

# Brain Circulation in Mexico: The Debate Remains

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## Abstract

This paper identifies the current state of knowledge in the matter of brain exchange/circulation from an international standpoint in reference to the Mexican context. This article describes and discusses the rationale behind the benefits and limitations of the brain circulation framework. As a conclusion, it was established that the relationship that prevails in the Mexican case is not one of a brain exchange/circulation in which “everyone wins”, even though there are success stories that are isolated, and therefore the bindings between the high skilled Mexican diaspora do not guarantee benefits towards the development of Mexico. Indeed, brain circulation would not be possible without a deep comprehension of the phenomenon; it is paramount to understand that brain circulation is inserted into the local knowledge production process as well as into the hosting innovation ecosystem; therefore, it should be analyzed as a complex system.

## Keywords

Diaspora Option, Brain exchange, Brain Circulation, Expatriate Networks, Knowledge Production

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## 1. Introduction

The concept of “brain circulation<sup>1</sup>” (BC) was officially introduced approximately in the year 2000 by the recommendation of some international experts from the World Bank, who suggested changing the negative term “brain drain” that was used as a reference to the effects of the mobility of highly skilled persons from a developing to a developed country. The implication was that the skilled migration phenomenon brings benefits to both the host and origin country [1]. The BC paradigm is that knowledge benefits every-

<sup>1</sup>The concept of brain circulation was used for the first time by Johnson and Regets in 1998, who wanted to explain the cycle of going abroad to study & work, then later to return to the country of origin which could use the acquired knowledge of such migrant (S. Mahroum, 1998). This concept that was institutionalized in 2000 by the World Bank to refer to the potential benefits home country had (D. Ermolieva, 2011).

one per se, because highly skilled migrants are likely to create positive synergies, promoting development *in* countries of origin [2].

Therefore, brain circulation makes reference firstly to the benefits that countries of origin received by the process of transfer & knowledge production, besides the competitive advantages gained by supporting entrepreneurship, increase foreign direct investment and modernize the high-tech industry; all this through the strengthening of partnerships between the skilled diaspora and the country of origin, as well as the skilled migrant incorporation to the local market when they wish to return [3]-[7].

Even though the benefits of skilled migration are probable, Mexico is suffering of *brain drain* because the mechanism that materializes benefits of BC has not been designed or applied. Skilled migration is not a new phenomenon, only in the United States it was estimated that there are 2.22 million of skilled Mexicans in 2013, of which 13.7% specializes in the areas of engineering, 5.5% in physics and mathematics, 3.2% in biology and chemistry, and 2.2% in agricultural sciences [8]. Therefore, brain circulation is a relevant topic, and researches in this area are valuable.

There is not any consensus regarding the results that could lead to strengthen the relationship with the skilled diaspora. The topic is still polarized. Some researchers have focused on finding evidence of the benefits of skilled migration, in order to support the paradigm of BC, and others show its limits and maintain the idea that skilled migration leads to brain drain.

This paper aims to present the current state of knowledge in this matter and for a practical purpose is divided into four sections structured as follows. The first section explains the different perspectives to the topic and describes the selection criteria of the chosen papers; the second section reviews the main literature about the brain circulation and discusses the research findings order to present current debate; the third section outlines the needs of future research, and finally the last section is dedicated to the conclusions and recommendations.

## 2. Skilled Migration Perspectives: Brain Circulation

The brain circulation/exchange topic follows the general framework of skilled migration. Therefore, it has been approached from different perspectives. In the *historical perspective*, research focuses on explaining the evolution of skilled migration in certain periods of time and its theoretical and conceptual approaches [9]-[14].

In addition there is the labor market assimilation *perspective*, which gives evidences about the diverse patterns, challenges and problems that skilled migrant experiences when they enter to the foreign labor market, besides it exploring reasons, ways and trends to migrate [15]-[21]. There is also the *demographic perspective*, where research is focused on migration flows, which are intended to census skilled migrants in other countries, as well as their social, economic and cultural profiles, in order to understand in more detail the phenomenon [14] [18]-[20] [22]-[26] and finally the studies focused on the *brain circulation/exchange perspective* aimed at the benefits of skilled migration, analysis of public policies, cooperation and limits of the paradigm of BC [4] [7] [27].

As shown in **Figure 1**, the subject could be approached from different perspectives. In order to carry out a more effectively analysis of the current state of knowledge of the brain circulation topic, this paper has established the following selection criteria:

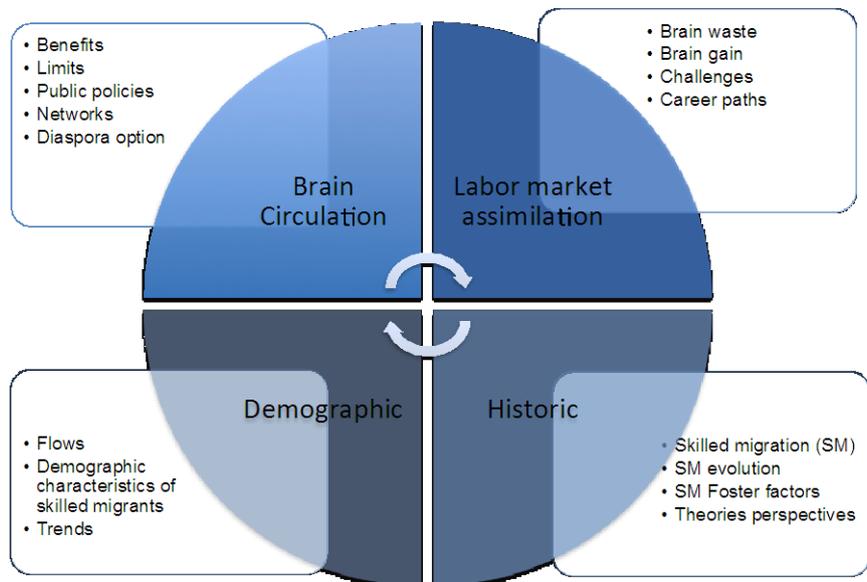
- 1) Analyze research concerning the paradigm of BC;
- 2) Exclude studies aimed at demographic, historical and labor market assimilation, perspectives;
- 3) If an author addresses more than one perspective, only findings directly related to BC will be considered;
- 4) Use publications from 2000 to date, and finally;
- 5) Exclude the benefits of remittances or politics influences, since both are presented regardless to the qualification of the emigrant.

The literature review started with a general perspective using keywords such as: skilled migration, highly skilled migration, brain drain, brain circulation, brain waste, diaspora option and expatriate networks. The databases queried include: Ebsco Host Web, JSTOR, Springer Link, Google Scholar and searching specific papers mentioned on the references of the articles.

### 3. Brain Circulation: Current State of Knowledge

Under these criteria, 32 publications were selected, of which 69% were quantitative researches, conducted through literature reviews, public policies and institutional programs analysis, censuses, statistical information from international organizations, and 31% were mixed or qualitative researches, due to their original empirical content this last group is explained in **Table 1**.

The state of knowledge brings us closer to understanding the paradigm of brain circulation. It illustrates its evolution and gives evidence of its scope, benefits, and limits,



**Figure 1.** Skilled migration perspectives.

**Table 1.** Empiric researches aiming brain circulation.

Author(s)	Year	Country	Objective	Methodology
Meyer	2001	Colombia & South Africa	Explore the conceptual changes in relation to the development of diaspora networks as a method to promote innovation and development	Comparative study, Literature review, Surveys, Questionnaires
Saxenian, Motoyama & Quan	2002	China & India	Contributes to the understanding of entrepreneurship, globalization and their interrelations; And to explore the scope and organization of the local and transnational networks constructed by the region's immigrant engineers and scientists in India and China	Comparative study, Literature reviews, 2.273 surveys, 12% US born, 88 % foreign
Saxenian	2006	China & India	Explore how Chinese and Indian-born engineers are accelerating the development of the information technology industries in their home countries	Structural analysis, Interviews, Structural analysis through data bases
kuznetsow, Nemirovsky & Yogel	2006	Argentina	Know how the scientific and technological diaspora could be used to develop a Knowledge-based economy in Argentina	83 interviews by telephone or questionnaires
Yun-Chung	2008	China & Taiwan	Show the limits of brain circulation thesis in Asia	Comparative study, Literature review, Structure analysis
Cruz-Barajas	2014	Mexico	Highlight HE importance as a source of scientific and technological development and how Mexican context influences talent expulsion	Surveys, Knowledge evaluation through knowledge economy index
Agulhon	2015	Mexico	Identify how to study in Frances had influences on mobilizing academic knowledge for teachers and future teachers in Mexico	Literature review, 10 interviews
Badillo & Didou-Aupetit	2015	France & Mexico	Analyze scientific collaboration between French and Mexican researchers, focused on social sciences	Literature review
Cruz-Barajas	2015	Mexico	Show the importance of skilled human capital in the west central Mexico region; Demonstrating the importance of designing a brain circulation strategy that involves education, science and technology	Mixed methods: a) quantitative, statistical analysis, databases and reports b) comparative analysis of public policies on three levels; regional, national and international (Chile, India & Mexico) and c) Qualitative analysis through 200 questionnaires and 20 interviews
Hernández & Córdoba	2015	Argentina	Obtain an analytical framework of the relations between the Argentine biotechnology sector (public and private) and Argentina diaspora	Literature review, Data bases analysis, 9 ethnographic cases (private and public institutions and enterprises)

as well as brings up the impact of public policies in this regard. Therefore, this section of the paper presented firstly the studies that support the paradigm of BC, where some success cases will be displayed. Subsequently, it analyses the public policies designed to maximize the BC, in which we can find that the creation and establishment of international networks is one of the most relevant; and therefore the third section aims the diaspora networks and it presents evidence of the limits of this paradigm and a conclusion is shown.

### 3.1. Brain Circulation Benefits

The work of Saxenian [4] [5] facilitated the institutionalization of the brain circulation paradigm, she found empirical evidence of the benefits that skilled migration has, for both the host and origin countries. Her studies focused on Asia, particularly in India, China and Taiwan; she was the first one to implement large-scale surveys; nearly 2300 surveys were conducted to skilled migrants who were working or had been worked in the Silicon Valley of California.

Through these studies it was concluded that skilled migrants are highly likely to become entrepreneurs. Consequently, Indian and Chinese skilled diaspora in the US, through the transfer and production of knowledge, revealed his influential role in the development and economic policies in their countries of origin.

The main discovery was that engineers and scientists that were interviewed had established a wide range of transnational connections to their countries of origin. In these networks members exchange information about technology, jobs and business opportunities with friends and colleagues who were in their home countries. Many of them invested their own money as venture capital, which helped to get start-up money to launch new business. They also provide mentoring programs in order to accelerate entrepreneurs' ideas or advising for public managers in their countries. In addition, a core group of transnational entrepreneurs had set up business operations in emerging technology regions of Bangalore, Bombay, Taiwan, Beijing and Shanghai, which were crucial for these countries.

Saxenian [5] indicates that not only those who worked in the US had contributed to their countries of origin, but also those graduates of American universities who had returned to their countries. They possess technological entrepreneurship. By becoming entrepreneurs, they decided not to imitate Silicon Valley models; but rather they developed a variety of adaptations to cope with the challenges and conditions of their own countries. Without losing the networks they had created, because these collaborative networks allowed information and knowledge mobility, technical skills, contacts abroad and venture capital to start up high-tech companies. Above all networks provide confidence that encourages local producers to participate in the global economy, creating synergies in their home countries.

Furthermore, Devane [7] explains how India and Israel enjoyed an increase in direct investment for business enterprise in the last decade. This increment was a result of the skilled diaspora participation. The author explains the Indian's experience was atypical,

because it is the only country where the software industry was developed, almost entirely, through its skilled diaspora, which has become a benchmark for other countries. India also replied this pattern in other sectors, as is the case of the health sector in the region of Bangalore, and the green technologies, where the skilled diaspora partnership became a determining factor for the success of these programs [18].

These success stories promote to analyses of the diaspora networks and their results. Kuznetsov & Sabel [27] focused their study on diaspora networks results, through a comparative analysis in China and Chile. They found that Chinese diaspora had been more involved in the developed strategy of their own country than the Chileans abroad. Chinese diaspora had contributed large sums of foreign investment in order to support entrepreneurship. By contrast, brain circulation in Chile just begins to bear fruit. Through highly skilled expatriate networks Chile was able to create successful companies such as Biogenética with the purpose of undertaking researches and to promote technology transfer projects in the agribusiness sector in Chile. A Chilean specialist in genetics and biotechnology established in the US, and Chile Foundation founded this company; the authors refer that the success of this company would not have been possible without the knowledge, experience and participation the expatriate scientist. According to the authors, Biogenética has achieved to improve the production of grapes and stone fruits, two export crops that are important for the Chilean economy.

In Mexico there are also similar examples. The Mario Molina Center creation has been one of the most important examples of brain circulation in this country. The center is an independent non-profit association established in 2004 with the purpose of giving continuity and consolidation in Mexico the activities that professor Mario Molina, Nobel prize in Chemistry in 1995 and currently professor at UCLA, has carried out. Another example is the creation of the International Center for Nanotechnology and Advanced Materials (CIMAV for its Spanish abbreviation), which was established by researcher Jose Miguel Yacamán, Mexican professor at the University of Texas [28].

In Argentina, the expatriate scientists favored the establishment of the biotechnology sector. They created laboratories and research departments through the experience, social capital and knowledge they had accumulated during their life abroad. For some companies the skilled diaspora is an asset that allows them to increase international networks, this is critical for access to human and financial resources [29].

Although success stories of brain circulation in Latin America are uncommon, they support the paradigm of BC. In this sense the evidence supports the idea that the diaspora who decided to return or to remain abroad could bring potential benefits such as: direct foreign investment, research increment, transfer and production knowledge, innovation skills, supporting local entrepreneurship, contribution to diversity, export opportunities, among others [3] [22] [23] [30].

### **3.2. Brain Circulation Policies**

For the above-mentioned benefits governments have designed diverse public policies in the pursuit of brain circulation. As a result, some authors have focused their studies on

the analysis of these policies [24] [31] [32]. The next section is dedicated to show the results of studies in these regards.

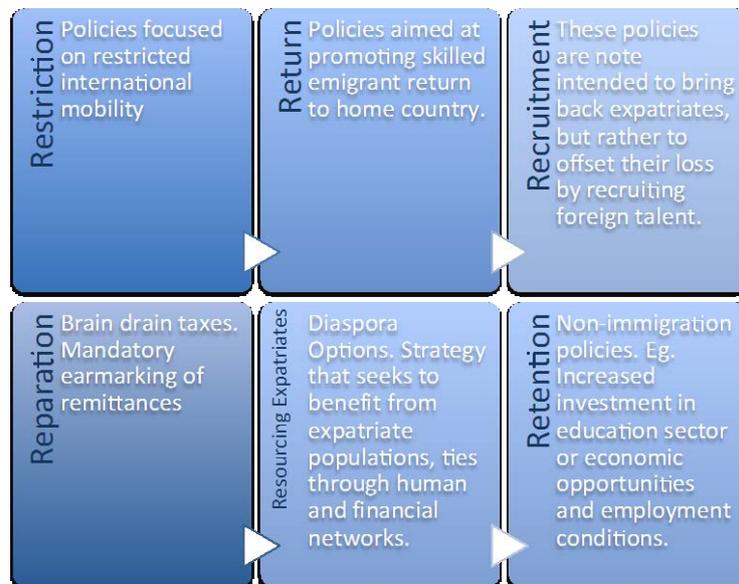
Lowell (2001) conducted an extensive international analysis on the policies responses to high skilled emigration. She detected six different types of policies: Return, Restriction, Recruitment, Reparation, Resources expatriates “diaspora options” and Retention, the Six R’s, as it can be seen in **Figure 2**.

Nevertheless, only Return and Resources expatriates “diaspora options” policies are aimed to promote brain circulation. The first one provides incentives and conditions for effective return and the second one favors the linking of groups of expatriate intellectuals to their origin countries.

### 3.2.1. Return Policies

According to Didou-Aupetit [31] return policies are most used public policies to promote brain circulation. Some countries that have applied these policies are Ireland, Malaysia, Canada, Uruguay, and some parts of Africa [32]. In Addition, the Argentina and Uruguay governments designed return policies to facilitate the return and reintegration of the sciences community that had been flourished during the dictatorships.

However, studies in Latin America claim that return policies are not the best strategy to cope with skilled migration [22]-[24]. The authors explain that Return and Retention policies in Latin-American, especially in Mexico, do not take into account that 1) repatriate scientists does not guarantee the scientific and technological development, since there is not investment in innovation 2) incentives provided to return are no adequate [33] and policies are superficial; 3) there are emigrants who have decided to stay abroad for personal reasons [28] and 4) Return and Retention programs are incipient [22] [24]. Thus they suggest that these policies should not become the main strategy to promote brain circulation.



**Figure 2.** Policy responses to high skilled emigration.

### 3.2.2. Resources Expatriate “Diaspora Options”

Diaspora options are becoming a significant part of the development strategies of countries with large emigrant populations as Latin America. These policies addressed a beneficial co-operation strategy. The home country of the expatriates gains through experience and knowledge that these may bring when they link with local institutions or organizations, with the main purpose of design research projects, favor academic mobility, mentoring, among others. Moreover, scientific and entrepreneurs’ co-operation provides stability, recognition and access to remote actors [34]-[36].

Diaspora networking is seen as more favorable public policy proposal. It allows linkage cooperation, promotes teamwork, international collaboration, facilitates transfer and production of knowledge [32] [36] Above all, networks represent a mechanism of re-bounding with a human capital that was considered lost [37].

Nowadays diaspora option is more viable. Renaud [38] explains that this is possible due to the technological advances and information systems that facilitate communication and collaborative networking, participation in international discussions and cooperation. The virtual environment is not limited to ensure communication; also allows creates to distance, experimental structures, data exchange and products develop in real-time observation. In terms of development projects, evidence indicates the potential of such cooperation networks, including research projects, technology transfer and academic training programs [37].

Among the most notable results that have been found in these networks there are: 1) collaboration and cooperation among researchers which facilitated academic mobility, therefore, the local scientific field is enhanced [39]; 2) links with other researchers remain and this favors participation in conferences, seminars and other academic activities, empower entrepreneurship in bi-national research [40]; 3) academic networks that facilitate international publications, increasing the prestige of researchers; 4) access to international research funds; 5) enriches the epistemological exchange, and 6) facilitates institutional agreements [41].

Mexico has several diaspora networks. Red Global MX is the largest diaspora network in Mexico, it was established on 2005 with the purpose of being a bridge between highly skilled Mexicans who live abroad and local institutions and organizations, in order to empower businesses or sectors that generate high added value, thus contribute to a better insertion of Mexico in the knowledge economy. Currently the *Red Global MX* is formed by 51 chapters around the world and has more than 4 thousand members<sup>2</sup>.

In addition, in México there is other smaller diaspora networks as *Theme Networks* of the National Council of Sciences and Technology (CONACYT) [36] and 14 small networks were born with the goal of gathering expatriates Mexicans; being the alumni association of University of Guadalajara and of the Monterrey Institute of Technology, among them [28].

### 3.2.3. Weaknesses of Diaspora Networks in Mexico

Even though the suggested policy is the diaspora option through networks it is neces-

<sup>2</sup>[http://www.redtalentos.gob.mx/index.php?option=com\\_content&view=article&id=213&Itemid=19](http://www.redtalentos.gob.mx/index.php?option=com_content&view=article&id=213&Itemid=19)

sary to understand their weaknesses. Recently Cruz-Barajas [42] [43] detected in her research that in Mexico the existing networks function more as cultural and social networking than knowledge networks, this due to the heterogeneity of the participants. It is not easy to create professional ties relating to a particular area of mutual interest. In contrast, Indian networks have been specializing in technology industries.

Mexican skilled diaspora claims that government initiatives such as *Red Global MX* have been a good progress. However, their perception is that this network has not evolved as quickly as is required, because in Mexico only diplomatic institutions involved. This is why they suggest that the strategy have to take into account other institutions to obtain more funds and formal conventions [43]

Ermolieva [1] explains that brain circulation depends on two keys 1) elemental institutional mechanisms to carry out the development of cooperation and 2) the will of linking of the skilled diaspora. Cruz-Barajas [42] [43] found that the diaspora motivation to be linked is not currently the most optimistic. The pursuit of professional success abroad turns out to be an absorbing process, thus bound to satisfy intangible needs with compatriots, is not a priority, besides distrust and apathy they present to Mexican institutions.

Bureaucratic procedures are one of the factors that discourage the participation of the diaspora. The time it takes signing of agreements, which give more confidence to the participants and facilitates access to funds for the development of projects, agreements, which are not signed, dissolve networks [41]. Others networks are diluted by the political instability that characterizes Latin American countries, which affects long term projects [37].

Diaspora networks have not been effective as its expected. Indeed, there is a partial comprehension of the current state of the diaspora networks in Mexico; therefore, to study in more detail linkages between skilled diaspora and their counterparts in Mexico, could bring evidence that allows understanding of the phenomenon, thus suitable public policies and management program could be designed [24].

### 3.3. Limits of Brain Circulation Paradigm

India and China cases have been successful, in part, due to their cultural traits. They established networks based on mutual collaboration prior to emigrate from their countries, generating a competitive advantage [4] Silicon Valley and Wadi Valley (in Israel) which countries try to imitate, is the sum of other factors. In one hand diaspora networks, but in the other hand is a mature technology industry, not incipient; in which the main driver was decades of government support to fund research and development in that country [7].

Kuznetsov , Nemirovsky & Yoguel [44] and Turner [6] found in their studies other factors that deter brain circulations such as: 1) limited capacity of the government to implement and maintain programs; 2) excessive bureaucracy; 3) corruption; 4) informality; 5) local governments passivity; 6) lack of leadership with a strategic vision; 7) the lack of bibliometric indicators in Latin America or others to measuring brain circu-

lation and networking and 8) little support for creating interactive and virtual spaces to support collective processes of knowledge production.

In addition, Yun-Chung [45] compared brain circulation experiences in Hsinchu, Taiwan and Zhongguancun (ZGC) Beijing. He concludes ZGC is not a case for brain circulation. Even though examples of both countries support the paradigm of BC, the results vary widely. Taiwan has a leadership and greater benefits of brain circulation. This is because the technological and industrial development in the high-tech sector of the country is quite unique and probably difficult to generalize.

In Taiwan, venture capitalists do not merely provide hard capital, which is a comparative advantage in the successful development of high technology, but also, they often mentor IT startup firms in making realistic business plans, and introduces useful third parties into the collaboration. Moreover, the Taiwanese industries have a strong history of institutional strengthening through the links, which facilitates collaboration, and finally have a facilitator State in technology transfer and innovation [45].

In the case of the biotechnology sector in Argentina, the contributions of the Argentina diaspora would not have been possible without the sustained and systematic intervention of the State. The State was crucial providing policies and coherent actions in favor of the sector [29].

Saxenian [5] explains that successful brain circulation in Asia was not due to the capacity of its members to adopt the Silicon Valley model in California and transferring their knowledge to their countries, but rather was the creativity and innovation that they invested to design a new and suitable model that could be implemented considering the circumstances of their home countries.

Fernandez-Esquinas & Perez-Yruea [46] claim that emerging or developing countries as Mexico tend to adopt “model strategies” that work for developed countries contexts. However, implementation of these models involves constraints from the social and cultural structure. That is why strategies based on Silicon Valley imitation are a myth. Consecutively, superficial public policies are designed to favor brain circulation because there is not an understanding of our own contexts.

Brain circulation is a complex phenomenon because it involves different factors that need attention [9]. It is required that the diaspora as well as being qualified, must be experienced in the management of transnational networks (R & D), there must be strong local institutional connections that enable the formal exchange of costs, access to public research facilities, risk capital, government agreements, technological structure, investment in research grants, investment in innovation and technological development [7] [45].

Therefore, the immediate short-term needs, focuses on building a research structure that allows modernize and restructure innovation systems to reduce levels of uncertainty and encourage investment in innovation and entrepreneur, and subsequently, brain circulation will be possible [2] [6].

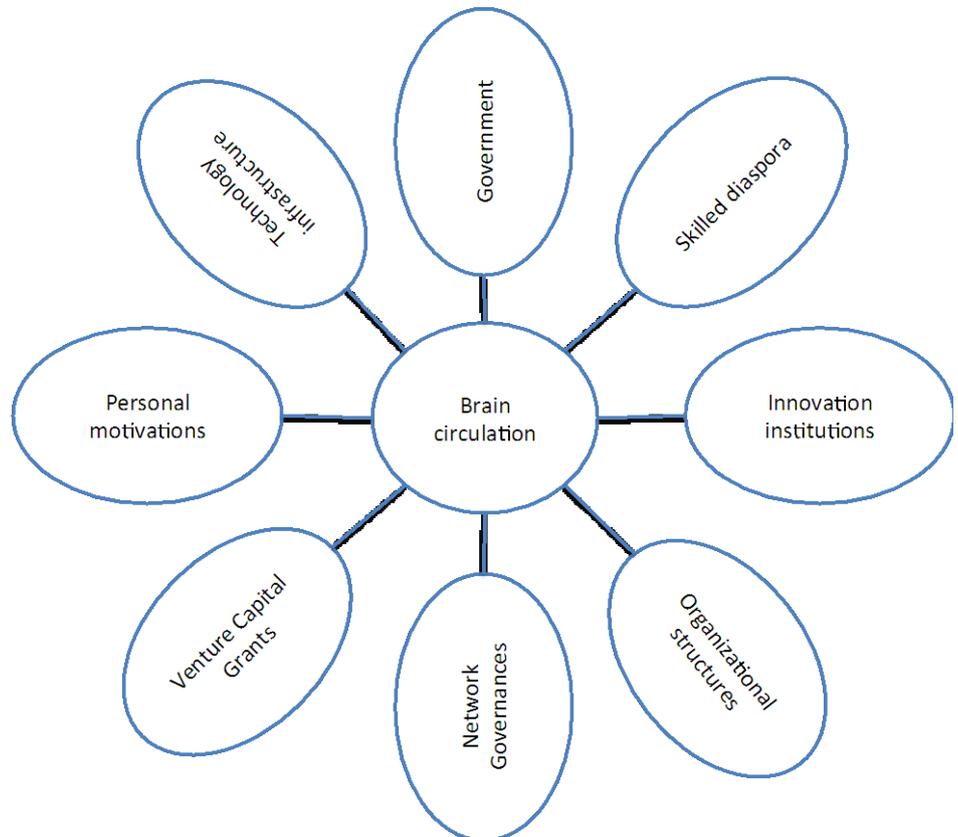
#### **4. Conclusions**

According to the literature review, it can be concluded that there is not “a model” for

the brain circulation, and therefore focusing on promoting diaspora networks is a disarticulate strategy. There are several interconnected and interrelated factors that deter or facilitate brain circulation. Clearly, networking is just a strategy, which does not guarantee transfer & knowledge production nor innovation, because brain circulation is inserted into the local knowledge production process as well as into the hosting innovation ecosystem.

Current research does not show how diaspora networks interact with local factors. Research conducted on the subject in Latin America has focused on making distant analysis through databases and the few qualitative approaches have shown the perception of skilled diaspora, as a result we have a biased approach. This does not mean that such investigations are not valuable. Indeed thanks to them we can conceptualize brain circulation as an complex system in which there are other factors or actors to be addressed such as: 1) government; 2) personal desire to collaborate; 3) skilled diaspora; 4) institutions (cluster, innovation units, universities, research centers); 5) organizational structures that facilitate the linkage between institutions that produce knowledge to the productive sector; 6) governance networks and local institutions; 7) venture capital and grants; and 8) technology infrastructure as **Figure 3** shows.

While the specific operation of the brain circulation phenomenon in Mexico is not understood, strategies will remain superficial and will produce few or isolated results.



**Figure 3.** Brain circulation system.

Future research should analyze this complex system in detail and altogether from different angles: political, sociological, economic, organizational and cultural; to address the root of the problem in order to fully understand it. Thus we will be at the position to align public policies to promote brain circulation.

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