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GREEN PRACTICES IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT IN THE AUTOMOTIVE INDUSTRY: END OF LIFE VEHICLE RECOVERING AND RECYCLING IN MEXICO

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ABSTRACT

The intention of this article is to review the dynamics related to the recycling of cars at the end of its useful life (ELV), focusing in green practices (ecological) and policies that automakers have in their home countries and in Mexico.

An increasing pressure has been put on the automotive industry for the implementation of ecological or green processes and their logistics, both by government organizations and member shareholders within companies. In the case of Mexico, automakers and the Federal Government have worked together in a Program of Vehicle Renewal (PRODIAT-C), but the results were not as expected, and this is the problem analyzed.

Three car manufacturers with operations in Mexico were selected for the analysis of their green policies related to the recycling of vehicles at the end of their useful life, as well as the current ecological practices in the industrial plants.

Keywords: Automotive recycling, ecology, logistics of supplies.

PRÁCTICAS ECOLÓGICAS EN LOGÍSTICA Y CADENA DE SUMINISTROS EN LA INDUSTRIA AUTOMOTRIZ: FINAL DE LA VIDA ÚTIL Y EL RECICLAJE VEHICULAR EN MÉXICO

RESUMEN

La intención del presente artículo es revisar la dinámica relacionada con el reciclaje de automóviles al final de su vida útil (ELV por sus siglas en inglés), enfocándose a las prácticas verdes (ecológicas)

y las políticas que los fabricantes de automóviles mantienen en sus países de origen y en México.

Una creciente presión –por parte de organizaciones gubernamentales y por miembros accionistas dentro de las compañías– ha sido puesta sobre la industria automotriz, para la ejecución de procesos más ecológicos o verdes y su logística. En el caso de México, fabricantes de automóviles y el Gobierno federal han trabajado en conjunto en la generación del Programa de Renovación Vehicular (PRODIAT-C), pero los resultados no fueron los esperados, lo cual se analiza.

Se seleccionaron tres fabricantes de automóviles con operaciones en México para el análisis de sus políticas verdes relacionadas con el reciclaje de vehículos en el final de su vida útil, así como las actuales prácticas ecológicas en sus plantas industriales

Palabras clave: reciclaje automotriz, ecología, logística de suministros.

I. GREEN LOGISTICS IN THE SUPPLY CHAIN MANAGEMENT AND END OF LIFE VEHICLE RECOVERING

During the last two decades, an increasing pressure has been put in companies and entire industrial sectors due the high degradation of the environment and the impact of manufacturing activities in climate that have caused global warming and other side effects (NASA, 2013). In the United Kingdom, during the last ten years, the efforts of car manufacturers have generate reductions in the energy required in car assembly processes up to 28% and 73% less waste entering to landfill sites.

The industrial forecast shows that manufacturers will continue driving down emissions as technical progress will help to move towards a more sustainable and low carbon future (SMMT, 2013).

Green logistics is concerned with producing and distributing goods in a sustainable way, taking in account environmental and social factors, and its activities include measuring the environmental impact of different distribution strategies, reducing energy usage in logistics activities, reducing waste and managing its treatment (Sbihi & Eglese, 2007). In the same way, the current approaches on green lo-

gistics, from a marketing point of view, rely on the existence of market segments willing to pay a higher price for products or services made in an environmental-friendly mode, and that motivates companies to develop green practices in order to attend those segment (Sharma & Gopalkrishnan, 2012).

The automotive industry is defined as all those companies and activities involved in the manufacture of motor vehicles, including most components, such as engines and bodies, but excluding tires, batteries and fuel (Encyclopædia Britannica Online, 2013). During the recent years, car manufacturers have been doing a relevant effort to adopt green practices in their facilities, and those practices are overall expressed as follows (General Motors LLP, 2013):

1. Restoring and preserving the environment.

2. Reducing waste and pollutants, conversing resources and recycling material at every stage of the product lifecycle.

3. Participating actively in educating the public about environmental conservation.

4. Pursuing the development and implementation of technologies to minimize pollutant emissions.

5. Working with all government entities for the development of technically sound and financially responsible environmental laws and regulations.

6. Assessing the impact of the facilities and products on the environment and the communities where we live and operate with a goal of continuous improvement.

General Motors is one of the top ten largest manufacturers of vehicles in the world and its public standing about environment and green practices resumes all the commitments in other car manufacturers (OICA, 2013).

The End of Life Vehicle recovering (ELV) is an activity that substantially differs between developed countries and developing countries. In one hand, European Commission through the End of Life Vehicle Directive regulates between its members the recovery and proper disposal or recycling of automobiles, setting targets for reuse and pushing producers to manufacture new vehicles with a new view to their recyclability.

This directive was officially adopted in 2000 and regulates the proper management of approximate 8.5 million of tons generated every year by end of life vehicles (European Commission, 2013).

Table 1 shows that in the United Kingdom, in 2011, the total recycle and reuse was 988,314 tons of vehicles, leading the path between European countries as only France recycled and reused a higher rate of tonnage of ELV than United Kingdom (see Table 2 for further data).

European Commission states that the metals used in the manufacture of vehicles are routinely recovered, reused and recycled to high levels, but at the same time there is a real challenge on recovering non-metallic parts to meet the levels required by law.

On the other hand, Mexico as developing country has not made an official regulation related to the management of ELV. Even when the Ministry of Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales, SEMARNAT) has published recently the national regulation related to carbon dioxide emissions in cars and trucks, there is still no regulation related to the recovery of ELV and most of these kind of motor units are usually found in junk yards, municipal car yards or private homes (Delegation of Mexico at the World Trade Organization, 2013).

By 2012, 37.7% of the total of automobiles in Mexico were twenty years old or more, and the total number of vehicles were 26,444,573 units that year (Terra, 2012). Some efforts had been made during the recent years, such as a national program for car renewals (PRODIAT-C), but rules for applying the program and a complicated logistics network to deliver the ELV to the proper facilities, made the

program a failure. This case is further explored in succeeding paragraphs.

Nevertheless, consumers play an important role in ELV recycling due traditional attitudes related to vehicle maintenance, as the only and most suitable action for managing CO_2 car emissions. Most of the consumers do not make the proper repairs and mechanical keeping to the units, which cause at later stages problems as emitting more CO2 than average, loose capability for braking or noise and fluid pollution through leakages.

By doing the appropriate maintenance, implementing activities such as sharing car for going to the office with their workmates and using public transportation, the user CO2 footprint will be reduce. In terms of ELV recovering, users of old vehicles cannot do much about recycling them, as no appropriate network exist for that goal, and recycling centers set in the past were far away in most cases.

II. END OF LIFE VEHICLE RECOVERING, RECYCLE AND REUSE IN MEXICO

A recent paper published related to reverse logistics in the Mexican automotive industry shows that the ELV management is driven by market conditions, where the most important components are recovered in order to generate profits in aftermarkets (Cruz-Rivera & Ertel, 2009).

The inefficient logistics existing at this moment could be explained by several reasons, both political and economic.

1. However, the main problems are resumed in the following:

2. The inexistence of a national network for collecting or recovering ELV, which includes both governments and car manufacturers.

3. The lack of incentive or subsidies for car owners in order to dispose their automobiles after they have completed its lifecycle.

4. The existence of a wide aftermarket for used spare parts obtained by ELV.

The efforts of the car manufacturers in Mexico and the federal government generated in 2009 the creation of the Vehicular Renewal Program (Programa de Renovación Vehicular). The program was open to Mexican owners of vehicles with more than ten years old for getting an incentive of MXP $15,000 (today, USD $1145) by the Mexican government for buying a new car.

This initiative would boost the sales of vehicles in an unstable economic environment caused by the 2008 world financial crisis, but at the same time it was intended to take out of the streets most of the vehicles that were old, unsafe and air polluting. The owners must take their car to a recycling center for its proper disposal and they would get a certificate for buying a new car with price no higher than MXP $170,000 (USD $13,000) made by any country with a Free Trade Agreement with Mexico (*CNNexpansión,* 2009).

However, this program was ended in 2010, only one year after the announcement and start in operation. The Mexican government did not renew the program to the car manufacturers, once they used all the budget by giving incentives. In addition, once the program ended, the owners have no further incentive for recycling their old units. In the case of Texas, United States of America, the State Government coordinates a program in which people can obtain up to USD $3,500 by recycling their cars with more than ten years or if it has failed environmental tests (Texas Commission on Environmental Quality, 2013).

It is important to mention that these kinds of dynamics were the ones proposed by Mexican government in 2009, however implementation wasn't done correctly because the incentive for recycling vehicles was quite low, and market prices for those kinds of vehicles were higher, so owners weren't encouraged to recycle ELV.

Recommendations in this matter is to generate a public policy related to a permanent program for ten years or older vehicle renewal that involves government and car manufacturers, in the manner of giving incentive according to market value of the ELV after the owner delivers the unit to the specialized recycling center, and car manufacturers through their dealerships to provide with competitive credit plans for buying a new car. Therefore, a reasonable amount of money obtained by recycling ELV, plus competitive financing plans for buying cars will incentive owners to change their vehicles often, reducing CO_2 emissions, maintaining safer cars in circulation and boosting the Mexican automotive (manufacturing) and banking (loans and financing) industries.

Other factors that would qualify as constraints for the car owners were some of the legal requirements for applying to the program (AMDA, 2009):

- Official identification card issued by an entity of the Mexican or Local governments.
- Evidence of address such as electricity, telephone or water bills.
- Original invoice of the automobile.
- Certificate of vehicle registry where it states the car has no alert on robbery or theft.
- Evidence of current payment on annual car tax.
- Car registration card and plates.

The first four requirements were easy to comply by the owners, but the evidence of payment on annual car taxes supposed a problem for them, as a part of the population stops paying those kinds of taxes when the car is getting old, and local authorities have no interest in demanding the payment of those taxes. Furthermore, it generated that car registration card and plates were old or past-due, and if an owner have wanted to participate in the program he or she

would be required to pay all due taxes, which involves a higher cost of transaction.

The program ended in March 2010, but not all the economic resources were used, and the final rate of effectiveness reached 77% of all the budget set. Also, the program was extended four more months after March, but there was still no demand (Lacayo Ojeda, N/A). This is additional information to conclude that the program didn't reach the expected results. Table 3 shows the total amount of resources available for every major car manufacturer in Mexico under that program, the total car sales made and the number of cars recycled during the period (Ministry of Economy, 2010).

As mentioned before, the program was also intended for boosting car sales on a crisis environment, but statistics show that the total car sales in 2009 were 754,918 units, which means a fall of 35.84% in front of 2008 sales, which reached 1,025,520 units. This data allows to conclude that the 12,291 units sold under the program had quite little impact in improving the industry situation from an economic point of view but also in the little CO_2 emissions amount that were offset from old vehicles.

III. THE IMPACT OF ELV PRACTICES IN CAR MANUFACTURERS

Due the high number of car manufacturers in the world and in Mexico, for the approach of this document the three major manufacturers in Mexico are taken for analysis, according the size of their operations and market share: General Motors (United States), Nissan (Japan) and Volkswagen (Germany).

First, General Motors practices related to ELV are expressed as the design of vehicles to be as recyclable and recoverable as is feasible, following ISO standards and developing internal standards to gain common benefits across global regions (General Motors LLC, 2013). The company expresses that on average, their vehicles are 85% recyclable and 95% recoverable by weight, which can be understood

as most of the supplies used in the production lines for making a new car are composed by recyclable elements or materials (e.g. glass, plastics, sound insulation foams, iron and other ferrous materials, etc.). This policy along with others related to waste management in their facilities and social initiatives (e.g. reforestation), have generated $2.5 billion dollars in revenue from 2007 to 2010 and $1 billion dollars in byproduct reuse and recycle revenue annually. Due the limitations of available information, it was not possible to determine the amount of material or savings that the company generated by ELV recycle. In Mexico, General Motors is focused on waste management in their facilities, and ELV activities are not executed, on which most of the cases is done third parties such as iron manufacturing companies and scrap recyclers.

On the other side, Nissan have special teams for conducting studies and experiments on dismantling and recycling ELV, and share the knowledge and techniques with other partners in their supply chain (Nissan Global, 2013). The results of these teams have led to improvements in the recovery, recycle and reuse of plastics and ferrous components (e.g. aluminum), along with oils and fluids required in the powertrain. By recycling plastics from bumpers and other items, Nissan is able to manufacture new bumpers in coordination with their supply chain partners.

Collaboration in recycling components and ELV is an important issue in different countries, and Japanese regulations have led Nissan to conform a group of action towards resource recovering to Subaru, Mazda, Mitsubishi, Isuzu and Suzuki.

However, their activities in Mexico are not included in ELV recovering, and their main effort in the country is expressed in manufacturing cars with CO_2 emissions lower than the level set by the government. These efforts have been successful and Nissan has maintained the certification of "Clean Industry" due the manufacturing processes, commitment to the environment and efficient waste management and recycling in their facilities (Nissan Mexicana, 2013).

Finally, Volkswagen leads the IDIS (International Dismantling Information System) in order to simplify the recycling of ELV

and optimize efficiency. The IDIS database contains relevant information relating to removal of fluids, airbags and other fasteners and components. Along with this, the company has set three stages in ELV recovery: dismantling, shredding and treatment of shredder residues; these stages conforms the VW SiCon process (Volkswagen AG, 2013). This allows the company to operate the system and process for recovering 696 models for 34 countries. In Mexico, Volkswagen focus their environmental practices in waste management and efficiency in the resources demanded in their processes, as most of the car manufacturers does. Mexico is not a market that is included in the IDIS, so that is evidence that the company do not manage ELV activities in the country (IDIS, 2013).

IV. LOW CARBON SUPPLY CHAINS: FRAMEWORK AND FUTURE

Even when there is no clear consensus among research about the definition of a low carbon supply chain, and this can be noticed between different databases and journal publications, in the attention of this document a low carbon supply chain can be addressed as network of different companies producing and distributing a specific product or service that complies within three different stages on carbon management set by Carbon Trust organization: direct emissions reduction, indirect emissions reduction and offsetting.

This company established by the United Kingdom Government (Carbon Trust, 2006) set three different stages on carbon emission reduction between partners in a supply chain, from raw materials to end consumer, driven by the recognize of companies to reduce energy cost and play a relevant position in mitigation of climate change:

1. Direct emissions reduction: focusing on reducing the direct polluting emissions of the companies by implementing cost effective energy efficiency measures, using new process technologies and delivering staff training and awareness programs, at the same time of developing low

carbon energy sources and addressing strategic business risks and opportunities associated with climate change.

2. Indirect emissions reduction: looking at opportunities to reduce emissions between other partners in a supply chain, allowing carbon footprint to be calculated and making reductions in energy consume. Working with partners in the supply chain would be possible to develop low carbon products that would generate higher profits over the time by consumers green attitudes.

3. Offsetting: this practice occur when a company buy credits associated with environmental projects that reduce CO_2 emissions, was way of offsetting their carbon emissions. Whereas this exercise might be a corporate social responsibility practice, the evaluation and measure of the environmental impact by offsetting should be made in a cautious way in order to conclude if the practice had success.

These stages might set a common framework for every company, no matter the size, in order to reach higher levels of green activities. Law regulation differs from one country to another (e.g. Kyoto Protocol worldwide, Climate Change Act in United Kingdom, some Federal Regulations with no enforcement in Mexico) (Hitchcock, 2012).

However, the current challenges for developing a low carbon economy and low carbon supply chains reside in the economic impact for companies by adopting new technologies and new practices in an environment not fully recovered by 2008 financial crisis.

The emissions reduction that companies make an effort to fulfil is driven mostly by cost reductions as we set in previous paragraphs. These cost reductions might generate a higher rate of return for investments and compliance with the legal framework is just made at the minimum level, in other words only what the law requires.

It is worth to mention that most of the global companies are doing important steps ahead adopting green technologies and improving logistics processes, along with collaborating with their supply chain partners.

As a matter of fact, at a microeconomic level, the conclusion is that a common framework is required so every company would be aware of challenges and opportunities in working towards green logistics processes in a supply chain, and the generation of creative and inexpensive tools or practices become highly important, so SME can adopt in a quick way that knowledge and reduce carbon footprint.

The importance of developing solutions for SME exist in the huge impact on a national economy, as they are the major contributors in the Gross Domestic Product for most of the countries (Edinburgh Group, 2012).

At macroeconomic level, the discussions between countries related to the level of emissions that has to be cut, the stipend for combating climate change or global temperature targets, have made more notorious the gap between developed countries and developing countries. Even when Climate Change Conferences are held on a regular basis by the United Nations in different cities of developing and developed countries, general agreement about investment for climate change is usually a hard-to-negotiate affair.

Conclusion on this paper is that technological development will be main catalyst between reducing the CO_2 emissions and, by consequence, reducing the carbon footprint along a supply chain. Political efforts on setting standards for emissions are expressed in terms of laws and regulations, but those are only possible to achieve if technology is available to deploy in the companies. Therefore, green practices in terms of logistics processes, supply chain management and corporate social responsibility, will be adopted according to the development of green technologies. Low carbon economy is an affair that any company must observe in its business planning, as collateral damages can occur to their supply chains due climatological or environmental factors that could affect directly to the availability of raw materials for the production of a product or service.

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APPENDIX

Table 1. Total Recycle and Reuse of End of Life Vehicles (expressed in tonnes).

Country / Year	2006	2007	2008	2009	2010	2011
Belgium	114,924	113,068	126,767	127,971	156,973	151,542
Bulgaria	37,164.99	20,960.43	31,263.34	52,114.23	66,136	58,916
Czech Republic	37,994.51	48,980	106,026	118,215	108,790	94,872
Denmark	79,226	79,597	83,696	81,638	94,947	93,525

Germany (until 1990 former territory of the FRG)	389,796	370,468	345,908	1,324,209	492,907	437,679
Estonia	8,779.1	10,139.85	12,679.01	6,726.75	5,937	9,230
Ireland	114,504	88,618	103,667	128,608	130,216	111,198
Greece	19,714	35,103.63	44,433.88	100,185	77,867	89,126
Spain	675,519	687,562.22	587,735.93	754,449	666,723	534,196
France	666,343	698,459	835,942	1,150,900	1,223,990	1,213,626
Italy	921,404	1,211,727	933,418	1,127,598	1,031,369	836,310
Cyprus	784.46	1,590.27	9,950.93	13,408.4	9,543	12,815
Latvia	4,866.91	9,713.72	9,278.9	7,638.02	8,270	8,638
Lithuania	12,368	14,862	16,431	16,258	20,159	24,251
Luxem-bourg	3,879.2	2,510.62	2,135.41	5,254.99	5,173	1,668
Hungary	13,295.2	24,646	23,473	20,857	12,803	12,622
Nether-lands	148,399	130,328	123,542	157,561	193,533	164,648
Austria	55,349.84	40,362.04	43,668.53	61,557.65	57,255	55,778
Poland	105,225.1	109,236.23	135,197.63	167,532.97	193,226	254,459
Portugal	17,836	64,415	77,365	80,682	79,736	59,444
Romania	13,592.38	26,786.32	36,853.87	38,763.39	131,316	91,191
Slovenia	5,996	5,264.87	4,197.79	4,567.4	4,698	4,910
Slovakia	9,857.57	20,142.75	26,418.11	48,020.09	24,216	28,261
Finland	11,698	11,866	77,392	72,335	98,139	112,161
Sweden	279,765.2	220,987	148,424	139,319	175,085	191,197
United Kingdom	786,066	904,475	968,515	1,058,693	933,315	988,314
Lie-chtens-tein	N/A	2.02	96.6	60.48	92	84
Norway	87,791.91	77,791.13	110,324.09	81,215.93	97,382	95,739
Source: Eurostat (2013).						

Table 2. Total Recovery and Reuse of End of Life Vehicles (expressed in tonnes).						
Country / Year	2006	2007	2008	2009	2010	2011
Belgium	117,915	115,849	130,050	131,074	160,966	155,563
Bulgaria	39,367.76	21,714.47	33,463.62	56,211.68	66,405	60,516
Czech Republic	40,928.27	52,762	113,979	127,048	116,919	101,961
Denmark	79,547	79,781	83,827	81,902	95,158	93,632
Germany (until 1990 former territory of the FRG)	402,311	380,067	360,256	1,384,016	547,981	506,830
Estonia	8,779.1	10,139.85	12,714.42	6,738.24	6,009	9,572
Ireland	114,504	88,682	111,760	134,228	130,971	114,315
Greece	19,714	35,103.63	44,433.88	101,217	79,722	91,690
Spain	743,582	714,257.16	610,400.61	786,214	690,700	563,735
France	677,970	713,503	851,881	1,203,067	1,268,451	1,272,843
Italy	952,786	1,223,980	963,969	1,166,657	1,059,636	841,454
Cyprus	795.46	1,585.26	10,140.93	14,309.6	10,220	13,215
Latvia	4,866.91	9,984.48	9,389.58	7,702.82	8,309	8,694
Lithuania	12,998	14,919	16,557	16,298	20,258	24,323
Luxembourg	3,909.41	2,575.71	2,147.01	5,550.49	5,371	1,840
Hungary	13,348.9	25,018	23,885	21,310	13,532	12,896
Netherlands	153,184	133,783	125,275	159,533	221,398	190,606
Austria	59,471.45	43,768.79	50,181.81	71,322.28	65,619	65,768
Poland	106,537.54	115,530.7	136,293.37	169,192.15	195,338	260,058
Portugal	18,680	67,581	83,468	83,159	83,551	62,995

Romania	14,147.62	27,427.17	38,063.75	41,301.71	138,696	95,481
Slovenia	6,215	5,368.15	4,295.26	4,739.25	4,806	5,148
Slovakia	9,964.55	20,275.85	26,549.62	48,417.54	24,719	28,692
Finland	11,731	11,918	77,734	73,068	113,039	129,189
Sweden	285,179.1	239,256	163,323	146,613	189,054	205,597
United Kingdom	798,682	918,453	985,120	1,076,801	961,580	1,014,749
Liechtenstein	N/A	5.67	100.64	73.5	112	97
Norway	88,363.83	79,367.76	110,970.09	84,184.87	110,036	121,366
Source: Eurostat (2013).						

Table 3. Total of Beneficiaries under PRODIAT-C Program for Vehicle Renewal.

Beneficiary (Car Manufacturer)	Available Budget (Mex. Gov.) (Millions of MXP)	Car Units with Subsidy**	Current Car Sales*	Percentage of Current Car Sales by Car Units with Subsidy
Nissan Mexicana	55,628,487	3,708	3,009	81.8%
General Motors de México	61,418,698	4,094	3,864	94.4%
Volkswagen de México	48,740,752	3,249	2,953	90.9%
Toyota Motors Sales de México	4,516,116	301	268	89.0%
Chrysler de México	39,522,952	2,634	1,506	57.2%
Honda de México	4,058,989	270	86	31.9%
Ford Motor Company	36,114,006	2,407	605	25.1%
TOTAL	250,000,000	16,666	12,291	73.7%

* Total sales in car units made with Certificates of Destruction (done and in progress).
** Total of allowance by car manufacturer according to their market share in Mexico.
Source: *Facilitation Project for the Free Trade Agreement between Mexico and European Union* (2010).

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