Reverse Logistics without a proper infrastructure – the case of used lub oil plastic containers in Brazil

Orlando Cattini Junior, PhD (orlando.cattini@fgv.br) Professor, Escola de Administração de Empresas de São Paulo da Fundação Getulio Vargas

Abstract
According to Brazilian law, Fabricants, Importers, Distributors and Retailers are equally responsible for the collection and environmental correctly disposal of plastic containers for lubricant oil. The paper proposes a return chain structuring considering long distances to travel besides a lack of a proper logistic infrastructure.

Keywords: Return chain, Recycling, Plastic containers

Introduction

Brazil has been late in regulating its reverse logistics systems regarding the return of solid waste. Law number 12,305, which established the National Solid Waste Policy, was only approved in 2010. Since that date, Technical Teams associated with the waste generating chains were constituted. These were responsible for elaborating reverse logistics proposals that support the elaboration of sectoral agreements (between the public authorities and the agents from each market sector), which in turn have as objective to share the responsibilities during the products' life cycles (cradle to cradle) stated in the agreement.

Proper disposal must be seen as a systemic interaction, meaning that the benefits are not always achieved by whoever performs the disposal activities.

Brazilian law for solid waste disposal states clearly that everyone throughout the entire chain (manufacturers, importers, wholesalers, retailers, local government, and citizens are equally responsible for the implementation of effective actions to embrace the law, and this responsibility comprises all the product's life cycle.

In the case of products which are considered hazardous – such as: pesticides; batteries (all kinds); tires; lubricating oil and its containers; fluorescent, mercury, sodium or similar light bulb types; and electronic products – fabricants, manufacturers, importers, distributors, and retailers are equally responsible for implementing an independent RL system to ensure the collection and proper disposal of this solid waste. If done by municipality, they (producers, importers, distributors, and retailers) should be charged for the service.

The geographical distribution of the activities and the consequent regional GDP is far from being uniform in Brazil. The same principle applies to the distribution of products and services, and, logically, to the return of their packages and waste.

Therefore, regions that are more distant from large urban centers cannot rely on a solid logistics infrastructure (highways, railways, waterway ports etc.), which hampers, or even renders the logistics of return of waste, packages, damaged or unusable goods impossible.

It is precisely toward these regions that the law establishes responsibilities concerning solid waste return and their proper disposal.

This research aims to explore technically and economically viable solutions to the implementation of waste reverse logistics to the country's farthermost and undeveloped regions. The anticipated operations for the expansion of Instituto Jogue Limpo's actions are especially analyzed. Instituto Jogue Limpo is an organization particularly constituted to coordinate used lubricating oil plastic container's reverse logistics (RL) operation, distributed in the nation's Northern, Central, and East Central regions, where the distances between municipalities and oil consumption sites are too far.

For this case, we suggest solutions that count with the intense participation of all the chain's constituents, mainly the final user, defined as the individual or chain link who, after using the packaged lubricating oil, ought to be the first to worry about ensuring the proper destination of the empty container (hazardous solid waste).

Apart from the obligation of compliance with the law, the relevance of the problem addressed is based on the image preservation of the companies involved as well as on the sustainability of this activity in the planet.

Reverse Logistics and Sustainability

According to RLEC (Reverse Logistics Executive Council), reverse logistics (RL) could be defined as "the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal". Verstrepen et al. (2007) define RL as "all physical and administrative processes related to the movement of trading and packaging materials from the point of use to the point of manufacturing, encompassing collection, inspection, disassembly, reprocessing and/or disposition of returned items".

A more comprehensive and useful definition for the development of integrated efforts and measures is the one provided by RLA (Reverse Logistics Association): "Reverse Logistics is the scientific process of managing assets, in every department in all industries and across all disciplines." (…) "Not only supply chain solutions in the High Technology Industry, but all industries and every department from Legal to Human Resources." Figure 1 illustrates this wider vision of RL.

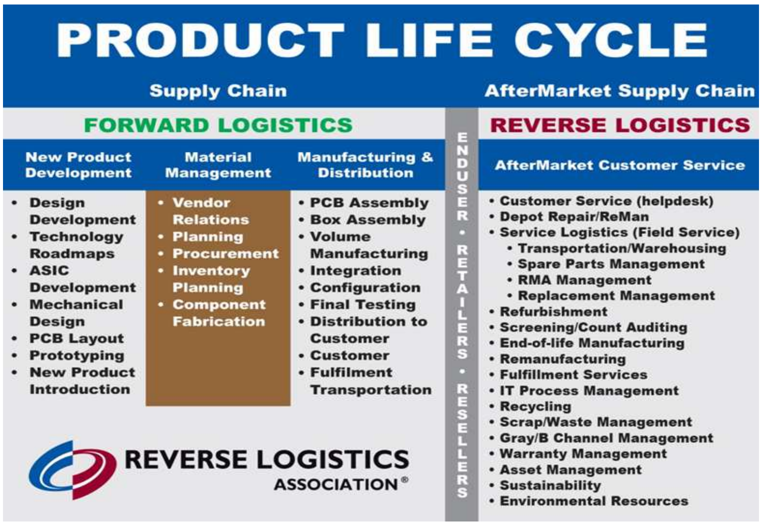

Figure 1: Reverse logistics and the Supply Chain (source: RLA (2015))

Based on this approach, the following activities as constituents of reverse logistics' scope can be identified (Cattini Junior & Ribeiro Filho, 2003):

1. processing of goods returned due to damage, seasonality, restocking, salvage, recall, or overstocking;
2. recycling of used packaging materials and containers;
3. product reconditioning, remanufacturing, and refurbishment;
4. obsolete equipment disposal;
5. correct disposition of hazardous waste, and
6. asset recovery.

In recent years, reverse logistics has increased in popularity and importance among universities and researchers (Srivastava, 2013). The trend to disposability and planned obsolescence results in the need of remanufacturing, reuse, or convenient discharge of an increasing amount of post-consumer products (Leite, 2009).

Particularly in Brazil, central government has implemented a bold integrated management of solid waste program which also includes hazardous wastes, establishing the responsibilities of the generators and the public authorities, and electing appliable economic tools (law 12,305/2010). In this context, when someone says "reverse logistics", it probably means "solid waste collection and return".

The case of plastic lubricating oil containers in Brazil

The sales volume of lubricants in Brazil (2013) is estimated to be 1,5 million cubic meters. Since not all importation/ reuse activities are properly registered, this number is an estimate.

Approximately 50% of all the lubricating oil produced and/or imported is distributed to big consumers (industry, transportation companies, Government agencies, agricultural enterprises etc.) (source: SINDICOM) in diverse containers and distribution systems.

The other 50%, which are distributed by wholesalers and retailers (30%) and directly to retail (20%), are sold to automobile repair shops, fuel stations, car dealers, oil change shops, auto parts stores, and hypermarkets, in the proportion shown in Table 1.

Table 1. Lube oil distribution in Brazil (2014)

DISTRIBUTION CHANNEL	Qty in Brazil*	Retail Volumes (m3)	Share**	Number of plastic containers ***	Estimated HDPE weight (kg)****
Automobile repair shops	112.603	247.500	33%	173.250.000	8.662.500
Oil change shops/retail	3.779	97.500	13%	68.250.000	3.412.500
Autoparts	166.252	67.500	9%	47.250.000	2.362.500
Hypermarkets/non specialized retail	742	7.500	1%	5.250.000	262.500
Car dealers and fuel stations	46.539	330.000	44%	231.000.000	11.550.000
TOTAIS		750.000	100%	525.000.000	26.250.000

* = rough estimation from diversified sources
** = source: SINDICOM
Anual lub oil production/distribution = 1.500.000 m3 - (estimated by SINDICOM)
Retail Volume = 50% of 1.500.000 m3 = 750.000 m3 - estimated by SINDICOM
*** = assumption: 70% of sales in bottles equal or less than 1L
**** = 50g per bottle

The Government and the constituents of the supply chain have made and agreement regarding the operation of the reverse logistics chain on plastic containers with the capacity equal or below 1 liter. This agreement already encompasses some regions of the country (South, Southeast, and Northeast, in addition to the nation's Capital), and is currently expanding to the other regions and distribution channels not previously prioritized. The operations are coordinated by Instituto Jogue Limpo (IJL), an organ which was especially created to attend to all legal requirements and to the shared responsibilities which are detailed in Figure 2.

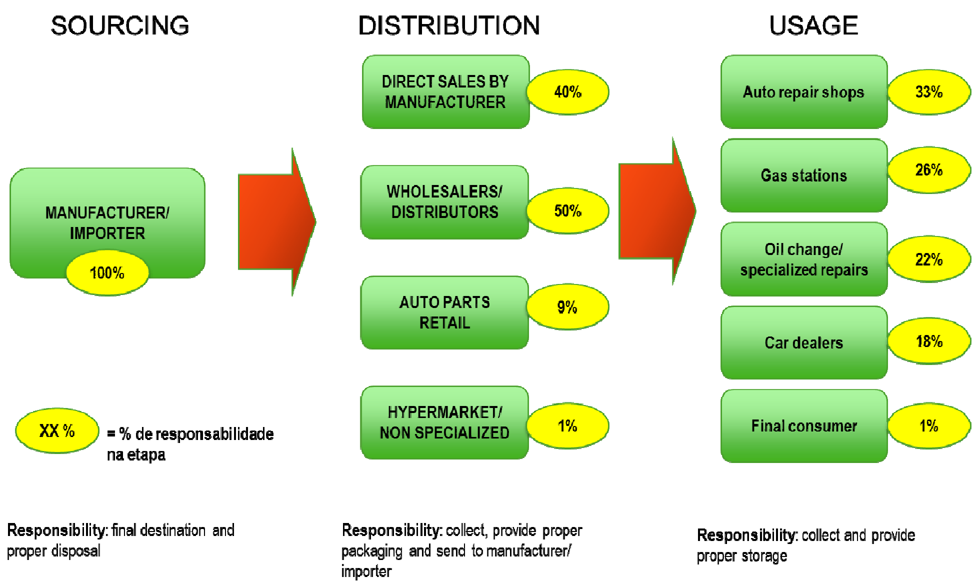

Figure 2: shared responsibilities through return chain

The demand for lubricating oil in Brazil grows at yearly rates close to 7% (source: ANP), well above the average growth of GDP (3.0% - 2011, 2012, and 2013 yearly average).

The weight of high-density polyethylene packaging (HDPE) for potential return is estimated at 26,000 tons/year. Approximately 9,000 tons/year of it are generated from regions devoid of a good transportation infrastructure (highways, railways, waterway ports).

Alternatives and possible solutions

The proposed solution to the Reverse Logistics (RL) system, with respect to the guidance of Institute Jogue Limpo's operation in its anticipated territorial extension, was constructed based upon the geographic characteristics of the outlined regions for each of the states attended to, considering the obstacles set forth caused by the geographic spread of these localities and the lack of a road infrastructure suited to the mobility needs and fundamental to the delivery of the lubricating oil plastic containers used at CP's (collection point).

The objects that constitute the proposed solution are displayed in the flowchart of Figure 3:

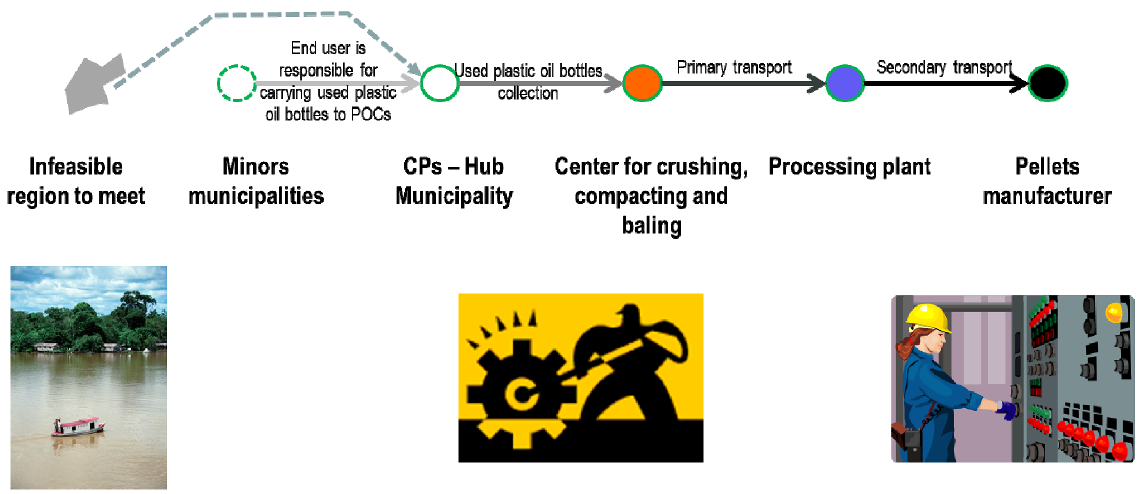

Figure 3 – Synthetic Flow of the Proposed Solution (RLS for disperse distribution)

Represented in the flowchart are:

Region with difficult accessibility:

These are regions with a low density of municipalities and lack of infrastructure, not only in transportation services, but also in mobility conditions. The latter is marked by the inexistence of a road network or, when existing, by its high level of degradation, resulting in difficulty in the delivery of plastic containers at the CP's installed in the Hub Municipalities that attend to the region. Some of the municipalities of the states in the Northern region have peculiarities that hinder the implementation of RL operations (extensive geographic area and great lengths between towns), restricting the establishment of logistics for transporting containers to the CP's that cover these municipalities. For such regions, the primary way of transportation to the CP from the nearest hub municipality will be assumed by the applier, who could take advantage of the return by the same way of transportation used to distribute the lubricating oil.

Applier:

These are the individuals responsible for the utilization of the lubricating oil and for forwarding used containers to the CP's installed in the hub municipalities. Among them are the final consumers themselves, mechanics, or automobile and motorcycle oil change specialists, located in the various municipalities and regions. For the purpose of this assessment, the geographic distribution of the return weight was assumed as proportional to the number of fuel stations installed in each municipality of the state's regions was considered (source: ANP). The regions were defined based on the distribution of the municipalities of each state, the distances involved, the absolute amount of potentially generated containers and the transportation infrastructure of each region; the collected containers are transferred to the Hub Municipalities, where the CP's are installed. Table 2 show the satellite towns in each state considered by this study, with indications of the number of "fuel stations" installed in each municipality.

State	Area (km²)	Num. of munic	Munic./ 1000 km2	Num. Fuel stations	Hub Municipality	CPs	Crushing Center	Proces. Plant
Acre	164.123,04	22	0,134	154	2	63	1	0
Amazonas	1.559.159,14	62	0,040	605	2	87	1	1
Amapa	142.828,52	15	0,105	117	1	31	1	0
Goias	340.111,78	238	0,700	1460	6	221	2	1
Maranhão	331.937,45	202	0,609	1209	3	108	2	0
Mato Grosso do Sul	357.145,53	78	0,218	591	4	145	2	0
Mato Grosso	903.366,19	141	0,156	1050	8	319	3	1
Pará	1.247.954,66	120	0,096	837	4	290	3	0
Piauí	251.577,73	207	0,823	838	4	139	2	0
Rondonia	237.590,47	51	0,215	535	3	109	1	0
Roraima	224.300,50	15	0,067	11	1	28	1	0
Tocantins	277.750,52	127	0,457	392	9	227	2	0
TOTALS	6.037.845,53	1278	0,212	7799	47	1767	21	3

Table 2: Distribution of RL facilities through states

Hub Municipality:

A hub municipality was chosen for each of the regions defined by the states covered by this study. These municipalities are responsible for storing the containers collected from the CP's (collection points) installed in each of the constituent towns of the region. The selection of the municipalities took into account the geographic data of the states addressed, i.e., area, number of municipalities, average area by municipality, and distance between municipalities in the state.

In these municipalities, installations will be built inside spaces provided by some constituent of the chain (fuel station, distributor, retailer) or in a especially built shelter in its own plot.

Centre for crushing, compacting and baling:

A unit responsible for receiving the material collected at the CP's, it is to be installed in the hub municipalities selected for each region of the encompassed states by the expansion of IJL. Each state covered by IJL's expansion plan will have Crushing Centers, according to their potentials of return.

Processing Plants:

A unit responsible for receiving the material – pre-selected and turned into pellets – sent by the Crushing Center. These pellets become the raw material for new containers and/or other products, after it has gone through the following operations:

- Grinding: the plastic container is ground and fragmented into small flakes;
- Washing: after being crushed, the plastic is washed to remove possible contaminants;
- Drying: the residual water is withdrawn by centrifugation in a special dryer;
- Baling: when dry, the material is compacted with volume reduction, then it is sent for extrusion. In this step, additives such as pigments may be incorporated to the plastic mass obtained by the increased temperature caused by the material's friction with the wall of the spinner used to bind the flakes;
- Extrusion: this step is done in the extruder, which fuses and makes the plastic mass homogeneous. The extruder produces a continuous "spaghetti" through the "head" located at the end of the equipment;
- Cooling: the "spaghetti" is cooled for use in the following step;
- Pelletizing: the cooled "spaghetti" goes into a granulator, where it is shredded and turned into pellets (plastic grains);
- Pellets (see Figure 4): material ready to be commercialized as "recycled plastic material".

Figure 4 - Pellets

Final remarks and recommendations

As observed during our study and survey, the RL solutions must be projected case by case: **one size does not fit all.**

In virtue of the technical obstacles in implementing RL systems, such as small municipalities dispersed in vast geographic areas, some of which are hard to access and even deemed as dangerous, there is a need for **partnership and commitment** throughout **the entire chain** (both downstream and upstream).

The used container collection operations must begin with consumer consciousness and involvement; this is precisely what makes this collection viable and less costly.

Inasmuch as the various players involved in the operation have distinct interests and are required to contribute with efforts and resources that are not always proportional to their participation in the revenues and profits, **Government pressure is necessary**.

Who must play the role of **first movers**? Despite the initial burden owing to matters of organizational image preservation, manufacturers (**start to "pay the bill"**), the Government, professional associations, academics, consumers' associations and the like must fight for more conscious return patterns.

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