RECYCLING OF WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT AS A STRATEGIC LINE TANGENTIAL OF CIRCULAR ECONOMY

Sara Nolasco Ruiz
Hector Nuricumbo Castro
Alejandro Vergara Berra
Candidates for PhD in Strategic Planning and Technology Directorate
Manuel Gonzalez Perez., PhD
Universidad Popular Autonoma del Estado de Puebla,
Interdisciplinary Center for Graduate Studies, Research and Consultancy,
Mexico

Abstract

Strategic planning allows the analysis and design of probable decisions in the environment of Organizations. Technological change has generated a large amount of electronic waste (E-Waste). In the health not only affects people but the entire World.

The methodological application of the circular economy in Waste Electrical and Electronic Equipment (R^2AE^2) is done by defining efficiency indicators through linearization. A recursive decision feedback scheduling strategy for a system of efficient power generation.

The competitive advantage of the circular economy through R^2AE^2 allows to obtain high revenues while providing adequate management in the Reduce, Reuse and Recycle (3R) of waste to avoid contaminating the environment.

The proposed methodology aims to obtain similar results when applying EC strategy in South- Southeast of Mexico.

Keywords: Strategic Planning, Strategic Tangential Line, Circular Economy, 3R Principle

Introduction

Strategic planning becomes an essential activity for decision-making in an organization. This medium requires other complementary activities critical to the achievement of the organizational mission. Therefore, facing a high degree of competition in today's globalization.

Technological change noted by Porter is a widespread and continuous phenomenon. Although technologies have made obsolete the traditional distinction between high and low technology industries and.

The technology planning as part of strategic planning, strategic generates tangential lines and differentiates the characteristics and needs of buyers across countries. While the tangential strategic lines differ the features and needs of buyers across countries.

Technological change has generated a large amount of electronic waste (E-Waste). In the health not only affects people but the entire world. The average life of the products of technological industries is 18 months. However, countries like Pakistan, China, India, Ghana and Nigeria are the most affected by this phenomenon.

The circular economy seeks to design products to facilitate waste disassembly and reuse. This form encourages economically reduce, recycle and reuse waste electrical and electronic equipment. Also, define business models for technology industries.

This document incorporates its state of the art, a proposed methodology for analysis and the results and conclusions of the study supported by their references.

State of the Art

Strategic planning describes by Michael Porter in his book *The Competitive Advantage of Nations* (1991). Allows analysis and design decisions likely in the vicinity of action of organizations. Develops aimed at identifying and implementing strategies competitive advantages. Reduces uncertainty in achieving the objectives set. Also, processes determined by an appropriate future for their circumstances.

The competitive approach sets the trend of behavior in most organizations worldwide publication Porter in *Competitive Strategy. Techniques for Analyzing Industries and Competitors* (1998) defined based on the interrelationship of the five forces model.

The five forces are tools for analysis, diagnosis, and management in the organization. It consists of the entry of new competitors, the threat of substitutes, bargaining power of buyers, bargaining power of suppliers and rivalry among existing competitors. These five forces directly influence on prices, costs and investment an organization in its sector and allow a new strategy of competition.

The Strategy sets a direction and focuses its efforts towards the common organizational goal, i.e., generates a sense of ownership. The strategy (Mintzberg, 1999) perceived organizational team a consistent understanding your organization method. The strategies, analysis criteria, methods and techniques of thought Porter and use scenario planning

Mintzberg, Porter diamond and as proposed medium Environmental Reduce, Reuse and Recycle (3R). Inspired by the Laws of Recycling Economy (LER), both Japanese and German.

The Circular (EC) Economics (Hernandez & Ruiz Galan, 2009) departs from the conventional linear flow of materials (resource-product-waste). So seeking product processing resource again. Therefore, it arises as a competitive advantage. The Circular (EC) Economy is a new economic development for businesses, benefiting the environment. According Xiaofei (2009) reduces the effects of current economies to natural resources and natural environments and implements the principle of the 3Rs in all phases of production, distribution and consumption.

Reducing costs in organizations has glimpsed an opportunity to competitive advantage. A cumulative cost of production per unit is lower than other competitors. Cost reductions achieved similar quality conditions in the product specifications. Mejia (2013) explains that must be examined in its origin and explore sources of improvement that highlights the rational use of resources.

In another aspect, the 3R campaigns acquire environmentally vision of contributing to the environment and enable the organization to reduce costs and improve their competitive position in the market in which it operates.

The organizations view with interest the proposal of Chinese environmental authorities. The strategy of current cases in China consist of three levels Hernández & Ruiz (2009) in New Circular Economy Law. Table 1 shows the relationship between the organization and levels.

Levels	Organizations
1st. Level	Organization individually. Managers seek efficiency through three basic principles: Reduce resource consumption and waste emissions. Reuse resources. Recycled byproducts.
2do. Level	Eco-industrial parks and industries group. Reuse and recycle resources. Resources are circulating within the local production system.
3rd. Level	Systems of production and consumption in the different Chinese regions. Circular resources between industries and urban systems.

Table 1 Relationship between levels and organizations

Cradle to Cradle generates the concept of eco-efficiency. Increase the value of the product and reduces environmental impact. For Vines, (2012) is the antithesis of the economy decline and fault management. Cradle to Cradle does not renounce the material welfare as a form of wealth. Moreover built is restored to its lifecycle. It also allows materials to maintain their

character quality resources. From the above, the concept of biodegradability arises. Reintroduces resources in nature when its use is no longer profitable. Technicals nutrient are designed to be reused again and again mounted and disassembly easily. These contribute to saving resources and energy.

Organizations are reducing the resistance to adopting a sort of circular economy. Fresneda (2014) defines: "What was once seen as an alternative or green solution now is something else. Companies realize that reuse and share resources are taking sense from an economic point of view. "It is a paradigm shift with benefits to the organization and the environment.

Methodology

Techniques and documented methods favor the establishment of various strategies. China goes beyond individual actions of organizations and strategies articulated by summing the stakeholders. The government maintains a scientific point of view in this regard. China has created a new social dynamics of environmental impact. The service industry, schools, green communities and government purchases of products easy to reuse among other actions show the implementation of circular economy in different Chinese cities.

The Asian country pilot projects are circular economy in three levels as defined Hongchun, Z. (2006). Cleaner production level of organization; build eco-industrial parks in industrial areas; and develop the province, involving citizens.

This country is yielding results: "China experimented with cleaner production management paper production and chemical industry through financial and technical support from the World Bank Resource. Efficiency has improved and achieved the reduction of pollutants through improved design, use of clean energy and adopting new technologies and equipment with best management practices "(Hongchun, 2006).

In support of these measures, the government encourages companies to clean up their production technologies and industrialization. The document Circular Economy in China and Recommendations (Hongchun, 2006) notes that it has successfully implemented more than 400 companies from 20 industries in 20 provinces or autonomous regions or municipalities 1993 to 2002. Being created industrial and local cleaner production centers with training and participation for all 10 thousand people.

The methodological application of circular economy in WEEE (James Yu-Shan Liu, 2012), is done by defining efficiency indicators through the linearization process. Starting from the traditional definition of efficiency can define the expression (1). Efficiency from the point of view of the EC does not meet the traditional standards.

The main reason is due to a law of return generating incremental income, and the law reduced by an additional input and receives a considerable addition. The second law of thermodynamics reveals that any reverse engineering (to reduce entropy) requires additional effort. Residues (more entropy state) are in the first instance recycled material inlet (less entropy state).

For a circular economy, the expression is amended as follows (2):

Efficiency = output / input (1)

Efficiency = Output * (1-β) / input * (1 + α) (2)

(B is a decay factor, α is a gain factor).

However, consider all costs associated with the traditional economy, the formula (1) reformulated as:

Efficiency = [output-sum (hidden impact on the environment)] / [login + sum (hidden costs incurred)] (3)

Formula 2 becomes less attractive to the circular economy. However, the formula (3) adds robustness to the concept of costs and causes more weight in the future strategy model.

The first step of the method in Table 2 shows the factors prerequisite for the initiation of the model.

	Efficiency Economic	Efficiency Environmental
Applicability in EC	Come Down	High
System logic	Optimal	Vivid
Indicators	Traditional (posses)	Sustainability
Formulas	Formula 3	Formula 2
Temporary	Intra-temporary	Inter-temporary / Lifecycle

Table 2. Economic Efficiency vs. Environmental

Based on this prior knowledge-based modeling EC, assessing Efficiency Performance EC should consider labor, resources and capital as inputs. The economic growth, social development, the applicable rate of treatment and waste discharge based on 3R as output indicators to construct the index system of performance evaluation of efficiency in the context of the EC.

There are several methods for modeling the framework. However, given the nature of the problem to confront, based on Data Envelopment Analysis model is a tool for analysis and modeling of efficiency under the EC proposal for Pingping et al. (2011).

From the point of view of technical efficiency and scale validation analysis was performed based on the recycling process in a framework and suggests policy decisions based on scientific theoretical strategy.

This method of analysis and modeling based on a dual programming problem based on a system of non-restrictive equations (C^2R) (4) and (5)

$$D^{I}_{C^2R}\begin{cases}\min\ \theta \\ s.t.\ \ \sum_{j=1}^{n}\lambda_j X_j + S^- = \theta X_0 \\ \sum_{j=1}^{n}\lambda_j Y_j - S^+ = Y_0 \\ \lambda_j \geq 0, j = 1,2,\cdots,n \\ S^+ \geq 0, S^- \geq 0\end{cases} \quad (4)$$

$$D^{I}_{BC^2}\begin{cases}\min\ \theta \\ s.t.\ \ \sum_{j=1}^{n}\lambda_j X_j + S^- = \theta X_0 \\ \sum_{j=1}^{n}\lambda_j Y_j - S^+ = Y_0 \\ \sum_{j=1}^{n}\lambda_j = 1 \\ \lambda_j \geq 0, j = 1,2,\cdots,n \\ S^+ \geq 0, S^- \geq 0\end{cases} \quad (5)$$

This last equation (5) can improve the assessment of the method by introducing the restriction on the values of λ such that:

$$\sum_{j=1}^{n}\lambda_j = 1. \quad (6)$$

The method restricted to values of θ between 0 and 1, representing the relative efficiency of the unit value of decision-making. This criterion is called efficient use of the entry for the output and reflects a reasonable degree of decision-Based on the location of rational evaluation of the parameter (Xin Zhu and Xianjun Yu, 2014).

This last constraint binds the model to a scheme decisions and allows performance evaluation resource efficiency applied to its recycling ratio (R^2A).

The possibilities decision is taken according to the decision strategy defined by Gracios, Nuno, and Vega. A recursive strategy decision feedback (FDRE) for the scheduling of a system for efficient power generation, and described by applying fuzzy logic algorithm to manipulate values in the required range of the parameter θ.

Results

The various areas where Circular Economy has been carried out in Information Technology (IT) and Electronic Waste Management. E-waste includes information and telecommunication components, computers, and other entertainment accessories.

Sarkis & Zhu (2008) note that the electronics, mobile telephones and ancillary equipment not used by consumers represent a significant secondary resource. These devices are suitable for direct reuse, refurbishment and

recycling raw materials restorative for the manufacture of other materials (including computer chips, plastics, and precious metals).

Electronic waste to China has become a problem. Despite being a valuable source of secondary raw materials when it comes improperly, becomes a major source of toxins and carcinogens (Cui and Forssberg, 2003).

Shorter life cycles and low cost in the IT industry in China requires infrastructure, logistics systems, technical, legal solutions and long-term environmental policies.

The production phase of a laptop is responsible for about 56% of total emissions of greenhouse gasses (Santkovsky 2013). This kind of items represents 214 kilos of CO2 (carbon dioxide) in an estimated useful life five years.

In the use phase, high values are not compensated by gains in energy efficiency. Emissions of greenhouse gasses represent 36% at the time of use.

Although a 10% increase, energy efficiency in a new notebook, replacing the laptop could only justified after 33-89 years and demonstrate, the impact is greater in its production during use.

In a report of the Federal Environment Agency of Germany: Öko-Institut (Institute for Applied Ecology) and Fraunhofer IZM (Fraunhofer Institute for Reliability and Microintegration), indicate that:

"It is feasible to reduce emissions of greenhouse gasses significantly in the production phase if the useful life of computers extends. Stressing the standards for sustainable products "(Santkovsky, 2013).

Also in Europe, the Spanish Association of Social Solidarity Economy (AERESS) brings together a number of responsible for carrying out the process of the circular economy entities. These develop strategic planning activities for a new process reuse. Second-hand sales and compliance with the hierarchy of waste management in line with the concept of a circular economy.

The strategy called 2020 and legislation, (State Waste Prevention Programme, Directive 2012/19 / EU WEEE;. Law 22/2011 of waste and contaminated soil and its derivatives), provides guarantees for proper environmental management level. This strategy is a social work employment generation and social integration of people or at risk of exclusion.

On 4 July 2012 the European Union through the Official Journal published on Waste Electrical and Electronic Equipment WEEE known by its initials. Enter more stringent collection and recycling of waste electrical and electronic equipment such as refrigerators, computers, and televisions objectives.

However, things did not happen as expected. The first operation of INTERPOL against the illegal trade in e-waste seized more than 240 tons of

electrical and electronic waste (WEEE). The organization initiated criminal investigations against approximately 40 companies involved in all aspects of illicit trade.

During November and December 2012 operating it called Enigma (News & Media INTERPOL 2013) aimed to identify and disrupt illegal collection processes, recycling, export, import and transport of electronic goods. These actions prevented the filling in sanitary deposits or other sites where they can cause serious environmental damage.

In the Americas, particularly in the United States, circular economy has its dynamics, highlighting two important cases: the "exchange of Apple plan" and the example of the US Postal Service (USPS). The post office has developed an initiative to help close the lifecycle of WEEE, and all stakeholders make a profit.

Jaime Potti in his blog (2014) explains that USPS for its wide coverage of the territory offers pick up and send free electrical and electronic devices small (in good condition or damaged) to maxBack. In this ISO, 14001 certified company devices generate a value and not take them to landfills. Scan the device and pays part of the benefits of recycling the owner for raw materials and UPSS for logistical service.

Apple meanwhile, launches the "exchange plan" iPhone to loyal users to buy the latest model. Used the plan to resell. In order not to lose market share to its competitor Galaxy S4 Samsung. The Apple "exchange plan" Apple benefits those who have an earlier model for switching to the new iPhone 5.

In Peru, circular economy is also evident. The Legislature approved the "Procedures for proper management of State Movable classified as Waste Electrical and Electronic Equipment - WEEE" directive.

These regulations govern nationally proper disposal of WEEE generated by public sector entities. To date, they have accumulated a significant percentage of the national total (Table Writing / RELAC 2013). State entities must have their WEEE specialized companies to perform this task fulfill the technical requirements set out in regulation.

Unlike many methods whose laws the penalty is mandatory, this regulation in the South American country is accompanied by policies for implementation. The regulations define the responsibilities of the three types of generators: homes, public companies, and private companies. For the first time, the focus of Extended Producer Responsibility (EPR) is incorporated.

Conclusion

For its advanced legislation, circular economy in China regularly incorporates improvements. A strong cultural base driven from the government increases the efficiency of resources, reduces pressure on the

environment in the course of modernization and seeks harmony between man and nature. Sarkis & Zhu (2008) define. "The notion of five balanced Aspects and building harmonious society Contain Both the notion of the harmony Between man and nature." Search this ideal is a primary characteristic of Chinese culture and civilization. The idea of "unity of heaven and humanity" is developed before the Qin dynasty, gaining meaning and practical application.

The circular economy has made Mexico the first provider in the United States on recycled electronic equipment such as motors, gears, alternators, injectors, engine-diesel, game consoles, routers and mobile phones. Mexico makes the recycling process and then sent to the United States.

Mexican entrepreneurs have managed to find in electronics and auto parts remanufacturing big business devices. In 2011, our country became the first supplier of remanufactured goods from the United States and moved to the European Union and China in the first two sites.

The director of the Foreign Trade Committee of the National Council of the Maquiladora and Export Manufacturing, Israel Morales, said a year industry assembly of our country exports about 4,000 million of these products to the US. Means savings from 40 to 70% of the cost of a new device (Scrap and Lags. Mesa writing 2013.)

It is "to give life to after the first life products, " says the document, and this reduces emissions, allowing to generate foreign exchange. In the first quarter of 2013 were exported about 1,000 million of remanufactured products, Morales said. This amount represents 1 percent of the size of the international market that the World Trade Organization estimated at 100,000 million.

Currently, fifty companies in the Manufacturing, Maquiladora, and Export Services in our country employ 308 000 workers. This activity is depending on the sector, on the imported used goods and the electronic waste by adding a volume of 108 700 tons.

Throughout the process, high technologies are applied to restore and leave as new product. Mexico complies with the provisions of the Basel Convention a proper management of electronic waste avoiding environmental pollution, the amount of metal used in electronic goods and that could cause risk to human health.

The Senate in Mexico approved amendments to comprehensive regulation and management of electronic waste not considered a definition for the reduction, reuse, recycling, collection, storage, transportation co-processing and disposal of electronic waste. These amendments limit the opportunities for recycling and reuse of technology products such as computers, printers, and photocopying equipment.

Reforms are a legacy of responsibility for waste management to the future, and the real possibility of its use is promoted from reuse, remanufacturing and recycling of the materials contained in them.

Lawmakers endorsed the incorporation of international best practices in the management of these wastes. Mexico has signed these agreements and reported in the Journal of Social Communication 1480 the Senate of the Republic (2013).

In this context, it is stated that electronic waste is obsolete, used, discarded, manufactured by the electronics or information technology, requiring electric currents or electromagnetic fields for operation or performance.

The useful life is over for them. They also include attachments, accessories, peripherals, consumables and subassemblies that make up when discarding.

The Federation will be responsible for issuing official Mexican standards and other legal provisions governing the integrated management of electronic waste. Join national management plans, and the states will be responsible for authorizing and take control of facilities for the comprehensive management of electronic waste.

In addition, judicial concurrence virtuous scheme is introduced. The Federation adds power to regulate the management of such waste. Creating legal certainty to all actors and induces suppliers to deliver bonds to guarantee bonuses to equipment replacement.

Legislative Bulletin (No.1480 Social Communication Senate 2013) states clearly that "electronic waste for disposal, should benefit from the management plans so that the burning or import bans for disposal. For disposal of electronic waste classified as hazardous the authorize the states. "

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