ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 5, Issue, 03, pp. 664-668, March, 2013

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

INNOVATION CLUSTERS AND AEROSPACE INDUSTRY, THE KEY INGREDIENTS FOR REGIONAL DEVELOPMENT

[1,*]Tonatiuh Najera Ruiz and [2]Angélica Santana Fierro

[1]SolBridge International School of Business, Republic of Korea
[2]Tecnologico de Monterrey campus Chihuahua, Mexico

ARTICLE INFO

Article History:
Received 27th December, 2012
Received in revised form
28th January, 2013
Accepted 24th February, 2013
Published online 19th March, 2013

Key words:
Innovation clusters,
Frequently,
Considered,
Sustainability,
Aerospace cluster.

ABSTRACT

The importance of innovation clusters has been studied frequently in recent literature. It is considered that the clusters are important for the economic development of the regions. However, its creation and subsequent sustainability does not happen automatically. It requires a series of policies and initiatives to encourage its creation. These policies, which can be classified into six categories, vary according to the life cycle stage in which the cluster is, to have the greatest impact. This paper analyzes the evolution of the aerospace cluster in the State of Chihuahua, Mexico, in which there is a grouping of 26 companies that generate more than 14,500 jobs. It is found that, by its nature, this cluster is in the early stages of development, and some policies that are clearly located in these same stages of their life cycle are identified.

INTRODUCTION

The importance of innovation clusters has been stated frequently in the recent literature. Not only for the employment generation or the technological spillovers, but for its implications on the generation of policies of regional development, and the creation of a strong infrastructure in several dimensions. Examples have been taken of different regions and cities around the globe of successful innovation and knowledge based policies that were implemented. Yu and Jackson (2011) discuss on the interconnections between current clusters and the new regional innovation clusters' policies of regional economic development and research on the local, regional and national levels. They also identify some of the barriers that reduce the effect of regional policies on economic development. This issue is also addressed by Arbuthnott *et al.* (2011), who analyze the threat that the current traditional established companies can oppose to the policies focused on the creation of new ventures and on the development of new innovative industries. Research has been done, too, on the life cycles of clusters and the policy implications of these periods.

Giuliani (2007) found that on the early stages, the leading companies of the clusters play the role of technological gatekeepers, becoming even larger sources of local learning, while on the other hand, Brenner and Schlump (2011) argue that clusters have been generally forced by the policy makers for a long time, even if the policy implications have not been systematically addressed in the scientific literature. This results, in turn, in the generation of policy recommendations that are made regardless of the stage of the life cycle in which the corresponding cluster is. On a different direction, Shin and Hassink (2011) illustrate the application of different policies according to the stage of the cluster with the case of the shipbuilding industry in South Korea. On their analysis, they show large subsidies from the government on the early stages of the cluster and a reorientation of the actors in the cluster to increase the heterogeneity and the external linkages to both the national and international levels. Incorporating innovation into regional development policies has become a necessity for the regions to compete in a globalized world with little to none restrictions to capital and to the production factors movement. The creation of collaborative knowledge networks becomes fundamental for the success of innovation clusters (Saad and Zawdie, 2011). Gonzalez (2009) analyses the "triple helix" model of collaboration between Universities, Industry and Government. She claims that the third mission of the universities imply that the academic production must be focused on the government needs and the use of funding organizations. Gonzalez states that the third function of the universities consists on contributing to the social and to the economic development through knowledge based innovations. Villasana (2011) adds that researchers seem to be highly motivated by the impact of their results on the local economy and community.

On this context, the third academic revolution is driven by the entrepreneurial universities, which assume the responsibility of creating new ventures on their laboratories and on their facilities, finding strategic niches and raising a new kind of academician: the scientific-entrepreneur (Gonzalez, 2009). Government and Industry through open policies and programs can encourage the creation of knowledge by funding both basic and applied research initiatives, sharing resources, and facilitating knowledge and technological spillovers. The aerospace industry is a complex high technology industry, on which the "increasing specialization…has created niche markets for technological and organizational knowledge in research, development, design, manufacturing, finance and markets" (Hickie, 2006). These markets are being developed in several regions around the world. Hickie (2006), on his analysis of knowledge and competitiveness in the aerospace industry claims that the large, complex and sophisticated network of subcontractors is fundamental to the industry. Moreover, it requires having a very close relationship

Corresponding author: tnajera@solbridge.ac.kr

between the customer and the suppliers, generating the relocation of some plants closer to their inputs and into regions in emerging economies, such as China, Brazil, India and Mexico. Goldstein (2002) in her analysis of the political economy of high-tech industries includes Argentina, Indonesia, Israel, Korea, south Africa and Turkey in the list of nations that decided to develop an aerospace industry. On this regard, MacPherson and Pritchard (2003), MacPherson (2009) and Heerkens *et al*. (2010) highlight the recent incorporation of regions in emerging countries as competitors and the withdrawal of some of the largest aircraft manufactures from that market, subcontracting up-to 90% of their manufacturing work. This paper presents an analysis of the evolution of the aerospace cluster in Chihuahua, Mexico which has brought together a range of public and private initiatives and policies to foster its development. The rest of the paper is divided as follows: the second section presents a brief review of the literature of the life cycles of innovation clusters. The third part presents the evolution and current state of the aerospace cluster in Chihuahua and the fourth section presents the main conclusions.

The clusters life cycle and their policies

Clusters can be classified according to their life cycle in four stages. Van Klink and De Langen (2001) distribute them into Development, Expansion, Maturation and Transition, while Menzel and Foenahl (2010) grouped them in Emerging, Growth, Maintenance and Decline. Following the terminology of Van Klink and De Langen (2001), the characteristics of each of the life cycle stages can be summarized as shown in Table 1.

Table 1. Cluster life cycle

	Development	Expansion	Maturation	Transition
Character of the value chain	Construction of the value chain with different firms	Specialization among firms in the chain	Stable roles of firms in the value chain	Reorientation of the roles of firms in the chain
Strategic relations	Development of strategic relations	Strengthening of strategic relations	Pressure on strategic relations	Reconfiguration of strategic relations
Cluster dynamics	Some entrants, no exits	Some entrants, no exits	Few entrants, few exits	Few entrants, many exits
Cooperative domain	R&D; standardization; cooperative routines	R&D; education; marketing; sharing infrastructure	R&D; education; marketing	R&D; education; new cooperative routines
Determinants for success	Presence of local resources, know-how and demanding home market	Presence of local resources, know-how and risk capital	Presence of local know-how and a balance between local and global orientation	Presence of (new) local resources and know-how and organizing capacity
Role of government	Providing information on local know-how	Stimulating outsourcing and market expansion	Professionalizing suppliers and stimulating neue Kombinationen	Stimulating neue Kombinationen

Source: of Van Klink and De Langen (2001)

During the Development stage, the first companies in the cluster are concentrated in specific regions. Spill-overs are generated as a mechanism of concentration of industry (Arthur, 1994 and Kepler 2007). At this stage, a mass of activity must be reached (Brenner 2001). Local conditions and the number of companies established in the region are key to achieving this mass. Brenner and Schlump (2011) summarize the importance, on this first phase of the importance of start-ups, knowledge transfers and the role of the anchor company. The existence of universities, research centers and other industries also contribute to the development of the cluster. At the expansion stage, the market increases significantly, as the number of companies and jobs generated (Brenner and Schlump, 2011). Networking increases and becomes one of the most important activities in the development of the cluster (Menzel and Fornahl, 2007). In the cluster expansion, the interaction between companies in the cluster and its environment through cooperation, networking and innovation are very important (Brenner and Schlump, 2011). Start-ups are still very important, but begin to lose weight. At the Maturation stage, the market has stabilized and has reached a certain equilibrium (Brenner, 2001). At this time, the creation of new enterprises is no longer important for the cluster. There is even empirical evidence that some companies no longer find any benefit of being located in the cluster (Audretsch and Feldman, 1996). The elements that, at this stage, support the cluster, are those of regional cooperation and networking (Brenner and Schlump, 2011). In the last stage of the life cycle of the cluster, the Decline or Transition, the market for the products of the cluster is declining, and this makes it to be in very difficult conditions, which forces the cluster to a re-conversion to open new market opportunities (Brenner and Schlump, 2011). Policies for cluster development can take many forms, and each has different impacts depending on the stage of the life cycle of the cluster. Brenner and Schlump, (2011) identify six broad categories of policies for cluster development: Education, Public Research, Supporting Research and Development (R and D) and Culture of Innovation, support Entrepreneurship, Organization and Support Network Cooperation and Local Conditions and Infrastructure. Education policies relate to initiatives for the formation of human capital. Depending on the magnitude of these measures, they usually appear in the expansion and maturation stages (Brenner and Schlump, 2011). However, the development of strategic skills is essential for the preservation of the cluster in the initial stages (DTI, 2004). Additionally, Martin and Sunley (2003) note the importance of linking the cluster with universities in order to benefit from their research and focus their programs to the technological needs of the cluster. Public research, partly connected with education, is important in the initial stages and in the maturation phase of the cluster. In the former, to become a supplier of knowledge and services. In the latter stages, the products of research are crucial to prevent the decline of the cluster (Brenner and Schlump, 2011).

The establishment of policies to support R and D and innovation culture is essential in the initial stages of the cluster (Brenner and Schlump, 2011). These are different from the policies of public research, and can be implemented only by companies and should be focused on promoting innovation in the cluster through the collaboration of different stakeholders and their qualifications (Fromhold and Eisebith, 2005). Examples of these policies are technology parks and business incubator programs (Bathelt *et al*, 2004). Policies to support start-ups are closely linked to the promotion of clusters, since the development of a broad base of companies to consolidate the cluster in the initial stages and to maintain them in the later stages is necessary (Brenner and Schlump, 2011). In the early stages of the development of the cluster, a number of policies for the organization of networks and cooperation are identified. Initially these are informal networks with occasional meetings. However, as the consolidation of the cluster advances, policies must focus on formalizing these networks and strengthen collaboration among key agents (Bathelt *et al*., 2004). Generally, local conditions and infrastructure are considered important factors for the economic development of regions. However, it is common

that conditions that are sufficient in the initial stages of a cluster are not for the later stages of expansion and maturation, which require bigger investments (Menzel and Fornahl, 2007). The policies have different impacts according to the life cycle of the cluster. Brenner and Schlump (2011) summarize these effects in Table 2.

Table 2. Policies and their implementation in the life cycle of clusters.

Most relevant phase in the cluster life cycle	Policy measure
Initial	Start-up promotion (science parks, incubators)
	Cooperation support
	Development of innovative culture
	Establishment of laboratories
	Research and development support
Initial/expansion	Education and training (conferences, learning processes)
	Networks (informal, institutionalized), joint activities
	Seed funds, better access to capital, venture capital
	Cluster marketing and service provision
Expansion	Screening activities, access to new technologies
Expansion/mature	Spin-off support (financing, collaborations, services)
Mature	Development of human capital, specialized work force
	Support services
	Renewal of networks, cooperation
	Lighthouse projects
	Set-up of research institutes

Source: Brenner and Schlump (2011)

The Aerospace Industry in Chihuahua

According to Promexico (2012), "Mexico's aerospace industry is constituted by companies that manufacture, maintain, repair, fit, engineer, design and provide auxiliary services to commercial and military aircraft". The growth of this sector has tripled in only six years. In 2011, the industry´s exports reached 4,337 billion dollars while the imports accounted for 3.782 billion dollars. Currently there are 249 aerospace companies in Mexico spread in 16 States: Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon, Estado de Mexico, Distrito Federal, Guanajuato, Queretaro, Jalisco, Puebla, Aguascalientes, San Luis Potosi, Tamaulipas, Yucatan and Zacatecas (Secretaria de Economia, 2012). Companies like Bombardier, Safran Group, Honeywell, Eaton Aerospace and ITR transferred to Mexico to supply mainly the United States, Canada, Germany and France. With the arrival of these 249 companies more than 31,000 employments have been created, and it´s estimated that in the following 5 years between 30,000 and 40,000 highly paid jobs might be created if the foreign direct investment continues flowing (Promexico, 2012).

Mexico is a destination of foreign direct investment in the aerospace sector mainly because of its strategic geographic location, experience, reliability, competitive costs, innovation, talent and certified quality (Promexico, 2012). There are three important divisions in the regional clusters of the airspace industry in Mexico: the Northwest (Baja California, Sonora and Chihuahua), Northeast (Nuevo León, Tamaulipas, Coahuila) and the Center (Querétaro, Distrito Federal, San Luis Potosí, Edo. de México, Puebla, Guanajuato. Chihuahua is clustered in the Northwest regional cluster which specializes in the manufacture and/or assembly of electrical and electronic equipment for aircraft, engine parts, assemble interior and seats, navigation and control instruments, design and testing of electrical systems (Secretaria de Economia, 2012). In the mid-1970s the State of Chihuahua was considered the worldwide capital for the production of harnesses for the auto industry. Companies like Packard Electric-Delphi created 24 offshore locations in Ciudad Juarez, in which they generated 30,000 jobs (Lara 2002). The convergence of automotive and electronic industries eased the creation of the aerospace industry. In the late 1990s the first aerospace contract came to the state of Chihuahua due to the negotiations between American Industries and Labinal, formerly Aerotec. It began its production as a complement for the harness-assembler industries. Labinal began producing the harnesses of military planes for Airbus. Later on that decade, Carlisle started to produce aircraft harnesses for Boeing in the State of Chihuahua. During the 1998-2004 administration of former governor Patricio Martinez, the maquiladora industry in Chihuahua reached its height. One plant was inaugurated per week. Such an increasing production made possible that the automotive and electronic industries became strongly consolidated. In 2000, at the request of the Private Sector, the State Government, through the Ministry of Economy and in coordination with the Ministry of Education, established in Ciudad Juarez the Training Centre in High Technology (Centro de Entrenamiento en Alta Tecnologia-CENALTEC). This Centre is an institution that offers training programs to technical staff in specific areas demanded by the industry. Later on, in 2006 CENTALTEC was opened in Chihuahua city. At the end of Martinez period a decline in the production of the auto and electronic sectors was registered and new opportunities were seek. On the following State Governor administration (2004-2010), a new plan for industrial development was developed. The Economic Development Council of Chihuahua (CODECH) was created in 2004 to fulfill the desire of a new course in the economic development of the region. This new vision aimed to integrate the production chains in higher value added industries such as the automotive, electronics and aerospace, and to generate a strong link between the industries and the universities (CODECH, 2004)

CODECH is a public-private and social council dedicated to coordinate and combine efforts of different actors in the regional economic development of the State of Chihuahua. It also serves as a facilitator for the design and implementation of initiatives that are based on the local arena and that will have an impact statewide. One of its main functions is to evaluate and monitor the implementation of programs and policies of regional development driven by the three levels of government (Federal, State and City), the productive sector and universities. Negotiations were made and Cessna, Honeywell Aerospace, Zodiak, among other companies transferred plants to Chihuahua. The radars of the foreign aerospace industry locate Chihuahua as a strategic location to host manufacturing operations: 4 out of 7 Original Equipment Manufacturer (OEM´s) in Mexico are located in Chihuahua. Nowadays, the aerospace industry in Chihuahua represents more than 30% of Mexico's total employment of this industry and has a potential growth for the next 3 years, since new projects are landing (FEMIA, 2012). Currently there are 26 aerospace industries located in the state of Chihuahua. That generate 14,688 jobs. Table 3 shows the companies that currently conform the cluster in Chihuahua.

When CENALTEC was established in Chihuahua city in 2006, it opened the Council of Entailment between the Academy and the Productive Sector (Consejo de Vinculacion Academico-Productiva-COVAP) with the main objective of promoting an effective linking scheme that allows the integration of supply and demand for graduates of upper secondary level, upper middle and universities with a focus in technology and industry. The Aerospace Cluster of Chihuahua was born as a committee within the Association of Maquiladoras and Exporters AC (Asociacion de Maquiladoras y Exportadoras-AMEAC) INDEX now, and was defined as a cluster in 2008, under the representation of AMEAC. Since 2008, the cluster has developed diverse strategies and actions to strengthen the development of human capital for the aerospace industry with the support of CENALTEC. The convergence or triple helix between the Private Initiative, the Government and the Academia has propelled the generation of human capital specially trained to capitalize the growth of the aerospace sector in Chihuahua. Universities such as Tecnologico de Monterrey Campus Chihuahua, Universidad La Salle, Universidad Autonoma de Chihuahua (UACH), Universidad Autonoma de Ciudad Juárez (UACJ), Universidad Tecnologica de

Table 3. Directory of companies that conform the airspace cluster in Chihuahua

Company	Country of origin	Operations	Year of establishement	Number of employees	Products
Safran- Labinal	France	3	1990	2799	Harnesses and control systems for Airbus as well as harnesses for aircraft.
Capsonic*	United States	1	1996	37	Solenoid to the ignition system of the engine for Boeing, F15, F16, SAP, Embraer, Bell Helicopter to Goodrich
S.G.I.*	Unites States	1	1997	350	Electromechanical parts for military uses.
JBT AeroTech (E.M.D.)*	United States	1	1999		Harnesses for aircraft
Cambrian Industries*	México	1	2004	30	Metal mechanical operations and secondary operations for aerospace products
SIPPICAN*	United States	1	2004		
CESSNA	United States	4	2006	768	Aluminum foil subassemblies, fuselages and carbon fiber wings for aircraft.
Honeywell Aeroespace	United States	3	2006	1429	1.-Production of gears (turning, heat treatment, gear Generation) 2.-Nondestructive Inspection using dye penetrant and x-rays 3.-Chemical cleaning using detergent and nitric acid 4.-Production of Blades (grinding) 5. - Impellers 6. - machining Center from 5 to 7 axes
Zodiac	France	5	2006	1162	Slides for Boeing 787, Airbus A320, Airbus A321 and rafts to accommodate up to 46 people, as well as fuel tanks for military helicopters Lifesaving rafts and slides for aircraft. Picnic tables and arm rests aircraft. Fuel tanks for military aircraft and helicopter. Coating of hoses for the landing gear. Electronic tablet for navigation pane.
ENTERR ENTERPRISES (AEROSAN)*	México	1	2006	4	Structures for aircraft assembly
HAWKER BEECHCRAFT	United States	2	2007	1089	Business aircraft
A E. Petsche	United States	1	2007	2	Kitting and Assy connectors
SOISA	México	1	2008	142	Covers for life rafts
TIGHITCO	United States	1	2008	186	Sheet metal
CAV Aerospace	United Kingdom	1	2008	118	Airplane seats and other internal parts of the plane
The Nordam Group	United States	1	2008	105	Structural assembly and manufacture of high-tech composite material parts for business and commercial aircraft.
Textron Internacional México	Canada	1	2008	268	Parts, subassemblies and structures for helicopters
Manoir Aerospace Forges de Bologne México	France	1	2009	15	Vanes and torque tubes
Kamman Aerospace	United States	1	2010	200	Structures and details of parts and metal components
Metal Finishing	United States	1	2010	52	Manufacture of radio tubes and thermographs
Souriau	Canada	1	2010	3	Production of metals and non metals, components and assembly. Chemical process and heat treatment.
ATLAS Group	United States	1	2011	60	Stamped and machined parts of aluminum, metal parts and assembly of simple and complex parts.
Arnprior aerospace	Canada	1	2012	136	Metallic component and assemblies
FOKKER	Holland	1	2012	323	Structural components for aircrafts
Jabil	United States	1		5410	Assembly of parts and subassembly components

*Companies located in Cd. Juárez Chihuahua
Source: (Secretaría de Economía del Estado de Chihuahua, 2012)

Chihuahua (UTCH), Tecnologico de Chihuahua I and II and Universidad Politectnica offer engineering careers with a specialization in aerospace. The demand for aerospace engineers in the state of Chihuahua is supplied with the students that are graduating from these universities. The development of technological parks in the Universities goes hand in hand with the consolidation of the aerospace industry in Chihuahua. Tecnologico de Monterrey Campus Chihuahua (Delgado, 2012) is building the Innovation and Transfer-Technology Park 3 (Parque de Innovacion y Transferencia Tecnologica- PIT3) which will be a key infrastructure for the development of this sector in Chihuahua because it will raise the competitiveness of the industry with the development of aerospace operations. PIT 3 will be the host of the Development Centre for Aerospace Industry (Centro de Desarollo de la Industria Aeroespacial-CEDIA) which will allow the integration of MSMEs in the aerospace industry as developers of technology by facilitating its incubation, acceleration and landing. The CEDIA will also provide the companies and the students with technological laboratories in areas such as IT, mechanical, design and aerospace. Expectations towards the consolidation of the aerospace industry in Chihuahua are supported by the State Development Plan 2010-2016 (Plan Estatal de Desarrollo de Chihuahua 2010-2016) in its section for Regional Development and Competitiveness subsection Economic Sector Program. The first objective of the Program towards the enhancing of its industrialization is to develop industrial projects and investment expansion in the automotive, auto parts and aerospace. The second objective is to strategically strengthen markets and opportunity areas of these sectors.

Conclusions

The development of innovation clusters is important for regional development for several reasons: it attracts investment, promotes job creation, the creation of new ventures, increasing collaboration, and all this translates into a higher standard of living. However, for the generation of these clusters is necessary the intervention of a series of policies that vary according to the life cycle of the cluster and its impact. The State of Chihuahua have developed a series of initiatives

aimed at creating a cluster in the aerospace industry, since this industry represents a growing market which is reflected in interesting opportunities for the conversion of auto parts companies and electrical components and electronics. There are currently 26 companies in the cluster, employing over 14,500 people and the prospects for the coming years are positive. Analyzing the current state of the cluster in Chihuahua, it can be concluded that it is in a state of transition between the development and expansion: it has several anchor companies that begin to generate sufficient mass of economic activity in a still growing market. Additionally, there is heavy investment in technology infrastructure and agencies and mechanisms that promote scientific and technological collaboration are being formalized. Higher education institutions are beginning to direct their research towards the needs of the sector and have also modified some of their study programs to generate skilled human capital. Some of the questions that remain open are how these policies have influenced the development of the cluster? Have actual policies been implemented at the right time to facilitate the creation of the cluster? These questions are important because their answer will help develop more effective actions for cluster development. This remains as an open line of research.

REFERENCES

Arbuthnott A., J. Eriksson, S. Thorgren and J. Wincent (2011) Reduced Opportunities for Regional Renewal: the Role of Rigid Threat Responses Among a Region's Established Firms. Entrepreneurship and Regional Development. Vol 23(7-8), pp. 603-635.

Arthur, W. (1994) Increasing Returns and Path Dependence in the Economy. University of Michigan Press: USA.

Audretsch, D. and M. Feldman (1996) Innovative Clusters and the Industry Life Cycle. Review of Industrial Organization. Vol. 11, pp. 253-273.

Bathelt, H., A. Malmberg, and P. Maskell (2004) Clusters and Knowledge: Local Buzz, Global Pipelines and the Process of Knowledge Creation. Progress in Human Capital. Vol. 28, pp. 31-56.

Brenner T. and C. Schlump (2011) Policy Measures and Their Effects in the Different Phases of the Cluster Life Cycle. Regional Studies. Vol. 45(10), pp. 1363-1386.

Brenner, T. (2001) Self Organisation, Local Symbiosis of Firms and the Life Cycle of Localised Industrial Clusters. Papers on Economics and Evolution Number 0103.

CENALTEC (2012) Centro de Entrenamiento en Alta Tecnología. Retrieved from: http://inadet.com.mx/cenaltec-chihuahua/

CODECH (2004). Consejo para el Desarollo Económico del Estado de Chihuahua. Chihuahua Nuevo Milenio. Retrieved from: http://www.juarezavanza.com/foros/economia/Chihuahua_Nuevo_Milenio.pdf

Delgado, T. (2012) CEDIA: Centro de Desarrollo de la Industria Aeroespacial. Parque de Innovación y Transferencia Tecnológica Tecnológico de Monterrey Campus Chihuahua. Vol 1 (3), pp. 10

Department of Trade and Industry (DTI) (2004) A Practical Guide to Cluster Development. Report for the Department of Trade and Industry and the English Regional Development Agencies (RDA's) by Ecotec Research and Consulting.

FEMIA (2011) Aeronautic Industry of Chihuahua. Retrieved from: http://femia.com.mx/themes/femia/ppt/Aeronautic_Industry_Chihuahua_March_2011.pdf

Fromhold, E. and G. Eisebith (2005) How to Institutionalize Innovative Clusters? Comparing Explicit Top-Down and Implicit Botton-Up Approaches. Research Policy. Vol. 34, pp. 1250-1268.

Giuliani E. (2007) The Selective Nature of Knowledge Networks in Clusters: Evidence From the Wine Industry. Journal of Economic Geography. Vol. 7, pp. 139-168.

Gobierno del Estado de Chihuahua (2010) Programa Sectorial del Estado de Chihuahua 2010-2016. Retrieved from: link inhabilitado por periodo de elecciones.

Goldstein A. (2002) The Political Economy of High-Tech Industries in Developing Countries: Aerospace in Brazil, Indonesia and South Africa. Cambridge Journal of Economics. Vol. 26, pp. 521-538

González T. (2009) Triple Helix Model of Relations Among University, Industry and Government: a Critical Analysis. ARBOR Ciencia, Pensamiento y Cultura. CLXXXV 738, pp. 739-755.

Heerkens H., E. de Brujin and H. Steenhuis (2010) Common Factors in the Withdrawal of European Aircraft Manufacturers from the Regional Aircraft Market. Technology Analysis and Strategic Management. Vol. 22(1), pp. 65-80.

Hickie D. (2006) Knowledge and Competitiveness in the Aerospace Industry: The Cases of Toulouse, Seattle and North-West England. Vol. 14(5), pp. 697-716.

Keppler, S. (2007) the Evolution of Geographic Structures in New Industries, in Frenken, K. (ed.) Applied Evolutionary Economics and Economic Geography, pp. 69-92. Edwar Elgar: UK

INDEX (2012) Table of Companies included in the Aerospace Cluster of Chihuahua 2012.

Lara. A. (2002 Packard Electric/Delphi and the birth of the autopart cluster: the case of Chihuahua, Mexico. International Journal of Urban and Regional Research International Journal of Urban and Regional Research. Vol. 26 (4), pp. 785-798.

MacPherson A. (2009) The Emergence of a New International Competitor in the Commercial Aircraft Sector: The China Syndrome. Futures. Vol. 41, pp. 482-489.

MacPherson A. and D. Pritchard (2003). The Global Decentralization of US Commercial Aircraft Production: Implications for US Employment and Trade. Futures. Vol. 35, pp. 221-228.

Martin, R. and P. Sunley (2003) Deconstructing Clusters: Chaotic Concept of Policy Panacea? Journal of Economic Geography. Vol. 3, pp. 5-35.

Menzel, M. and D. Fornahl (2010) Cluster Life Cycles – Dimensions and Rationales of Cluster Evolution. Industrial and Corporate Change. Vol. 19, pp. 205-238.

Promexico (2012) Strategic Industries: Aerospace. Retrieved from: http://mim.promexico.gob.mx/wb/mim/perfil_del_sector

Saad M. and G. Zawdie (2011) Introduction to Special Issue: The Emerging Role of Universities in Socio-Economic Development Through Knowledge Networking. Science and Public Policy. Vol. 38(1), pp. 3-6.

Secretaria de Economía (2012) Industria Aeronáutica en México. Secretaría de Economía/ Dirección General de Industrias Pesadas y de Alta Tecnología. Retrieved from: http://www.economia.gob.mx/files/Monografia_Industria_Aeronautica.pdf

Shin D. and R. Hassink (2011) Cluster Life Cycles: The Case of the Shipbuilding Industry Cluster in South Korea. Regional Studies. Vol. 45(10), pp. 1387-1402.

Van Klink A. and P. De Langen (2001) Cycles in Industrial Clusters: The Case of the Shipbuilding Industry in the Northern Netherlands. Tijdschrift voor Economische en Sociale Geografie. Vol. 92, pp. 449-463.

Villasana M. (2011) Fostering University-Industry Interactions Under a Triple Helix Model: The Case of Nuevo Leon, Mexico. Science and Public Policy. Vol. 38(1), pp. 43-53.

Yu J. and R. Jackson (2011) Regional Innovation Clusters: A Critical Review. Growth and Change. Vol. 42(2), pp. 111-124.

****