Implementation of reverse logistics as a sustainable tool for raw material purchasing in developing countries: The case of Venezuela

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ABSTRACT

This study aims to analyze and understand the benefits that acquiring raw materials through the application of reverse logistics can generate, especially in developing countries. An empirical study has been carried out in the handmade sector of five municipalities in the state of Mérida, Venezuela, into the contingency factors of reverse logistics (information and communication systems, total ownership costs and life cycle of products), as well as the effect of uncertainty. A case study methodology was used to test the effect of the independent variables on the "raw materials purchasing" variable, and involved the technique of stepwise multiple regression. The results reveal that the preference for purchasing raw materials through reverse logistics is mainly determined by the "uncertainty" variable, contingency factors of "information and communication systems" and the "life cycle of products". According to the results, firms in the handmade sector should implement an information system and be in constant communication with their customers, who play a dual role as buyers of their products and as input suppliers, therefore, greater contact can help reduce uncertainty. Handmade sector workers make products with a long average life cycle and, therefore, with greater chances of being reused, restored, repaired and to finally be subjected to recycling. National and local authorities should encourage the application of reverse logistics in other productive sectors, such as manufacturing, agriculture, services, as it can reduce the problem of acquisition of production inputs and mitigate environmental damage caused by the production of raw materials.

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1. Introduction

Following the Second World War, production of raw materials in industrialized societies grew significantly. More recently, demand has continued to increase but in a different way, since consumers' tastes have become more individual and refined. Thus, at the beginning of the 21st century, the quantity and variety of manufactured and consumable articles is of such magnitude that the damage to the environment, such as from pollution and the generation of solid waste, make it ever more unfeasible to maintain this pace of production and consumption.

Recently, two phenomena have emerged that are making this problem even worse: these are obsoleteness and disposable products, leading to excessive consumption in order to promote economic growth and employment, as in the opinion that *"the faster things are used and can be thrown away, the faster the economy will grow"* (Brown, 2003:178).

One of the most important factors associated with the generation of waste is that of raw materials used in the production of goods and services. In this context, reverse logistics is a business management tool that can contribute to reducing the problem of obtaining raw materials for production and, furthermore, mitigate environmental deterioration caused by waste (Srivastava, 2007). It thus becomes a key strategy for business competitiveness (Autry, 2005).

The above is especially relevant in the case of developing countries, where, in addition to the environmental problem, there are factors arising from structural difficulties with their economic system. This makes it necessary to experiment with new methods and alternatives to overcome these factors (El-Hamouz, 2007; Aye and Widjaya, 2006; Joseph, 2006; Ahmed and Ali, 2004).

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In this context, the present study carries out an analysis of the handmade sector of a developing country, like Venezuela, with the aim of determining the potential of using a system of reverse logistics, as well as highlighting the main facilitating and limiting factors. The method used is that explained by Welch et al. (2011), specifically, one of "contextualized explanation", an "emerging alternative" which considers that given the heterogeneous nature of causation in social sciences, it is necessary to assume that generalizations are not universalities.

To begin with, reverse logistic literature is reviewed and its role and importance in waste management. Afterwards, starting from the definition of contingency factors in the application of reverse logistic programs, the principal hypotheses of this work are put forward. Following this, the empirical study is described and the main results are analyzed, and finally the main conclusions and recommendations are given.

2. The role of reverse logistic in waste management

Every human activity generates waste materials and products that should be minimized and appropriately treated so that their final disposal does not lead to dangerous consequences. The United Nations Organization for Industrial Development (Organización de las Naciones Unidas para el Desarrollo Industrial (ONUDI), 2007) defines waste as everything generated as a result of an activity, whether by man or by the activities of other living organisms, forming a heterogeneous mass, which in many cases is difficult to reincorporate in natural cycles. Solid waste encompasses all solid or semi-solid material originating from urban areas, industrial, agricultural and mining activities (Roa, 2005) and can be defined as *"all the material that is a result of production, transformation and utilization processes, which can be treated, reused, recycled or recovered under the technological and economic conditions at that time, specifically for the extraction of its valuable parts"* (Ferrara de Giner et al., 2008: 139).

The negative effects arising from solid waste can appear via biological vectors, such as rats, mice, fleas, flies, cockroaches and others; as well as, chemical factors like the metallic components of batteries, vehicle oil and the incineration of waste that affects human health and well being (Roa, 2005). The technological obsoleteness of products, such as electronic ones and computers is a growing concern. A study carried out by the Silicon Valley Toxics Coalition in 2001 estimated that between 1997 and 2004 around 315 million computers became obsolete just in the United States of America (Brown, 2003).

This problem appears with even greater intensity in developing countries and is a growing concern that is of academic interest: correct waste disposal and its economic analysis can be seen in the works of Aye and Widjaya (2006) for the traditional markets of Indonesia.[3] In the works of Ahmed and Ali (2004) in Bangladesh (India) and El-Hamouz (2007) in Palestine, we observe that the competition between the public and private sector can become complementary and cooperative to improve environmental efficiency and create new employment opportunities. The research by Scheinberg et al. (2011) deals with the valuation of waste and urban recycling and was carried out in six urban centers corresponding to mid–low income countries: Cairo—Egypt, Cluj-Napoca—Romania, Lima—Peru, Lusaka—Zambia, Pune—India, Quezon City (Manila)—Philippines. The study explored the participation of the informal sector in waste management and recycling. This cooperation often operates together with the private sector and can contribute to the improvement in waste management systems through fair and sustainable recycling. The work by Chakrabarti et al. (2009) on public and community participation in residential waste management in the District of Baranagar (BM) in the Metropolitan area of the city of Calcutta (India) demonstrates the necessary participation of the private sector together with people from the community and the payment of incentives and subsidies for these services. As well as the need for adopting recycling appropriate for the climate, the waste's characteristics and the socio-economic status and cultural habits of the local population need to be taken into account. Joseph (2006) carried out research in the main cities in India into the participation of interested parties in sustainable waste management within an integral, interdisciplinary framework, in which the resources of developing countries and the quality of the waste handling services are limited, and the costs are high. The author highlights the fact that the implication and participation of all interested parties, such as the waste generators, processors, formal and informal bodies, non-governmental organizations and financial institutions are key factors in the sustainable management of waste.

The environmental planning of manufacturing processes need to be taken beyond improvements in product and material recovery, new priorities must be introduced into consumption. Manufacturing practices need to be reviewed with the aim of developing products that last longer and can be reused. These measures would reduce the demand for raw materials and energy in the industrial process, which would finally lead to a more sustainable industrialization (White et al., 2003).

Research by Bravo et al. (2005) and Fraj et al. (2007) analyze the main factors that encourage firms to consider the environmental dimension in their strategic decision-making in corporate and marketing issues through the use of the concept "company ecology", which can be defined as "*the recognition of the legitimacy and importance of the biophysical surroundings in the formulation of a strategy for the organization and the integration of environmental aspects within the strategic planning process.*" (Banerjee, 2002:181). Montaño and Chavarría (2007) carried out a study to determine the perception of environmental aspects, levels of environmental management and the consideration of environmental certification as a strategy that provides a competitive advantage to firms. Moreover, organizations have added environmental protection as another function within the area of operations, that is to say, within key activities, with the aim of contributing to sustainable development (Burgos and Céspedes, 2001). The research by Hanna et al. (2000) explores the relationships between process types, operational performance, employee participation and environmental effort. They conclude that in repetitive manufacturing processes, there are solid and positive relationships between operational objectives, team results and the environmental result. In fact, these issues should be framed within a wider tendency for many businesses to try to reduce the number of returns and their associated costs by improving the quality of their products, eliminating or reducing delivery errors, management of inventories, greater attention to consumers and others (Stock et al., 2006).

In this context, the concept of reverse logistics is situated, which aims to achieve two goals simultaneously, often considered as conflicting: cost saving through improvements in efficiency and the positive perception by consumers through improvement in environmental and quality aspects of products and services.

3. Definition and dimensions of reverse logistics

Srivastava (2007) defines reverse logistics as the process of planning, implementing and controlling efficiently and effectively

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[3] In traditional markets in Indonesia, retailers and wholesalers meet on a daily basis. The majority of these markets sell food, although there are some exceptions, for example Jakarta is an electronics, textile and medicine center. Traditional markets come second in the generation of waste after that of families in this country.