Chapter 2
Potentials and Challenges for a Circular Economy in Mexico

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Abstract This chapter deals with the potentials and challenges – the strengths and weaknesses – of Mexico in moving towards a circular economy. In answering this question, the chapter does not look at reduction, reuse and recycling of waste in a narrow sense but approaches the topic from a wide and systemic perspective inspired by the concept of national innovation systems. The authors first provide some key data with respect to the current handling and management of waste in Mexico and then present in a conceptual way their systemic view on a circular economy. Subsequently they explore the potentials and challenges for Mexico, revising the following elements of their conceptual model: "market trends and conditions"; "competitiveness and productivity"; "the political and regulatory framework"; "education, training and knowledge transfer"; and "learning culture". They finish off with some conclusions concerning the potentials and challenges of Mexico in moving towards a circular economy.

Keywords Mexico · Circular economy · National innovation system · Learning culture · Legislation and politics · Education and training · Market conditions · Competitiveness

2.1 Introduction

What are the potentials and challenges – the strengths and weaknesses – of Mexico in moving towards a circular economy? We will try to answer this question, not by looking at reduction, reuse and recycling of waste in a narrow sense but by looking at a circular economy through a wide and systemic perspective (Leendertse 2016).

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We are convinced that a country's general economic conditions, cultural features, history, educational system and learning capacities strongly affect and determine its capacity to innovate, change and adapt to new conditions, opportunities and challenges. For Mexico, this is not different, yet the answer is necessarily multifarious, as the country is extremely multilayered and heterogeneous. Mexico is a complex country that has one foot in modernity and the other still in a pre-modernity. This strongly affects the country's possibilities to transform into a circular economy. To give an idea of what this means, we start off with a rather long citation of Philip et al. (2015) (with some modifications), as they made a good characterisation of Mexico:

> On the one hand, Mexico's elites – business, governmental and academic – are all generally advanced in their outlook. Many of Mexico's policymakers are at home in Western institutions, and numerous Mexicans now have degrees from American, Canadian and European universities. In addition, at least a portion of the tertiary education system is well advanced in terms of international competitiveness. On the other hand, Mexico suffers from many problems that are not typical for OECD countries. Challenges include a wasteful and over-unionised education system, extreme poverty, rampant corruption, rampant organised crime, chronic tax evasion and clientelistic governance at the state and municipal levels. [Philip et al. coordinators (2015:2)]

There is a well-educated – elitist – minority in Mexico that wants to change towards a modern sustainable country, but there is also a large majority that is either apathetic or overtly resistant to change. This resistance is fed by the emotion of missing the necessary capacities to work under conditions of modernity and results in a rejection of modernity rather than in the desire to acquire the skills needed to function under conditions of modernity. This strongly affects the country's learning capacity, flexibility, productivity and economic competitiveness. It is this image of a double face that will emerge in the following paragraphs, when assessing the strengths and weaknesses of Mexico in moving towards a circular economy.

2.2   A First Glance at Mexico's Waste Management Situation

In 2012, Mexico produced 103,000 tons of wastes per day – 905 g per day per Mexican – making the country the 10th largest producer of solid waste in the world (SEMARNAT 2012). Data provided by INEGI, the National Institute of Statistics and Geography, show that the total production of municipal solid waste has increased by 33% in the period between 2001 and 2013 (Góngora Pérez 2012). This constitutes an increase of 2.7% annually in that period. The country actually has 650 open-air dumpsites and about 200 landfills, and many of them are in poor conditions and lack basic infrastructure to ensure a sound operation and monitoring of the waste streams (Gasnier and Portales 2008). In 2008, it was estimated that 67% of the total municipal solid waste generated in Mexico was disposed of in sanitary landfills and controlled sites, while the remaining 33% was disposed of in uncontrolled ways (Gasnier and Portales 2008). In 2009, the government developed financial support programmes designed to help modernise the country's waste management system. Grants were issued to upgrade to landfills, close open sky

dumps and engage in technical landfill studies, municipal waste collection and the development of state, municipal or inter-municipal waste management plans. Many governmental agencies, however (mainly local governments), continue to see waste management as a low priority, and many industries, especially the smaller ones, are hardly stimulated to reduce, reuse or recycle (Velasco Pérez Alonso 2011).

According to data of SEDESOL, the Mexican Ministry of Social Development, the economic potential for recycling of waste in Mexico is over $1.34 million USD daily, while data provided by INEGI, the National Institute of Statistics and Geography, shows that the existing recycling businesses generated $630,119 USD per day, which represents just 47% of its full potential (ITA 2016). Despite of this potential for recycling, the practice of reduction, reuse and recycling of wastes is developing slowly.

Mexico is far away from having a circular economy, and it will take time and effort in many sectors of the Mexican society to transform into a circular economy (Perry-Gottesfeld and Durand 2011). Such a transition process will not only require changes in recycling and reuse of waste; it equally requires changes in production and consumption, and in the institutional systems surrounding production and consumption, such as in legislation, education, knowledge transfer, environmental awareness, entrepreneurial cultures and more. In this chapter, we explore the possibilities of a transformation process towards a circular economy in Mexico, through such a systemic lens inspired by the concept of national innovation systems (Lundvall 2010).

2.3 A Circular Economy Seen as Entirety of Production and Consumption with a Surrounding Support System

A circular economy can best be seen as a complex system with three basic parts: production, consumption and the surrounding support system (RSA Innovate 2016). Each of these parts has its own elements and characteristics, and the interaction of them determines the chances for Mexico to transform into a circular economy. That first part encompasses the core concept of a circular economy. By this, we refer to the actual changes in industrial production through rethinking how linear manufacturing models can become circular closed-loop models (Yuan et al. 2008; Ellen MacArthur Foundation 2013). It implies seeing material flows in an economy as being part of cycles and more in particularly of two basic cycles with distinct characteristics: biocycles and techno-cycles. With respect to the biocycle, the objective is to make biomass return into the biosphere after product use, in direct ways or in a cascade of consecutive use. With respect to the techno-cycle, which is built up of inorganic products and materials such as metals and plastics, the strategy is to keep them in closed loops to ensure the possibility of reuse and recycling and to prevent potential pollution (Jackson et al. 2014; Cramer 2014).

One of the first to conceptualise the idea of a circular economy was the American economist Kenneth E. Boulding (1966) in his article, "The economics of the coming spaceship earth". We live on a spaceship, he argued, with limited natural resources,

and because of that, we cannot maintain our linear "take-make-dispose" economy. We must find ways to bend the linear chain of production, distribution and consumption in a circular one. Since then, many concepts were introduced and tested that all touch upon parts of a circular economy, such as the concepts of cleaner production, industrial ecology, eco-design and design for reassembling and socially responsible entrepreneurship. In 2002, Michael Braungart and William McDonough made an important contribution to the circular economy in their book "Cradle to Cradle: Remaking the Way We Make Things", discussing the idea of an economy that works in loops with positive impacts on economic competitiveness, job creation, resource savings and waste prevention (McDonough and Braungart 2002). All these concepts question linear manufacturing models and are part of the core of the concept of a circular economy.

The second part of the system "circular economy" deals with consumption and consumption patterns. The main driver behind industrial production is consumption with particular market dynamics as cultural needs, marketing influences and market trends. These dynamics are important positive or negative factors in a transformation process towards a circular economy. Today, marketing is largely a negative factor as it predominately stimulates a culture of consumption telling us that we are what we consume and what we possess (Raworth 2012). Ecofriendly marketing exists as well but remains in the margin of mainstream marketing efforts. The globalisation of industrial markets offers products of low prices distributed worldwide and often stimulates a fast rate of consumption of non-durable consumption goods. It can however also have potential positive impacts on a circular economy, as we will show in the case of Mexico, later on. Generally speaking, many trends in consumption go against a circular economy, so strategies and policies are needed to curve this trend.

Three different strategies can be identified to make consumption fit into a circular economy: (1) addressing products, (2) persons and (3) functions and markets (Persson 2015; Boulanger 2016). The strategy to address products fits into that what Boulanger calls the *eco-efficiency* perspective, and aims at diminishing the environmental impacts of the use and possession of products, mainly through redesign and creating systems for reuse and recycling. The second strategy fits into what Boulanger calls the *sufficiency* perspective touching upon the person instead of the product. The logic of sufficiency consists of consuming the right quantity of material goods and services, which escapes "both the Charybdis of under consumption (poverty) and the Scylla of overconsumption" (Boulanger 2016:5). This strategy is mainly cultural and touches upon attitudes and orientations of people. It is realised through education, information and enhancing awareness. The third strategy aims at the creation of a *sharing economy* where the conventional ownership of things is being replaced by schemes of "bartering, lending or renting" (Botsman and Rogers 2010, p. xv). Here, the function of products becomes central, rather than the ownership of products. This strategy is conceptual as it aims at reformulating both what a "product" is and what a "market" is. It aims at changing the interaction between consumers, retailers and manufactures around new concepts such as "performance-for-pay models", "rent or leasing schemes" and "return and reuse practices" (EMF 2013, p.10). These three consumption-oriented strategies are crucial in a transformation process towards a circular economy.

The third part of the system "circular economy" is the surrounding support system of production and consumption and is made up by various cultural and structural characteristics of a country or region. Stimulating innovation and transformation towards a circular economy requires a certain political and regulatory framework that gives incentives, set conditions and interferes, so actors change behaviour facilitating the innovation and transformation looked for. Regulations create conditions, and policies may indicate directions, which are all needed to create an environment of change into a certain direction. Economic actors equally need to be educated and trained and because of that, a properly functioning knowledge transfer system is a crucial part of the surrounding support system of a circular economy.

Cultural characteristics of an economy are crucial in understanding the way the economy moves, functions and performs (Tabellini 2010) and are equally crucial in determining the potential for change and transformation into the direction of, in our case, a circular economy (Lundvall 2007). Such cultural features can be found both on a macro and a micro level and are usually mixed, manifesting themselves on various levels simultaneously. Entrepreneurial cultures in companies, for instance, differ in some ways but are at the same time largely influenced by national cultures. Finally, the essence of support systems is not found in the mere existence of institutions, regulations or structures but, as the OECD rightfully argued, is to be found in the linkage and interaction among actors. It is the complex or set of relationships among actors that produce, distribute, consume, generate knowledge, educate and apply knowledge in various concrete practices, which create the strength of the support system (OECD 1997). This is the cultural complex of capacities, attitudes and orientations, which determine the strengths of a country to innovate and transform.

2.4 Mexican Potentials and Challenges for a Circular Economy

What are the potentials and challenges – the strengths and weaknesses – of Mexico in moving towards a circular economy? In answering this question, we explored various elements of the here above presented complex set out. Those elements were put together in Fig. 2.1. Based on these explorations, we made a qualitative assessment of the potentials and challenges for Mexico to move towards a circular economy. The assessment is presented in Sect. 2.2 of this chapter.

2.4.1 Market Trends and Conditions

The Mexican economy has been relatively stable over the past decades, with an average growth of 2.6% in the past 10 years (Pèrez 2015). Based on this growth pattern, and compared with growth patterns in other large countries, Mexico is projected to become the world's 8th largest economy in 2050, before Russia, the UK and France (Pèrez 2015). Mexico's geographical location favours economic

The political and regulatory framework

Competitivity and productivity   Market trends and conditions

CLOSE LOOP PRODUCTION;
REDUCE, REUSE, RECYCLE

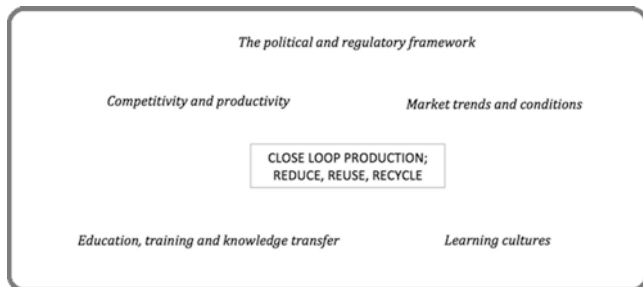Education, training and knowledge transfer   Learning cultures

Fig. 2.1 Relevant elements in the transformation to a circular economy (contribution of the authors)

development, as it is rather centrally located in between most of the world's economic centres. The average flying time from Mexico City to New York, L.A., Rotterdam, Yokohama, Río de Janeiro, Shenzhen and Shanghai is 14.4 h, while the average flying time for European and Asian cities to fly to the other major economic centres is between 20 and 25 h (Pèrez 2015). The dependency on the American economy however makes the Mexican economy vulnerable to changes in political relationships between the two countries, as well as to fluctuations in the American economy (Moreno-Brid et al. 2005). A diversification of the economic relationships of Mexico with other parts of the world is therefore needed to ensure a safe economic growth in the coming decades. The overall economic situation of Mexico, and the trends for the future, does not show obvious hurdles for a transformation towards a circular economy.

Mexico still is predominantly a country of manufacturers, complemented with tourism, mining, agriculture, real estate and construction, while the financial and service sectors are gradually gaining importance in the national economy (PwC 2014). Industrial production and manufacturing is realised in the rather famous Mexican *maquiladoras*, the assembly industries. These maquiladoras are concentrated in the northern part of the country, in the relative proximity of the US border, but they are obviously also found in other parts of the country, though in lesser concentration. Tourism has an important concentration in the Yucatan region and especially the Cancun area. But again it must be added that tourism is found all over Mexico, but with less regional concentration. The upcoming financial and service sector is largely found in the big cities, with a significant concentration in Mexico City.

An important characteristic of manufacturing, tourism and finance is their international character, with perpetual flows of import and export and travel of people in and out of Mexico. We see this as a potential for a transformation process towards a circular economy. The Mexican industrial sector, for instance, is manufacturing, as a single nation, a significant part of the world's cars (trucks 5.4% and light vehicles 8.1%), TVs (4.2%), cell phones and communication equipment (3.9%), car parts and accessories (5.7%) and computer parts (5.2%) (Pèrez 2015).

Design and product specifications of cars, computers and TVs, but also of food products such as beer, ice cream or chocolate, take place outside of Mexico in the

headquarters of companies like Chevrolet, Volkswagen, Nissan, Dell, Nestlé, Unilever, Danone or Heineken. All these companies are present in Mexico and pre-scribe to Mexican manufacturers how to produce, manufacture and assembly according to their product and production specifications. Mexico is in this respect a follower and will without any doubt follow when companies decide to change the design of their products and production processes to fit circular economy pattern.

The tourist sector, especially in the Cancun area, has similar characteristics, as foreign hotel chains dominate the sector, with names as InterContinental, Marriott, Ritz Carlton, Fiesta Inn, Ibis or Hilton. In many of these chains, environmental management standards are company-wide established and internationally main-tained, while changes in standards and requirements are made in the headquarters of the companies. Here as well, we see potential for a change towards circular econ-omy, even if there is little incentive to change towards a circular economy inside of Mexico. The financial and service sector strongly represents the modern world and introduces in Mexico those values and lifestyles that represent the modern world. This has both positive and negative impacts. In Mexico City, representatives of this sector were the first to embrace the bike-sharing system introduced some years ago and equally are promoters of car-sharing systems and the consumption of organic food. On the other hand, they frequently fly which results in ecological footprints that are certainly not sustainable. In general, we favour the cultural impact they have on their country.

Mexico is not only just following however. There is a growing interest in applying environmental technology in all sectors of the Mexican industry, mainly due to more stringent environmental legislation. This creates a demand that is largely satisfied through importing technology from other countries, mainly Europe and the USA, with the USA holding the largest stake in Mexico's import of environmental technol-ogy. Export of environmental technology from the USA to Mexico has been growing rapidly in the past years. The US International Trade Administration talks about "an unprecedented investment in environmental infrastructure, that gave Mexico an upward mobility by improving two points in the world ranking in the Environmental Technologies Top Market Study" (ITA 2016: 20). Mexico gained this position, imme-diately following China, thanks to investments in air pollution and the water sector, and to a much lesser degree, thanks to investments in waste management. Technologies with a high level of application in air pollution are, among others, continuous emis-sion monitoring systems, selective catalytic reduction systems, electrostatic precipi-tators and catalytic converters. In the water sector, a whole range of technologies is being imported nation-wide, as, for instance, water reclamation technologies, water reuse equipment and services and advanced filtration technology such as membrane filtration, reverse osmosis, UV disinfection and anaerobic digestion.

In the sector of waste management, however, Mexico is still not doing well. While the country holds the number 2 position overall in the import of environmen-tal technology from the USA, it is ranked only number 13 in imports of waste man-agement technology. Waste management technology imported from the USA includes waste handling equipment, biogas capture technologies, sanitary landfill systems and sorting machines.

2.4.2 *Competitiveness and Productivity*

While the market conditions are generally speaking rather favourable for Mexico, the country's competitiveness and productivity are not. This generates a negative incentive for a change towards a circular economy, just as the positive market conditions create a potentially positive impact (Sánchez 2014). A country's competiveness is usually seen as its capacity to produce high quantities of product, in time and with high quality, and to be flexible, creative and innovative with good capacities to enter new markets and adapt to new ways or conditions of production. Competiveness depends on both macro and micro factors (Békés-Gábor 2015). Macro factors are the availability of infrastructure (roads and IT infrastructure) and of capital (accessibility to credit), the flexibility of the market and the quality of regulation and of education and research. We will address regulation and education in subsequent paragraphs and will therefore waive these issues here. Micro factors are the presence of an entrepreneurial culture, a skilled workforce and participation rates in post-school education (Martin 2004).

The availability of IT infrastructure has been a challenge for Mexico for a rather long time, but considerable improvements have been observed in the last decade (Hanson 2011). The poorly functioning credit market however remains a critical factor in Mexico's competitiveness. Over the past decade, Mexico managed to open the market for private credits to small firms and households but still struggles with issuing long-term credits for investments in large-scale infrastructural projects (Hanson 2011). The Bank of Mexico concludes that Mexico's competitiveness is very low, due to the country's market rigidity, too much regulation and a too strong influence of unions (Chiquiar and Ramos-Francia 2009). The bank promotes political reform that typically fits into a neo-liberal discourse yet touches in Mexico on number issues that are widely perceived as real problems. This is first of all the overregulation of the Mexican market, an abundance of regulation that is supposed to be enforced by often incompetent and corrupt governments. As a response to this, many companies choose to operate within the informal economy, and the informality of the Mexican economy is widely seen as a major factor in the country's lack of competitiveness (Hanson 2011; Chiquiar and Ramos-Francia 2009). A second factor is the strong position the unions have in both the private and the public sector. Though unions in principle play an important and positive role, Mexican unions tend to block any form of change, not because of the proposals as such but because of the type of resistance mentioned in the introduction of this chapter. This resistance is rather cultural than economic of operational.

On the micro level, a key component to competiveness and productivity is a culture that stimulates initiatives and embraces new ideas. Such a culture, however, is weakly developed in Mexico. Gordon (2010) analysed Mexican business cultures using the dimensions that Hofstede developed in his famous cross-cultural analysis of 50 countries (Hofstede 1980). These dimensions are individualism versus collectivism, power distance, uncertainty avoidance and masculinity versus femininity. Almost all of these dimensions – with the exception of masculinity versus femininity – explain why Mexican entrepreneurial cultures do not favourite competiveness

and productivity. The idea of making career through hard work and showing that you are more competent than your co-workers clashes with the collective culture of Mexico. Mexico has a "being" rather than a "doing" culture, where relationships are more important than work and where "unfinished tasks or jobs are not a worrisome thing" (Gordon 2010:9). Mexicans equally have, on average, a low tendency of uncertainty avoidance, meaning that they accept life as it comes, rather than working hard in an attempt to control and shape future developments. The phrase "What will be, will be" or in Spanish "*Que sera, sera*" is rather exemplary for this attitude or culture (Davis and Nayebpour 2004).

Traditional Mexican management styles are based on punishment rather than on stimulation or empowerment. As a result, Mexican workers try to avoid taking responsibility and are often more comfortable with a low profile than a high profile. While doing an anthropological study in one company, Gordon discovered that the word "empowerment" did not exist in the vocabulary of the managers and that they had difficulties in understanding the concept, as in translating it into Spanish. This all is not helping the creation of entrepreneurial cultures where creativity, initiative and new ideas flourish and are easily embraced.

Culture matters, as Guido Tabellini demonstrated through his research in different economic regions in Europe. His research findings indicate that culture and a particular cultural history strongly correlate with regional economic development and explain quite well why some regions develop faster than others (Tabellini 2010). Because of this, we look at Mexican business cultures as a real challenge for a transformation process towards a circular economy. (See also Lewandowski 2016).

2.4.3 The Political and Regulatory Framework

Mexico has 32 states, Mexico City recently being included, and has about 2454 municipalities. Its legal system is based on the European, and especially French, system, with a division between the legislative, executive and judicial branch. The legislative branch is comprised of a congress with a chamber of deputies and chamber of senators. The executive branch – the president, ministers and their administrative entities – is responsible for executing the laws enacted by the congress, and the judicial branch has the function of interpreting the laws and resolving disputes. On the federal level, the key administrative body responsible for environmental affairs is the Secretariat of the Environment and Natural Resources (*Secretaría de Medio Ambiente y Recursos Naturales*, SEMARNAT). Many environmental areas have special agencies with far-reaching authority to develop and execute politics, such as the National Water Commission, the National Commission for Protected Natural Areas or the National Institute of Ecology and Climate Change. Other areas are decentralised, such as municipal waste management that largely is the responsibility of local and municipal governments. The differentiation and decentralisation of politics are seen as a positive development, but what is missing is a proper coordination between different institutions and levels of government (Gasnier and Portales 2008).

Mexican politics, in general, has been going through a process of change since the end of the previous century. Policy development was heavily influenced by corporatism, meaning that politics was developed by a conglomerate of big industries and politicians from the PRI, the Institutional Revolutionary Party, which ruled the country since the Mexican Revolution until the year 2000 (Diez 2006). The liberation of the political system in the year 2000 seemed to make an end the old form of corporatism and promised to democratise the policymaking process to some extent. It is hard to predict what the future will bring however, as tendencies to return to the old system are clearly present (Loxton 2016).

Another key characteristic of Mexican politics and regulation is the existence of the huge gap between policy formulation on the one hand and implementation and enforcement of regulation on the other hand (Diez 2006). In the environmental field, this accounts for a serious lack of enforcement of legislation, with many companies operating without the proper permits to do so. Clientelism and corruption deepen this problem, as does the informal character of the Mexican economy. In practice, the gap between norm and deed is a real hurdle for the Mexican society to change towards environmentally more friendly ways of production, distribution and consumption. This is especially true for medium and small companies. The larger companies, and certainly the multinational ones, conform rather frequently to their own internationally applied standards, irrespective of the political/regulatory framework inside of Mexico.

Despite of the obvious flaws in the Mexican political/legislative framework, there are also positive developments to be mentioned. Since some years, Mexico is developing a National Development Plan (NDP) to drive developments in a certain direction with clear objectives and goals. The National Development Plan 2013–2018 was launched by president Enrique Peña Nieto, who´s presidency worked to make profound changes to the country in five distinct areas:

1. To achieve peace in Mexico that will advance democracy and security
2. To make Mexico more inclusive to all citizens, while protecting their social rights
3. To improve the quality of the education system so that youth in Mexico can meet the challenge of an ever-more competitive world
4. To promote prosperity by stimulating economic growth in a way that Mexicans will feel the prosperity directly in their pockets
5. To consolidate Mexico as a responsible international player, defending international law and promoting free international trade, showing its solidarity with other countries

The words environment, sustainability or circular economy are not found among the five key objectives, but they are present as objective 4.4, under the heading of prosperity. Objective 4.4 of the national plan aims at stimulating "green growth", while the way to operationalise this is published in the "Sectorial programme for environment and natural recourses 2013–2018" (PROMARNAT), developed in parallel with the overall national plan.

The PROMARNAT plan presents a comprehensive diagnose of the current environmental situation in Mexico, in the areas of air, water, waste and biodiversity, followed by various concrete plans and objectives. For waste, the objective is to reduce the percentage of uncontrolled disposal of waste from 30% in 2013 to 17% in 2018. This must be realised through various policy plans, such as plans to improve integral solid waste management on the municipal level and to create more infrastructures needed to manage waste in municipal dumpsites. This reduction of the percentage of uncontrolled disposal of waste is a serious step forward towards a circular economy, even though lots of subsequent steps are obviously needed.

A positive development as well is the engagement of the private sector, the international character of the Mexican economy as mentioned before and the support given by other countries in this respect. One interesting example is the seminar "Emerging Mexican Circular Economy Market, Possibilities for Finnish Companies", organised on March 7, 2017 by the Finnish-Latin American Trade Association. The seminar explored concrete option of collaboration around topics as biogas projects at landfills and waste-to-energy projects within energy-intensive industries, such as cement, steel and petrochemical industries.

2.4.4 Education, Training and Knowledge Transfer

Seventy percent of all children in Mexico attend a public school, while 30% attend a private school (Barraza 2001). Due to the vast population growth, total student enrolments in public schools increased from 3.25 million students in 1950 to 28.22 million students in 2000, up to 34.8 million students in 2011 (Clark and Monroy 2013). As budgets for public education increased only at a margin of the increase in students, basically all public schools face budget problems and an abundance of students in their classrooms. The average number of students in one classroom is about 35 (in Mexico City frequently up to 50), and this obviously affects the quality of education (INEE 2005). A second characteristic of Mexico's public educational system is its traditional pedagogical orientation, emphasising mere knowledge transfer instead of teaching through active involvement of the students in their learning process. Thirdly, the average competence of teachers is low, because many are not selected and contracted based on their knowledge and teaching skills but because they are friends or family of the union representatives in charge of the selection process. The 2013 educational reform aims at improving the quality of the curricula, the teaching and teachers, and seeks to improve selection and wages of the teaching personal (Levinson 2014). The outcome of this reform may be positive, but this depends really on the way it will be executed and the budgets that will be allocated to ensure a sound execution.

Since the 1980s, environmental education is part of the curricula in all schools in Mexico, and each of the 32 states has a state-wide plan for education, training and communication in environmental matters (Marcos-Iga and William 2011). Many

cities today have centres specialised in environmental education, and basically all universities offer a bachelor or master's programme in one or more environmental specialisations, like environmental education, environmental engineering, environmental planning or environmental law (Cecadesu 2006). There are however some serious restrictions, mainly due to a lack of innovation in teaching methods and teaching orientations (Ruiz et al. 2009). Most environmental education focuses on isolated environmental issues as water, waste or air pollution and lacks a more systemic orientation of sustainability, linking the environment with economic and social issues (Cecadesu 2006). A holistic orientation, linking individual action with societal effects and consequences, equally is missing in most of the curricula (Paredes 2005). Paredes Chi observes that, like education in general in Mexico, environmental education has too much focused on mere knowledge transfer, and she suggests that students should become actively and more critically engaged in problem definition and identification of possible environmental actions to address these problems (Paredes 2005).

Many universities offer post-academic continuous education in environmental matters, targeted at adults and professionals. Such *diplomats* usually take 6 months of classes (up to 6 h per week) and are finished with the writing of an essay or thesis. The *diplomats* have academic value and are recognised by both the public and the private sector. They open opportunities for adults – who need to have as minimum a bachelor degree – to deepen or change their career and to specialise in a certain environmental field. Here once more however, the teaching method and orientation create some limitations. Many Mexican universities teach with a rather exclusive theoretical orientation and have little experience in trace disciplinary collaboration with nonacademic actors of the public or private sector. This seriously limits the potential of the *diplomats* in preparing the participants to apply what they learned in practical contexts.

Finally, Mexico has multiple platforms and networks for knowledge transfer in environmental matters and in sustainability, mainly initiated and maintained by the private sector. Mexico equally participates in various international networks, initiated by the World Bank, the OECD or the UN. An example of the last is the Green Growth Knowledge Platform, which provides general information on best practices both with an international and a national perspective. Examples of information disseminated are the results of a comparative study of green growth in Mexico, Brazil and Chile and information on urban-industrial environmental management in Mexico. The World Bank has a rather similar website providing both international and Mexican information on business and sustainability. Various national networks exist, as for instance, the "Programme for Green Jobs[1]", the "Mexican Association of Environmental Enterprises" or the "Green Network". These networks exchange experiences of Mexican companies in green entrepreneurship and provide information on Mexican legislation and special sustainable projects in the country.

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[1] http://empleosverdes.mex.ilo.org/empresas-empleadores/que-son-los-empleos-verdes

2.4.5 Learning Culture

The final issue to address is that of Mexico's learning culture, the country's capacity of adapting to new practices or technologies. On one hand, Mexicans are very quick in adapting to new technologies and new technology-induced practices. In this context, the experience of an American educator who visited Mexico City is rather illustrative. I was surprised to find the following in the streets of Mexico City, he said: "the taxi driver relied on Google Maps to navigate the chaotic network of streets, and driving from the airport. Public Wi-Fi spots are commonplace and their number is growing. When I checked for a Wi-Fi connection at traffic lights there would usually be many, many domestic Wi-Fi spots" (Grove 2014). Mexico City, as many other cities in the country, shows a face of fully being adapted to the modern world. Mexico has a collective culture where being connected to others is a condition "*sine qua non*" for life in general and survival in particular. Today, most Mexicans are constantly connected through Facebook, WhatsApp, Instagram and other social media.

In other ways though, Mexicans are not so open for change. Most Mexicans stick to their traditional extended family life and traditional ways of spending leisure time, and these two largely overlap: leisure time is spending time within the extended family. In professional setting, many refuse to adapt to modern forms of communication and collaboration. They apply the family model in professional settings and have problems distinguishing between the personal and the professional (Gordon 2010). Critique expressed in professional settings is not perceived as functional input to improve performance but is rather soon perceived as personal attack. What is missing is a culture of reflectivity where people, either individually or in collectively, critically interrogates their actions, with the intention to learn from experience and improve professional performance. This seriously hampers collaboration in – especially horizontal – teams and networks and poses a real challenge for a transformation process towards a circular economy, as the support system for such a transformation depends on the interaction, collaboration and reflective actions of the institutions and actors within the system (Jakonis 2010).

2.5 Conclusion

As mentioned in the introduction, Mexico is a complex country with at least two rather different and often contradicting faces: a modern and a premodern one. These two together define Mexico's chances to transform towards a circular economy. The market conditions and long-term market trends in the country are positive and should be seen as a potential positive condition for a – long-term – transformation process towards a circular economy. The country's National Development Plan aims at stimulating green growth and recognises the need to improve the existing infrastructure for reuse and recycling of waste. The Mexican Ministry of Social

Development identified a huge economic potential for recycling of waste, and governmental funds are liberated to upgrade state, municipal or inter-municipal waste management plans. Environmental education exists since the 1980s, and each of the 32 states has a state-wide plan for education, training and communication in environmental matters. Knowledge transfer systems equally exist, on both national and international levels, and, in general, Mexicans are keen to adapt themselves to new technologies and new technology-induced practices. Most of these indicators provide a positive outlook on Mexico's potential to change to a circular economy and show that many opportunities exist.

The question is if Mexico will be able to seize these opportunities. This question is real, as a number of serious challenges exist as well. Markets are rather inflexible; banks refuse to provide long-term credit; and above all, many organisations, both in the private and the public sector, lack practice that favours new ideas, innovation and creativity. A collectivistic culture of "being" rather than "doing", combined with a low perceived need to reduce uncertainty and a related desire to shape and control the future, leaves Mexico with a mentality of "*Que sera, sera*" or "what will be, will be". Such a mentality does not create incentives to seize opportunities. The discrepancy between the creation and execution of policy plan is another real challenge. Good intentions and plans exist, but the Mexican history shows that realisation of plans is not easy. With respect to environmental education, something similar can be observed. Even though environmental education exists, its content is not really geared at learning-by-doing and reflective practice, and its potential in a transformation process towards a circular economy is therefore limited. Finally, Mexico really misses a learning culture that stimulates reflective practice and collaborations or co-creation in teams. This flaw in learning capability is a characteristic that permeates many spheres of economy and society and is one of the biggest challenges to overcome.

References

Barraza L (2001) Environmental education in Mexican schools: the primary level. J Environ Educ 32(3):31–36. https://doi.org/10.1080/00958960109599143

Békés-Gábor (2015) Measuring regional competitiveness: a survey of approaches, measurement and data. Műhelytanulmányok discussion papers. Institute of Economics, Centre for Economic and Regional Studies, Hungarian Academy of Sciences Budapest, 2015. Mt-dp – 2015/29. ISBN:978-615-5447-91-4, ISSN:1785 377X

Botsman R, Rogers R (2010) What's mine is yours: the rise of collaborative consumption. Harper Collins, New York

Boulanger PM (2016) Three strategies for sustainable consumption, S.A.P.I.EN.S. http://sapiens.revues.org/1022. Accessed 10 Apr 2017

Boulding K (1966) The economics of knowledge and the knowledge of economics. Am Econ Rev 16:1–13

CECADESU, Centro de Educación y Capacitación para el Desarrollo Sustentable (2006) Estrategia de educación ambiental para la sustentabilidad en México. SEMARNAT. http://cecadesu.semarnat.gob.mx/. Accessed 9 Apr 2017

Chiquiar D, Ramos-Francia M (2009) Competitiveness and growth of the Mexican economy. Banco de México. Working papers. No. 2009-11. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.622.7227&rep=rep1&type=pdf. Accessed 6 Apr 2017

Clark-Nick, Monroy C (2013) Education in Mexico. World Education News & Reviews, WES Group Manager for Latin America. http://wenr.wes.org/2013/05/wenr-may-2013-an-overview-of-education-in-mexico. Accessed 6 Apr 2017

Cramer J (2014) Moving towards a circular economy in the Netherlands: challenges and directions. Utrecht Sustainability Institute, Utrecht University and Economic Board Amsterdam, The Netherlands. http://usi-urban.wp.hum.uu.nl/files/2015/04/Paper-HongKong-JC-april-2014.pdf. Accessed 5 Apr 2017

Davis AS, Nayebpour MR (2004) Obreros (workers) against Gerentes (managers): changing values in the Mexican workplace. Lat Am Bus Rev 5(1):71–93

Diario Oficial de la Federación 12-Diciembre-2013. México

Díez J (2006) Political change and environmental policymaking in Mexico. Routledge, New York

Doing Business in Mexico, Turismo (2014) Guía para la inversión y desarrollo del turismo en México, PwC México

"Emerging Mexican Circular Economy Market, Possibilities for Finnish Companies" organised by the Finnish-Latin American Trade Association. http://www.inee.edu.mx/bie/mapa_indica/2005/PanoramaEducativoDeMexico/PG/PG01/2005_PG01__pdf. Accessed 10 Apr 2017

EMF Ellen MacArthur Foundation (2013) Towards the circular economy: opportunities for the consumer goods sector. http://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/sustainability/pdfs/towards_the_circular_economy_emf_report.ashx. Accessed 10 Apr 2017

Gasnier A, Portales LE (2008) PETSTAR: Adding value to the chain of recycling and improving the scavengers' working conditions. Latin America & Caribbean, Mexico. Sector Waste. United Nations Development Programme. http://growinginclusivemarkets.org/media/cases/Mexico_Petstar_2008.pdf. Accessed 8 Apr 2017

Góngora JP (2012) El reciclaje en México. Comer Exter 64(3)

Gordon G (2010) Managing in Mexico – an ethnographic comparison to theory and previous research. J Int Bus Cult Stud 2

Grove J (2014) Researching mobile learning culture in Mexico city's schools. Resource document. McGraw-Hill Education. http://blog.mheonline.com/researching-mobile-culture-in-mexico-citys-schools. Accessed 10 Apr 2017

Hanson GH (2011) Understanding Mexico's economic underperformance. Migration Policy Institute, Washington, DC

Hofstede G (1980) Consequences: international differences in work-related values. Sage, Beverly Hills

INEE, National Institute for the Assessment of Education in Mexico (2005) Tamaño promedio de los grupos en primaria y secundaria. http://www.inee.edu.mx/bie/mapa_indica/2005/PanoramaEducativoDeMexico/PG/PG01/2005_PG01__pdf. Accessed 10 Apr 2017

Jackson M, Lederwasch A, Giurco D (2014) Transitions in theory and practise: managing metals in the circular economy. Resources 3:516–543

Jakonis A (2010) Organisational culture in multicultural organisations – Mexico. J Intercult Manag 2(2): 83–96. ISSN:2080-0150. http://jml2012.indexcopernicus.com/fulltxt.php?ICID=935412. Accessed 10 Apr 2017

Leendertse P (2016) The transition from a linear to circular economy: an innovation system analysis of the composites industry. Master's Thesis Internship-Sustainable Business & Innovation. Utrecht University, Faculty of Geosciences

Levinson BA (2014) Education reform Sparks teacher protest in Mexico. Sage Journals, Phi Delta Kappan. http://journals.sagepub.com/doi/pdf/10.1177/003172171409500811. Accessed 8 Apr 2017

Lewandowski M (2016) Designing the business models for circular economy—towards the conceptual framework. Sustainability 8(1):43–48

Loxton J (2016) Authoritarian successor parties worldwide: a framework for analysis. University of Sydney

Lundvall B-Å (2007) National innovation systems-analytical concept and development tool. Aalborg University and Tsinghua University. Conference in Copenhagen, Denmark

Lundvall B-Å (2010) National systems of innovation: toward a theory of innovation and interactive learning. Anthem Press, London/New York/Delhi

Marcos-Iga J, William S (2011) Current state of environmental education in Mexico: a study on practises, audiences, settings, and topics. Appl Environ Educ Commun 10(4):219–227. https://doi.org/10.1080/1533015X.2011.669687

Martin LR (2004) A study on the factors of regional competitiveness. A draft final report for the European Commission Directorate-General Regional Policy Cambridge Econometrics. University of Cambridge, Cambridge

McDonough, Braungart (2002) Cradle to cradle: remaking the way we make things. North Point Press, New York, p 208

Moreno-Brid JC, Santamaría J, Rivas-Valdivia JC (2005) Industrialization and economic growth in Mexico after NAFTA: the road travelled. Dev Chang 36:1095–1119. https://doi.org/10.1111/j.0012-155X.2005.00451.x

National Innovation Systems (1997) Organisation for economic co-operation and development. https://www.oecd.org/science/inno/2101733.pdf. Accessed 9 Apr 2017

Occupational Knowledge International. http://www.global-chemicals-waste-platform.net/fileadmin/files/doc/Case_Studies/Case_Study__Mexico_ULAB.pdf. Accessed 9 Apr 2017

Paredes CAA (2005) Theory and practise in environmental education: a Mexican case study. Thesis Doctor of Philosophy. Deakin University, Australia

Pèrez CF (2015) Circular economy & business opportunities in Mexico. ProMéxico

Perry-Gottesfeld, Durand K (2011) Case study Mexico: lead battery recycling

Persson O (2015) What is circular economy? − the discourse of circular economy in the Swedish public sector. The Department of Earth Sciences, Uppsala University Published at Department of Earth Sciences, Uppsala University (www.geo.uu.se), Uppsala, 2015. http://www.diva-portal.org/smash/get/diva2:841910/FULLTEXT01.pdf. Accessed 9 Apr 2017

Philip G, Faust J, Thunert M (2015) Sustainable governance indicators, Mexico report. Bertelsmann Stiftung

Plan Nacional de Desarrollo 2013–2018. Gobierno de la República, México. http://pnd.gob.mx/wp-content/uploads/2013/05/PND.pdf. Accessed 10 Apr 2017

Programa Sectorial de Medio Ambiente y Recursos Naturales 2013–2018 (PROMARNAT)

Raworth K (2012) A safe and just space for humanity: can we live within the doughnut? Oxfam international discussion paper. Oxfam International, Oxford

RSA Innovate UK (2016) Designing for a circular economy: lessons from the great recovery 2012–2016. The great recovery. Redesigning the future. ISBN:978-0-901469-85-4

Ruiz I, Barraza L, Bodenhorn B, Reyes V (2009) Evaluating the impact of an environmental education programme: an empirical study in Mexico. Environ Educ Res 15(3):371–387. https://doi.org/10.1080/13504620902906766

Sánchez M (2014) Structural challenges for the Mexican economy. The Bank of Mexico and the Hong Kong University of Science and Technology. Hong Kong, China. http://www.banxico.org.mx/dyn/publicaciones-y-discursos/discursos-y-presentaciones/discursos/%7B5E768822-DDCE-0D70-9539-ED763A2E34DC%7D.pdf. Accessed 6 Apr 2017

SEMARNAT (2012) Residuos. Informe de la Situación del Medio Ambiente en México. Compendio de Estadísticas ambientales, indicadores clave y de Desempeño Ambiental. http://apps1.semarnat.gob.mx/dgeia/informe_12/. Accessed 10 Apr 2017

Tabellini G (2010) Culture and institutions: economic development in the regions of Europe. J Eur Econ Assoc 8:677–716. https://doi.org/10.1111/j.1542-4774.2010.tb00537.x

Top Markets Report (2016) Environmental technologies a market assessment tool for U.S. exporters. U.S. Department of Commerce, International Trade Administration, Industry & Analysis (I&A). ITA 2016. http://trade.gov/topmarkets/pdf/Environmental_Technologies_Top_Markets_Report.pdf. Accessed 5 Apr 2017

Velasco MG (2011) Generation and disposition of MSW in Mexico and potential for improving waste management in Toluca Municipality. Department of Earth and Environmental Engineering Columbia University

Yuan Z, Bi J, Moriguichi Y (2008) The circular economy: a new development strategy in China. J Ind Ecol 10:4. https://doi.org/10.1162/108819806775545321