Towards a Sustainable Management of End-of-Life Vehicles in Qatar: A Closed-Loop Circular Economy Model

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Abstract

The end-of-life vehicles (ELVs) are potentially harmful for the environment if they are not processed or recycled in an environmentally friendly manner. In Qatar, the municipality removed almost 13,878 ELVs from different cities by the end of 2012. Experts estimate that around (1,000) ELVs are released to Qatar’s streets each month. That adds up to (12,000) ELVs per year since 2012. This research highlights the importance of the ELVs problem in Qatar, and proposes a sustainable management of ELVs using a closed-loop supply chain strategy. The proposed solution will be to build a new reprocessing factory called as Qatar Automobile Reprocessing Plant that reprocesses and recycles the ELVs. The social, economic and environmental impacts of ELVs is discussed as well. The analysis envisages to have significant benefits for Qatar such as analyzing the sustainability impacts of recycling processing from a life cycle perspective and creating a circular economy model for local industries that will able Qatar to independently reprocesses ELVs without the need of exporting to other countries.

Keywords  
Circular Economy; Closed-Loop Supply Chain; End-of-Life Vehicles; Sustainable Management
1. Introduction

End-of-Life Vehicles (ELVs) are potentially harmful for the environment if not processed or recycled properly. According to the Directive 2000/53/EC on ELVs-Guidance Document, ELVs defined as “vehicles that have become waste”, and waste defined as “any substance or object which the holder discards or intends to discard or is requires to discard” (EUROPA, 2000). Environmentally speaking, “the disposal of cars is a major source of hazardous waste and toxic emissions. About 25% of a vehicle’s weight is classified as hazardous waste, so vehicles account for up to 10% of the total amount of that waste generated annually in the European Union”. On 2012, Qatar Municipality removed (13,878) ELVs from different cities in Qatar (Al-Raya Newspaper, 2013). ELVs dumped in specific area designated by the Traffic Authority.

2. Background on the State of Qatar

The State of Qatar is a small Arab state locates in Western Asia with an area of (11,606.8 km²). The capital is Doha with an area of (132.1 km²). Recent statistics for the end of Mars 2018 showed the total number of population reached (2,685,053) person (Committee, 2012). In 1970 the population was about (111,000) person, and they have become (1,732,718) person in 2011” (Committee, 2012). The massive growth is a result of “migration flow of foreign workers needed to accomplish comprehensive development process” (Committee, 2012). Corresponding with the population number, there were (815,096) registered cars in 2011, which are also increasing by an annual average of 5.7% based on (2006-2011) data.

This paper aims to shed further light on the problem in Qatar, introduce new ways of addressing the challenge by capitalizing on existing environmentally focused approaches to recycling products, like vehicles, at the end of their lifetimes.

The rest of this paper is organized as follows: Section 3 describes the proposed methodology. Section 4 presents worldwide solutions for the ELVs issue. Section 5 briefly outlines the problem in context. Section 6 introduces the status QUO. Section 7 explains the closed-loop supply chain. The improved process is reported in Section 8. The conclusions were drawn and reported in Section 9.

3. Methodology

In conducting this study, various sources have been reviewed and a rich body of data has been collected. For technical matters (such as closed-loop supply chain strategies), specialized academic books, journal articles and official government and private sector sources have been relied on. For relevant data on the researched topic in the specific context of Qatar, various print and online newspaper articles, statements from government officials, car companies, environmental organizations and other relevant stakeholders have been reviewed.

Finally, a line of communication with the Qatari statistics authority has been initiated; as a result, certain data that were not immediately available for public consumption has been obtained.

4. Worldwide Solutions for ELVs

4.1. Europe

By year 2000, ten European countries (Austria, France, Italy, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom) had concerned about the issues related to ELVs. The Directive on End-of-Life Vehicle 2000/53/EC is “the first EU waste directive with which the EU Commission (executive body of the European Union) has introduced the concept of Extended Producer Responsibility (a strategy designed to promote the integration of environmental costs associated with goods throughout their life cycles into the market price of the products). The directive aims at reduction of waste arising from end-of-life vehicles.” (EUROPA, 2000).

- In Sweden, the 1997 regulations “required manufacturers to accept ELVs free of charge and established a system for their management”. For example, “Volvo” car manufacturer offers a free “take-back” service for ELVs since 2007.
- In Netherlands, Auto Recycling Nederland (ARN) recycled 90% of the (234,000) discarded EOVs in 2006.
- In United Kingdom, a collaborative project called CARE is involving UK motor vehicle manufacturers/importers and vehicle dismantlers to test materials recycling processes for reducing the amount of waste.

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4.2. Asia

- In Japan, “consumers pay a fee when they purchase a new car or, for cars sold before the enforcement of the law, at the time of mandated regular inspection.” For example, “Nissan” car manufacturer used recycled plastics from ELVs to produce Nissan LEAF.

- In South Korea, the Korea’s 2007 Act for Resource Recycling of Electrical and Electronic Equipment and Vehicles “creates a framework to hold producers and importers responsible for their use of resources. The law addresses the use of hazardous substances, recyclability of materials and collection of ELVs.” (EUROPA, 2000)

4.3. United States

Since 2000, the End of Life Vehicle Solutions Corporation (ELVS) “supports the auto industry’s belief that the most important step that can be taken to reduce the amount of mercury entering the environment from motor vehicles is to have the mercury switches removed by the recycling/dismantling industry at the vehicle’s end-of-life” (ELVS, 2000) End of Life Vehicle Solutions “manages, transports, retorts, recycles, or disposes of elemental mercury from automotive switches” (ELVS, 2000). It is created by the automotive industry to promote the industry’s environmental efforts in recyclability, education, and outreach, and the proper management of substances of concern. Several companies are members in ELVS, some of which are Chrysler Group, Ford Motor Company, Mercedes-Benz USA, Mitsubishi Motors North America, Nissan North America, Porsche Cars North America, Toyota Motor Sales USA, and others (ELVS, 2000). The United States has 200 shredders to shred 12 million ELVs annually and that produces 16 million tons of recovered ferrous and non-ferrous scrap for use in the metals industry (Jody & Daniels, 2006). “Over 95% of the ELVs are recycled for their metals content, which represents about 75% of the weight of the vehicle. The other 25% typically ends up in landfills, with a small percentage used as landfill cover” (Jody & Daniels, 2006).

5. The Problem Statement

In Qatar, the number of registered vehicles in 2011 was (814,373) with an increase of 5.7% from 2010. Assuming the rate is constant for following years, the number will reach approximately (910,655) in 2013. By the end of 2030, the number will hit (2,336,864); see Figure 1.

One of the recent problems in Qatar is the unbelievably increasing number of ELVs. Only on 2012, Qatar Municipality removed (13,878) vehicles from the different cities in Qatar (Al-Raya Newspaper, 2013). From the beginning of 2013, Qatar Municipality removed (6,355) vehicles and still the work is in progress to remove others (Al-Arab Newspaper, 2013). (Figure 2) shows the trend of increasing the ELVs with a constant rate of 5.4%.

Since 2008, environmental activists and lawyers were bringing this issue to public attention either publishing in newspapers or through internet forums; yet no solid actions were taken toward it. The quick response is to remove the ELVs from the street and increase the number of area storing them. The following sections will cover the current process for dealing with ELVs in Qatar and the closed-loop supply chain strategy for solving this issue.

\[\text{Figure 1. Projection for Total Registered Vehicles in Qatar by the end of 2030}\]
6. The Status Quo: ELVs treatment in Qatar

6.1. The Problem
When the owner of the ELVs decided to get rid of it, two option will arise: 1) Sell it to a car dealer, or 2) Leave it on the street. All problems occur when the owner decides to go with the second option. Some owners leave their ELVs on the city street, or park it anywhere away from their properties. Others drive to rural areas and leave their ELVs there. The ELVs are not only a threat for the environment, but they are a threat for the people living around. Some problems that may occur due to ELVs are:

1) Affecting the street view
2) Increasing traffics
3) Increasing insects, bugs, and rats
4) Encouraging illegal activities

6.2. The Cause
There are several reasons for people to leave their ELVs. Some of which are as follows:

1) Maintenance costs for the car is high
2) Owners travel outside the country
3) The vehicle has many violation tickets (the cost of paying back the tickets are more than renting or buying used car) (reaches to $4500)
4) Owners do not have vehicles’ insurance
5) Owners want to buy new vehicles

6.3. Actions
Qatar Municipality started to solve this problem, but only a temporary solution. Each city’s Municipality sends a team to locate the places of ELVs. Traffic Department then puts stickers on those vehicles. These stickers identifying that if the vehicle does not move within specific period of time, Traffic Department will remove it. ELVs will be taken to a special garage that owned by Qatar Municipality. After three months, the ELVs will be taken to the scrap area in the Industrial City where this area has a security and is fenced and protected. During these months, if the owner claimed his vehicle, he have to pay two fees; one for violating by leaving the vehicle (between $150 - $350), and one for removing it from the garage (between $50 - $100). If the owner did not claim it, Qatar Municipality will own the vehicle. Qatar Municipality will either sell those cars in auctions, or destroy them safely. Figure 4 shows the current process of treating ELVs problem.

Qatar Municipality is trying to solve this problem by first assigning more lands to hold ELVs. For years, there was only one area filled with ELVs. This area is near the Industrial City. Now, there will be three more: Abu Hammor, Al-Mashaf, and Um-Alhoul. Then, Qatar Municipality will increase the number of contracts with companies to purchase more quantities of special trucks to pick up and remove the ELVs.

As it appears to be, these solutions are only temporary and do not solve the main problem. Assigning more lands will have its own problems. It will even increase the ELVs by encouraging people to leave their vehicles. Moreover, it will take a piece of land that might be taken to another project for developing the country. On the other hand, purchasing...
special trucks to remove ELVs will need huge amount of money. This amount could be used to build a project to protect the environment in different way; despite the fact that those trucks will end up as ELVs.

7. Closed-Loop Supply Chain and ELVs

There are two types of Supply Chain: Forward and Reverse. Forward Supply Chain is to produce new product from raw materials and distribute it to customers. On the other hand, Reverse Supply Chain is to collect used products from customers and reprocess it. The combination of Forward and Reverse Supply Chain is called a Closed-Loop Supply Chain (Pochampally & Gupta, 2009).

Sustainability Dictionary defines Closed-loop Supply Chain as “an ideal in which a supply chain completely reuses, recycles, or composts all wastes generated during production; at minimum “closed-loop supply chain” indicates that the company which produces a good is also responsible for its disposal” (Corbett & Savaskan, 2001).

According to many researches, reprocessing (remanufacturing or recycling) is helping countries to save natural resources, energy, clean air, clean water, landfill space, and money (Pochampally & Gupta, 2009). Closed-loop supply chains are used in many different industries over the world, aircraft, automobiles, computers, and chemicals (Pochampally & Gupta, 2009). In any typical closed-loop supply chain, there are three essential parties (Figure 7):

6) Collection Centers: collects used products
7) Recovery Facilities: remanufactures or recycles used products
8) Demand Centers: sells reprocessed products

Closed-Loop Supply Chain (CLSC) is one solution to solve permanently the ELVs problem in Qatar. The following section presents an improved process using this strategy.

Figure 4. Current Process of dealing with ELVs
8. Improved Process

Qatar Automobile Reprocessing Plant (QARP) is a main part of the improved process. It will eliminate several amount of ELVs. Besides, QARP will contribute to the QNV 2030 in its four pillars. Human Development: Increasing employment rate especially for Qatari, Environmental Development: decreasing environment and health problems, Economic Development: contributing to Qatar economy, and Social Development: saving society. The following steps show the improved process for ELVs using Closed-Loop Supply Chain. For this research, “Car” is used as an example to show the process, and can reflect the other types of vehicles (Figure 8).

1. Car Dealer sells new cars that are from car manufacturers outside the country, and sells remanufactured products (good conditions’ spear parts) from QARP
2. Customers get their new car/spear parts from Car Dealer
3. After reaching EOL, Customers return their used cars/spear parts
4. Car Dealer sends EOL cars/spear parts to QARP
5. QARP remanufactures EOL cars/spear parts as follows:
   a. Separates good conditions’ parts and send it to Car Dealer
   b. Classifies different materials: plastics, aluminum, steel, and glass
   c. Sends plastic to Plastic Industry in Qatar to reprocess
   d. Compress Aluminum as sheets and send it to another countries

![Figure 7. Closed-Loop Supply Chain (Pochampally & Gupta, 2009)](image7)

![Figure 8. Improved process for ELVs using Closed-Loop Supply Chain](image8)
9. Conclusions
In light of the growing problem of ELVs in Qatar and the lack of detailed research on the issue, this study will carry potential values for relevant parties in the country. The paper is also likely to serve as the basis for further and more in-depth research that can potentially inform sound policies to tackle the matter more effectively. Future studies will include in depth analysis to the effect of this plant in Qatar economic, as well as implementing the life cycle assessment for the plant.
What reinforces the realization of this predication, about this study, is the strong commitment of the Qatari government to make progress towards and achieve the development objectives articulated under the Qatar National Vision 2030, including social and environmental goals.

10. Paper Contribution
The era of recycling never ends, and more improvements and techniques revealed every now and then. Having a closed-loop supply chain system for end-of-life vehicles in Qatar will minimize the waste and improve the existing system. QARP will be the core part of the new system and by allocating the parts to different industry the total waste will be reduced. QARP will not only help the technical system, but also will create new job opportunities and will help reducing the environment hazards from ELVs. In a nutshell, QARP will support Qatar Vision 2030 in the environment, social and economic dimensions.

References


Biographies
Shimaa Al-Quradaghi is a Teaching Assistant in the Department of Mechanical and Industrial Engineering at Qatar University. She is currently a PhD student pursuing the Industrial Engineering program at University of Central Florida, USA. She has a Master’s degree in Engineering Management from Northeastern University, USA, Shimaa was among the first batch of graduates of the Industrial Engineering pioneer program in Qatar University, and she is the first Qatari to pursue the doctoral degree in Industrial Engineering. In the Department, she was also the coordinator for senior Industrial Engineering students. She improved many internal systems from department level to college level. Prior to join the academic sector, Shimaa worked as Workforce Planning Analyst in RasGas Company in Qatar. She is a member in the Institute of Industrial and System Engineers (IISE).
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