the moment, industrial engagement is seen by the university faculty as a science and engineering pursuit rather than a role that could be embraced by the entire university community including business schools, social sciences and the humanities. For example border security could be seen in broader terms in order to ensure sustainable border conditions and cross border collaboration. A sector such as tourism is rarely seen as a focus for university activity but could be a focus for research, work-based learning and outreach.

... Ciudad Juárez and the State of Chihuahua have excelled in “Triple Helix” collaboration to upgrade and develop industry skills. Higher education institutions have focused their research on leading edge R&D and collaboration with big companies. The “City of Knowledge” aims to develop a high-tech knowledge hub with the capacity to draw foreign investment and impact regional development. Care should be taken to ensure that it will benefit not only big companies, but also small and medium sized enterprises and new business formation ...

Ciudad Juárez, the largest manufacturing region in North America and the leading *maquila* city in Latin America, has approximately 345 *maquila*

facilities that were owned and operated by more than 200 multinational corporations, which focus primarily on the automotive and ICT/software industry. As global operations, they can purchase the R&D anywhere in the world and do not rely on obtaining it from the local higher education institutions. Many plants are also driven exclusively by cost competition. In order to maintain plant loyalty to the region, the regional government aims to ensure that opportunities for skills development and labour market training are in place to produce continuous productivity increases.

The Chihuahua State has invested in “triple helix” collaboration between the government, academia and industry. It has developed multiple mechanisms to facilitate cluster development mainly through targeted skills improvement. The higher education institutions support the state government’s ambitions by focusing on high-end research. The Monterrey Tech is working towards the diversification of the regional economy and collaborates in close partnership with manufacturing centres and *maquiladoras*, with the aim of bringing leading edge R&D to the region. The Autonomous University of Ciudad Juárez (UACJ) has a focus on collaborating with the leading industries in the region through R&D and provision of co-operative work-based learning opportunities, mainly in the field of engineering. There is a growing understanding among the higher education institutions of the opportunities for “bespoke” industry courses and the contribution of university research to addressing industry and business problems. While focus on the “high end” of R&D is important, it is not a sufficient approach to economic development and should not be carried out at the expense of strong undergraduate programmes.

The development of the new campus “Ciudad del Conocimiento” (the City of Knowledge) for the Autonomous University of Ciudad Juárez will bring together the key higher education institutions in Mexico and state government in order to form a major knowledge hub with the capacity to draw foreign direct investment and to impact regional economic development. The City of Knowledge will provide an opportunity to widen the access to the university. The challenge is to ensure that the investments in real estate will underpin enhanced knowledge exchange and innovation for the benefit of regional development and integrate and sustain the wider effort over time. There is also scope to expand the collaboration with the higher education institutions on the other side of the Rio Grande, in view of the broader development needs of the region. Future challenges include ensuring that both students and graduates are engaged in entrepreneurial activities, that a pipeline of spin-off firms and graduate start-ups is developed and that effective support is delivered to small and medium-sized enterprises and not only larger firms.

Higher education institutions have each developed their own mechanisms for engaging with business and industry, and the US universities have gone down the route of having dedicated offices for technology transfer and intellectual property. Stronger impacts could be achieved through concerted efforts of universities....

The existing technology transfer or licensing offices (TTOs and TLOs) in the Paso del Norte US universities lack the economies of scale or scope to optimally commercialise faculty innovations and the scale of commercialisation activity remains relatively low. As with TTOs and TLOs in the United States, it can be expected that the existing technology licensing offices actually may lose money. It can also be expected that much of the current activity involves commercialisation outside the region. On the Mexican side, the legal basis for intellectual property protection is not yet fully developed. As a consequence, internal procedures or policies to address intellectual property rights as well as incubation programmes are at early stages of development in many Mexican higher education institutions.

Given the limited scope of the revenues generated by the technology transfer offices, broadening the understanding of knowledge transfer, knowledge utilisation and exploitation would be useful. By focusing on how the university research can support jobs, industry productivity and innovation in the region, the university technology transfer offices could move to a system that is based on developing continuous partnerships with regional industry, government and other partners. The new approach should embrace working to further develop open access/open source systems and inventions that have low revenue potential but high societal return.

In the United States small businesses employ 30% of high tech workers such as scientists, engineers and information technology workers. Spin-off companies are also often likely to be locally based and have a local economic benefit. The current rate of business formation in the Paso del Norte Region appears to be modest and the Paso del Norte universities are not prominent in fostering new enterprises in the region. Efforts in entrepreneurial activities and entrepreneurship education are in an early phase of development. This is reflected in the limited breadth and refinement of entrepreneurship education activities in the higher education institutions and the small proportion of students benefiting from them.

Collaborative mechanisms between the higher education institutions in the Paso del Norte Region to boost innovation, business incubation and development remain limited, with the exception of the Bi-National

Sustainability Laboratory (BNSL) that brings together Sandia National Laboratories, the US-Mexico Foundation for Science, the University of Texas at El Paso and the New Mexico State University and other regional organisations to help new technology driven start-ups. The Paso del Norte Region would benefit from concerted efforts to support entrepreneurship activities and share good practices among the higher education institutions, business and government. For example, a joint centre in entrepreneurship and small and medium-sized enterprises (SMEs) could be set up in collaboration with the regional development agencies in order to pool resources and gain critical mass. Furthermore, university programmes in business development and incubation should be extended and tied more closely to regional efforts, such as those being undertaken by regional development agencies. The focus should be on industries rather than on individual firms. Learning from the experiences of the Monterrey Tech, one of the leading entrepreneurial universities in Latin America would also be useful. Monterrey Tech has a broad approach to entrepreneurship that ranges from a wide portfolio of high-tech spin-offs to support for social entrepreneurship, including work in remote and rural areas.

There is currently no mechanism for pooling the knowledge and expertise of all higher education institutions to deliver support to industry. While setting up a joint front office for higher education institutions in a bi-national, tri-state context is a challenge, modern technology could facilitate collaboration in this area. For example, in North East England, the Knowledge House provides a single point of contact for five universities in the region as well the North East branch of the Open University in England. By using virtual and face-to-face collaboration, the Knowledge House has overcome barriers in collaborating with small and medium-sized enterprises (SMEs) and with industries, and increased the amount of technology transfer taking place between universities and local firms.

The following measures would promote regional innovation in the Paso del Norte Region:

- A systemic perspective should be applied to construct a regional development strategy by improving the connectivity in the regional innovation system through stronger collaboration and networking, focusing on consensus building for economic development and more efficient division of labour between the educational institutions and their partnering industries. The goal is to encourage collaboration across higher education, research and industry, and particularly small and medium-sized enterprises. Consistent innovation indicators should be developed and monitored over time.

- The state and local governments should ensure that research on clusters and the demands of industry extend into the service sector. Clusters should also be conceptualised as cutting across the manufacturing-service divide. For example manufacturing innovations increasingly incorporate service components. Higher education institutions should be encouraged to draw upon business schools, the humanities and social sciences in providing assistance to businesses.
- To upgrade existing industry and to improve graduate retention, the region should consider establishing specific “people-based” mobility programmes to link the students, graduates and post-graduates with the local business and industry in a more systematic way. Models for linking postgraduate students with the local industry include the Knowledge Transfer Partnership Scheme in the United Kingdom that has improved the competitiveness of the participating companies through introduction of some form of innovation or new technology and helped retain 75% of the postgraduate associates which participate in the projects.
- The Paso del Norte Region, its higher education institutions and the public and private sector should make systematic concerted efforts to support new business formation, minimise the administrative burden and build an environment and mechanisms that support start-up and entrepreneurial companies through aligning incentives for a sustained period of time. The higher education institutions should strive to match global levels of excellence in supporting entrepreneurship throughout the curriculum. This curriculum should build comprehensive support programmes encompassing entrepreneurship training and provide practical experiences in creating new businesses. It should support incubation facilities along with seed funds for new graduate ventures. Consideration should be given to establishment of a regional resource centre supporting entrepreneurship and small and medium-sized enterprises in order to pool resources and gain critical mass. Private funding sources willing to invest in “ideas” rather than real estate should be strengthened.
- To support the revitalised entrepreneurship agenda, public authorities should construct efficiency/performance indicators for public agencies including higher education institutions involved in innovation to reduce the tendency to measure success in innovation by the amount of (public) investment made, rather than the amount of commercial return generated or jobs created. Indicators could

include: *i*) time to process project applications; *ii*) cost to the proponent (in time and resources) of applying to various public programmes; *iii*) administrative costs for the programmes, etc. The indicators should be benchmarked against a set of credible comparators that include good private sector actors as well as top public sector agencies.

- The universities in the Paso del Norte Region should focus their joint efforts on challenge-driven innovation addressing the key issues in the cross border region, such as water, Hispanic/border health and border security in its broader sense and use the region as a “laboratory” for research, knowledge transfer and outreach to reach global levels of excellence. Job creation should be seen as the focus of innovation activities.
- The universities in the Paso del Norte Region should broaden their understanding of knowledge transfer, utilisation and exploitation and place less emphasis on financial return to the university. By focusing on how university research can support jobs, industry productivity and innovation in the region, the university technology transfer offices could move towards continuous collaboration with industry, government and other partners. There should be stronger emphasis on the development of open access/open source systems (e.g. Digital Commons at UTEP) and interventions with high potential to yield societal returns in order to build support among broader segments within higher education institutions (beyond business and engineering faculties) and within non-profit sectors in the cross border region.
- The Paso del Norte higher education institutions should develop a hands-on engagement with business and a more collaborative way of handling enquiries from business and industry with the use of virtual collaboration. This service should be proactive rather than introducing a stand-alone portal. The states should provide additional funding to encourage greater involvement by the small and medium-sized enterprises (SMEs). Knowledge House in the North East of England demonstrates a well functioning model linking five universities and Open University. Each higher education institution should consider establishing a single office to manage the institution’s external interface including regional collaboration in order to improve communication within and between the higher education institutions, generate cost savings and create more approachable structure from the perspective of external stakeholders.

- State government and higher education institutions in Ciudad Juárez should balance the current focus on industry skills development and high end R&D with considerable efforts to develop small and medium-sized enterprises and new business formation.
- El Paso and Las Cruces should continue their efforts to expand higher skill/higher wage jobs in the environmental and health fields, defence-related fields and in global service operations that take advantage of the bi-lingual and bi-cultural environment and the ability to reach markets across NAFTA countries and Latin America. The higher education institutions on the US side should play a more active role in helping the Paso del Norte Region build a more robust economy based on knowledge and innovation.
- Incentives for higher education institutions should be strengthened in order to advance their capacity to act as technology transfer “agents” to bring non-local knowledge to the region and to create community partnerships. Incentives for higher education institutions and their staff to engage in local and regional development should be developed. The state governments could seek to encourage greater collaboration between higher education institutions through joint investments in research facilities and incentive programmes.

Environment, social development and border health in the Paso del Norte Region

The Paso del Norte Region faces difficult environmental challenges including climate change, persistent drought and the lack of water. These factors are exacerbated because of the fragility and limits of the desert environment, poverty and rapid population growth. Higher education institutions have taken steps to contribute to sustainable development in the region...

The air quality in the Paso del Norte Region remains a serious issue on the US-Mexico border. Climate model experiments indicate that the South-western part of the United States and Mexico will experience progressive drought during the 21st century. Ciudad Juárez, the largest and most rapidly growing city in the Paso del Norte, faces a near-term crisis due to severe depletion of fresh ground water. Further industrial expansion and many

economic development interests work to attract more industry into the region, thus increasing population growth and water demand. A comprehensive, regional approach to water planning and growth management is a challenge due to the political and institutional fragmentation in the bi-national, tri-state region. As a consequence of the jurisdictional divisions and differences in water laws, water planning in the region remains decentralised while more progress has been made in the cross border collaboration for air quality improvement.

Faced with the considerable challenges of environmental sustainability, the Paso del Norte higher education institutions have engaged in on-campus good practice and research activities. The New Mexico State University and the University of Texas at El Paso integrate sustainability guidelines in new construction and capital improvement projects. In Mexico, the new campus of the Autonomous University of Ciudad Juárez “the City of Knowledge” will be powered by wind and solar energy and will contain energy efficient buildings.

There are also a number of research centres in place to address environmental challenges in the region. The University of Texas at El Paso has several centres that focus on environmental sustainability, such as the Centre for Inland Desalination Systems (CIDS) and the Centre for Environmental Resource Management (CERM), which collaborates on a long-term basis with the City of El Paso and reaches out to neighbourhoods to provide energy efficient technologies and water disinfection technologies. CERM’s award winning *Agua para Beber* (Drinking Water) is a community-based, train-the-trainer programme that teaches appropriate water disinfection technology and home sanitation and healthy home environments in low-income neighbourhoods. The New Mexico State University (NMSU) has the Water Resources Research Institute as well as the Institute for Energy and Environment that combines expertise in environmental education and technology development and renewable energy resource development. The Autonomous University of Ciudad Juárez collaborates with the federal government through the National Water Commission, CONAGUA, in a multidisciplinary research programme on water resources. The Monterrey Tech has a three-tier action plan to promote sustainability through curricula, awareness raising among university community and collaboration with private and governmental agencies, for example through research on wind and solar energies and the development of sustainable low-income housing.

... furthermore, ongoing cross border initiatives raise hope of concerted efforts to address the challenges and to underpin a more comprehensive approach to natural resource management...

The Bi-national Water Program was established in 1992 by the University of Texas at El Paso as a response to potential conflicts over the use of the region's diminishing water resources and public anxiety over health risks. It has brought together federal, state and regional agencies, municipalities and irrigation districts as well as private sector and non-governmental organisations. The programme has been extended and expanded over the years with the help of federal grants and foundation funding and culminated in the establishment of the Paso del Norte Water Task Force, which has provided a forum for the exchange of information and development of a regional Geographic Information System (GIS) to facilitate the compilation, mapping and analysis of the region's water resources. Other regional initiatives of importance include the collaboration of UTEP and the co-operative extension at New Mexico State University to conduct research on increasing irrigation efficiency in the Rio Grande Basin, the collaboration between the New Mexico State University and farmers in Chihuahua to develop and implement water conserving agricultural production methods and the participation of the region's higher education institutions in the educational and research programmes being undertaken by the Paso del Norte Watershed Council.

An important opportunity for cross border planning capacity lies in the above mentioned joint initiative to develop Geographic Information Systems (GIS) that can provide spatial data for the region as a whole. This initiative was developed through the University of Texas at El Paso (through the Regional Geospatial Service Center), New Mexico State University and the Autonomous University of Ciudad Juárez to develop a Coordinated Water Resources Database and GIS website as well as to develop a model of Rio Grande water flows. A comprehensive data system should be created to combine environmental and social-demographic data and present a picture of the region as an integrated eco-system in order to galvanise regional leadership and on policy makers.

Cross border, cross-state collaboration for sustainable development is a challenge in water resource planning and air quality control and has implications to higher education institutions' work who often limit their collaboration in their immediate surroundings. The universities in the Paso del Norte Region have played a brokerage role in addressing the challenges linked to water resources and air quality, initiated data gathering

and participated in collaborative efforts which have begun the process of addressing environmental problems on a regional scale and in an integrated manner. These can underpin governmental efforts to provide a more comprehensive approach to natural resource management.

Environmental challenges can be turned into opportunities by scaling up research efforts in water management and alternative energy sources. The development of a “green” economy in the Paso del Norte however depends on the availability of skilled labour...

Environmental challenges can provide an opportunity to develop a more resilient and sustainable economy. They can encourage positive developments for the region, including increased efficiency in energy management, industrial production, spatial development, public and private transport, construction and operation of buildings and water management. Jobs related to renewable energy and energy efficiency are projected to increase to several millions worldwide by 2030, many of them in a small number of innovative regions. In addition, despite the current financial crisis, venture capitalists anticipate a continuous increase in their investments to boost clean technologies.

Up-scaling the research and innovation effort in sustainability could yield significant returns in local and regional development. Positive outcomes would require concrete action to identify opportunities for change, to create innovations in water management, to make low-carbon technologies more attractive and to develop skills to make wider use of green technologies.

The development of a “greener” economy in the Paso del Norte Region will depend on the availability of skilled labour to fill the new jobs related to renewable energy and energy efficiency. Extensive retraining and up-skilling as well as developing a diverse set of new skills will be necessary. Skill creation for “green” jobs could be more efficiently organised by pooling learning resources of educational institutions and industries at the regional level. This requires transparent pathways between different levels of education and also between higher education institutions.

The Paso del Norte population has a high incidence of poverty-related health problems and limited access to health care services.

Despite the range of health services available, the region remains under-served by health professionals given the size and needs of its population. Cross border collaboration could help the situation

The Paso del Norte Region is home to a low-income population, many without access to any form of health care insurance and unable to afford health care provision. Because of poverty, a lack of access to preventive health care and exposure to environmental hazards, the population has a high incidence of tuberculosis, chronic diseases such as Type II Diabetes and diseases, such as typhoid fever, that have been virtually eliminated in many countries. Many of these diseases are transmittable and raise risks for the regional population as a whole.

The Paso del Norte Region has a chronic shortage of medical and health care professionals. The development of joint medical and health care programmes by the higher education institutions in the cross border region remains a challenge because of the significant differences in the organisation of training, scope and practice of health professions and licensing of practitioners in Mexico and the United States. However, while physicians and nurses may be limited in their ability to practice across the regional border, cross border utilisation of medical services are common in dentistry, vision care and pharmaceutical services.

There are also examples of successful co-operative projects to train health care personnel between higher education institutions in Mexico the United States. Bi-national programmes are being pursued between California and Baja California where bi-lingual nurses are being sent to Mexico to receive a portion of their training because of the lack of capacity in US nursing schools. Furthermore, the University of Arizona and the *Colegio de Sonora*, a private postgraduate training and research institute in the State of Sonora in Mexico have established a joint Master's degree programme in Border Public Health. The University of Arizona and the University of Sonora also have in place a summer training programme that provides intensive clinical and language training to medical students from both institutions. Model cross border programmes should be developed in the Paso del Norte Region building on the high quality of nursing and medical education and commitment to lifelong education and career development in El Paso which will assist the development in the region as a whole.

...The Paso del Norte Region has considerable scale and expertise in the clinical health care programmes and border health issues. This should be applied to develop strategies to increase the quantity and quality of health care provision across the region. Existing research programmes on health issues specific to a low-income population should be scaled up and extended across the border in order to develop the region into a world class centre of expertise in border health ...

The higher education institutions in the Paso del Norte Region are developing challenge driven research expertise in the specific sources of health problems that show a high incidence in border communities such as low-income population health (Texas Tech's Paul Foster School of Medicine), regional genetic disease profiles (Autonomous University of Ciudad Juárez) and low cost bio-medical devices to improve preventive health care and bio-information (across all higher education institutions in the region). The research projects that focus on health problems in border communities have a strong potential for co-operative research efforts that could serve the needs of the Paso del Norte Region for more effective health care. They have the capacity to position the region as a whole as an international centre of expertise and innovation on health care practices and technical innovations that improve health care outcomes in particularly health care disadvantaged populations.

The Paso del Norte higher education institutions also have a tradition of serving their communities to improve their health outcomes. For example the Texas Tech at El Paso's clinics located in East, West, Central and Northeast El Paso provide care to underserved areas lacking adequate healthcare. The University of Texas at El Paso has partnerships with clinics, hospitals, schools, non-profit organisations and governmental agencies through 400 formal agreements. The New Mexico State University's partnerships in the health and medical services include internships in clinical nursing where students are placed in local schools, hospitals and nursing care programmes. Its Co-operative Extension Services provide health-related services to the individuals and families around the state. The Ciudad Juárez, the autonomous university of provides medical and dental care through *Brigadas Médicas*. This commitment, combined with the scale and scope of training programmes in health care, should form the basis for a broader regional effort.

Higher education institutions in the Paso del Norte Region have a tradition in community service and outreach. Mexican higher education institutions follow the national requirement that all university students must complete social service, while on the US side community service is on a voluntary basis. Despite commendable examples in this field, there is a need to improve the co-ordination, monitoring of results and to move towards community development ...

In Mexico, the national requirement of mandatory student social service for at least 240 hours as a graduation requirement has generated good results in mainstreaming community service activities into the core business of the higher education institutions. For example the Autonomous University of Ciudad Juárez (UACJ) has instituted a minimum of 300 hours of social service in the curricula. The university's service learning/internship programme has on average per semester 1 680 students working in companies and 1 300 students working at the university. Similarly, Monterrey Tech's campus in Ciudad Juárez has a community service programme that engages students in programmes that generate social, economic and education development in marginalised communities and social assistance organisations. Collaboration is often organised through The *Fundación del Empresariado Chihuahuense (FECHAC)*, a pioneering intermediary organisation in Mexico between the business community and the over 100 non-profit organisations that serve the community. A total of 38 000 local business people from Chihuahua contribute through FECHAC toward social and development projects throughout the state of Chihuahua.

The university graduates of the New Mexico State University (NMSU) and the University of Texas at El Paso (UTEP) participate in community service and volunteer activities at or above the national rates. UTEP contributes to the quality of life in El Paso by providing public access to a variety of social and cultural programmes relevant to Latin populations. Its Center for Civic Engagement, recruits students into service learning opportunities on a volunteer basis. The centre has engaged thousands of university students in public service learning. The voluntary participation of students is notable because the vast majority are working part-time or full-time. The projects at their apex connected with 100 community organisations in communities in the United States and Mexico.

The New Mexico State University (NMSU) has, as a land-grant institution, a special mission to serve the State of New Mexico and has

cooperative extension offices in all 33 counties of New Mexico. The university is home to a Heritage Center that preserves and protects the histories and cultures of different ethnic groups in the region. The university's Office of International & Border Programs includes an office in the capital of the neighbouring Mexican state of Chihuahua. About 500 students and faculty are involved in mobility programmes and programmes with extensive collaboration in civil engineering, aerospace, management, agribusiness and special education, between NMSU and Autonomous University of Ciudad Juárez and Autonomous University of Chihuahua. It also sponsors about 40 joint R&D projects with partners in Mexico and therefore provides an excellent opportunity to scale up cross border collaboration.

The programmes developed by individual higher education institutions are notable for their partnerships with external stakeholders and capacity to work across all sectors in sustained commitment. However, there is limited evidence of collaboration between all higher education institutions in the region and systematic monitoring of results, which would help evaluate the outcomes of outreach activities as a whole. Furthermore, despite the obvious benefits of these programmes there is less evidence of long-term community development programmes that would build capacity within these communities to help themselves. The scope and impact of the activities are constrained by the transiency of the population in many poor communities as well as short term project funding. Finally, the activities of the community serving organisations in Ciudad Juárez and El Paso, including those assisted by the regional higher education institutions, have been significantly curtailed by the recent violence in Ciudad Juárez.

The following measures would enhance the contribution of higher education institutions to the social, cultural and environmental development in the Paso del Norte Region:

- A systematic exchange of information and experience should be put in place through the establishment of a forum between higher education institutions in social, cultural and environmental matters facilitated by the Paso del Norte Group in order to bring about greater efficiency in these areas. Such a forum should organise thematic events, with regular information retrieval and exchange facilitated by a dedicated website. As a first step, higher education institutions' current connections, initiatives and projects involving stakeholder collaboration, community development and/or outreach should be mapped and published in the collaboration platform.

- Higher education institutions in collaboration with the public and private sector in the Paso del Norte Region should increase their conjoint efforts to support sustainable environmental and economic development through a comprehensive regional approach to water planning and growth management bringing together diverse regional actors to sustainability process. Higher education institutions should scale up their efforts to provide learning and further education programmes for “green” jobs and act as a source of expertise through research, consultancy and demonstration. Major areas of concern in the region are drought, scarce water supplies and air quality. The cross-border climate observation networking should be improved and expanded due to convergence of natural and man-made drought. In addition, drought planning and water conservation efforts should be enhanced. There should be an analysis of the benefits and costs of controlling emissions from the wide variety of sources, for example, foundries, brick kilns, airborne particulate matter from unpaved roads, and the *maquiladora* plants with data on abatement costs. Further, there should be a review of vehicular emission controls to reduce vehicle emissions.
- Building on existing successful models, capacity should be developed in regional data gathering, and sharing regional data repositories and technical skills associated with using regional data. Successful models in the area of natural resource management should be extended to the field of health. For example the Paul Foster Texas Tech Health Sciences Centre research agenda to document and learn about the incidence of health problems in the region could benefit by intersecting with the programmes undertaken in environmental science and resource management. The economic, social, and environmental analysis undertaken by the Institute for Policy and Economic Development at the University of Texas at El Paso should be used to lay the groundwork for a cooperative regional and analytical capacity, inclusive of all higher education institutions in the region. In addition, higher education institutions should engage students in gathering data on health problems and socio-economic and environmental conditions. With this effort, they would learn about survey research, the intersection between environmental conditions, socio-economic status, and health problems, and methods for analysing data.
- The region should take steps to develop a world-class programme that improves health outcomes in the region and has an impact on global knowledge about methods to improve health care provision and outcomes for low-income populations. This opportunity could

be enhanced through cooperation with the higher education institutions in the region in providing the regional data to contribute to the design of research and innovative health care provision programmes. Regional expertise in health should be applied to develop strategies to increase the quantity and quality of health care provision across the Paso del Norte Region. This expertise should be used to develop the region as a whole as an internationally recognised centre of expertise and innovation on health care practices and technical innovations that improve health outcomes in particularly health care disadvantaged populations. It should especially address the health needs of the *colonias* settlements, which are sizable in the exurban areas on both sides of the border.

- The Paso del Norte Region should focus on health occupations that offer significant potential for building human capital assets and regional research programmes that can set the region apart. The training of medical and health care personnel should be scaled up to the critical needs of the low income population across the region. Possibilities should be explored to increase access to Mexican health services by the US residents. Model cross border programmes in health and medicine should be developed building on the high quality of nursing education and commitment to lifelong education and career development in El Paso. Collaboration should be enhanced across the region in clinical trials and the development of low cost bio-medical technology. In addition, the region should focus on nursing training to improve overall quality of life.
- Cross-border interactions between higher education institutions and non-governmental organisations should be strengthened and further developed in order to maintain and enhance regional civic co-operation. The role of non-governmental organisations in the bi-national Paso del Norte Region is critical and the higher education institutions are already in collaboration with non-governmental organisations in connecting students with service learning opportunities.
- In addition to providing services to various communities, higher education institutions should engage in long-term community development, seeking ways to empower communities to find their own solutions to various economic, social, cultural, environmental challenges, which are global, national and local in nature. They should consider ways to balance the current approach, which has a focus on combating poverty, with fostering wealth and job creation through social entrepreneurship. The region should be seen as a

“laboratory” for developing research, students’ work-based and experiential learning and development projects in many different fields.

- The knowledge base about regional issues should be expended through stronger involvement of students and faculty. For example, local cable television affiliates have a weekly programme, whose goal is to report on subjects that affect the residents of El Paso, Ciudad Juárez and Las Cruces. A weekly programme *Nuestra Frontera* primarily covers education and health. The higher education institutions in the region should be conduits for content for this programme and for other media that attempt to reach and report on the region as a whole.

OECD reviews of higher education in regional and city development

Universities and other higher education institutions can play a key role in human capital development and innovation systems in their cities and regions. In the context of global economic and financial crisis, OECD countries are seeking to mobilise higher education institutions (HEIs) to support more strongly their economic, social and cultural development.

In 2008, the OECD/IMHE launched a second series of OECD Reviews of Higher Education in Regional and City Development to address the demand by national and regional governments for more responsive and proactive higher education institutions. As a result, 14 regions in 11 countries have undergone the OECD review process in 2008-10.

This OECD Review of Higher Education in Regional Development of the Paso del Norte region in the United States of American and Mewixo(<http://www.oecd.org/dataoecd/17/61/45820961.pdf>) explores a range of policy measures and institutional reforms to mobilise higher education for the development of the region. It is part of the series of the OECD reviews of Higher Education in Regional and City Development. The reviews analyse how the higher education system impacts local and regional development and help how this impact can be improved. In addition to human capital and skills development, technology transfer and business innovation, the reviews also considers higher education's contribution to social, cultural and environmental development and regional capacity building.

To know more about the OECD review process and requirements, visit Higher Education and Regions' website at

www.oecd.org/edu/imhe/regionaldevelopment.