

## Reverse Logistics and selective waste collection: environmental education as an auxiliary tool on the process of recycling of domestic electronic waste

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### Abstract

*The general objective of this work was to analyze from the perspective of reverse logistics, the contribution of environmental education as a tool of management of selective collection of waste in the context of recycling of domestic electronic waste in the city of Manaus. In relation of the methodology, it is a field research carried out through a study case at Descarte Correto company, accomplished in the Municipal Department of Cleaning and Public Services (SEMULSP, in Portuguese) and application of questionnaire to 16 reclyable waste collectors of Aliança Cooperative in Manaus, what made possible to reach the aims of this work, also focusing on the environmental and social benefits came from reverse logistics. The outcomes revealed that in Brazil the iniciatives to the solution of electronic waste problem are still incipient. In the city of Manaus then are almost nonexistent. In fact, at local level, what takes place are some initiatives, as the ones developed by Descarte Correto company and of some cooperatives. Nevertheless, manauara society are not aware yet, as it should, to the issue of electronic waste and to the importance of Selective Waste Collection (SWC) and of reverse logistics. Therefore, it proved, despite incipient, some individual or corporate actions which addresses the issue of electronic waste as of vital importance in contemporary society.*

**Key words:** Selective collection; Environmental education; Waste; Electronic waste; Reverse logistics.



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### INTRODUCTION

In the urban domestic waste scenario, electronic waste is a serious problem as a result of the great dissemination of cellular telephony handsets use, laptops, household appliances, among others. The IBGE (Instituto Brasileiro de Geografia e Estatística, 2016) enlightens that Manaus is the most populated city in the State of Amazonas and of Amazon region, with a population of 2,057,711 inhabitants. It is also the seventh most populated city at a national level and the 131th most populated in world-wide level. The city of Manaus, due to Industrial Polo of Manaus (IPM), increased gradually its participation in the composition of Brazilian Gross Domestic Product (GDPI) in recent years, representing for 1,4% of Brazil's economy. The city of Manaus is the seventh city in Brazil which produces more waste, with around 2,4t/day, depositing its waste at a sanitary landfill and not carrying out selective collection of it. In Brazil 228 tons of urban waste are produced daily, and only 17,8% of them carry out the selective collection of waste. At the sanitary landfill of Manaus is deposited all the waste of the city, without separation and correct disposal of domestic electronic waste (Semulps, 2016).

Eletronic waste disposal in Manaus characterizes as a problem in true scale which reaches the population of the city as a whole, after all, the town faces challenges nowadays like population growth not planned and which contributes to the worsening of the problem of waste. Due to exposed, the problematic situation that gave origin to this article came from the observation of urban waste which is currently presented as one of the biggest problems and a challenge to be tacked in the next decades, mainly by public administrations, be they at municipal or state level and in the city of Manaus this situation in not different.

Taking into account the problem of electronic waste in the city of Manaus, it questions: how environmental education can be a management tool of selective waste collection and how it can

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contribute to the reduction and recycling of electronic domestic waste in the city of Manaus, from the perspective of reverse logistics, reducing still the environmental impacts?

In the hypothesis which guides the research it takes from the premisses that it is necessary the implementation of an electronic waste handling management which takes into consideration Reverse Logistics (RL) and a suitable conduction of collection service and final disposal, not only important on sanitary point of view, but also economic, financial and social one, with efficient public policies for domestic electronic waste management in the city of Manaus, by using environmental education as a tool at conducting this process.

## LITERATURE REVIEW

According to Ballou (2007), Logistics can be characterized as a way to obtain the best degree of profitability referent to the services of delivery to clients and final consumers by means of action plans, order and effective control to the operation activities and storage, with the aim to facilitate the flow of products.

Reverse Logistics is one of the fields of business logistics which includes the traditional concept of logistics, "aggregating a set of operations and actions related, since the reduction of primary raw material up to proper disposal of products, materials and packaging with its consequent reuse, recycling and/or generation of energy". As a result of this, "it can be noted that reverse logistics has also denominations like integral logistics or inverse logistics" (Pereira *et al.*, 2013, p.14).

In Brazil, Law No 12.305 approved on August 2nd, 2010 and which institutes the National Solid Waste Policy (PNRS, in Portuguese acronym), in its Art. 3º, Chapter II, defines the RL as a set of actions and procedures to enable the collection, waste recovery to be reused on its cycle or in other cycles, and lastly its final destination environmentally appropriate. This Law states also in Chapter III, Section II, about the shared responsibility of manufacturers, distributors, traders and importers of electronic goods (Brasil, 2010).

In accordance with Ayvaz *et al.* (2015, p.1), Reverse Logistics (LR) is the concept "of reusing products used to reduce waste and to increase the environmental performance of an industry". In the sphere of sustainability, RL can be defined "as a strategy of business which acts as a driving force to put activities of recovery into action effectively, in order to increase sustainability".

Reverse Logistics is a tool characterized as "a set of actions, procedures and means destined to economic and social development programmes", with the purpose "to allow collection and recovery of solid waste from business sector to reuse in its cycle or other productive cycles or other environmentally sound disposal" (Guarnieri *et al.*, 2015, p.4).

According to Agrawal *et al.* (2015), the RL contemplates a sequence of activities which involve the collection of the product used by consumers, aiming: reuse, repair, remanufacture or recycling.

In Brazil, the National Solid Waste Policy (PNRS), states in Chapter III, Section II, about the shared responsibility which makes compulsory, as Article 33, structuring and implementation of RL by manufacturers, distributors, dealers and importers of electronic products, since, "this structuring is the implementation of RL which shall be done independent of the public service responsible by urban cleaning and waste management" (Brasil, 2010, p.18).

Getting in even deeper the legal sphere of reverse logistics, Pereira *et al.* (2013) highlight that the great majority of legislations about goods of after-sale and post-consumption is principally directed to manufacturers, demanding of them the responsibility by means of programs like Extended Product Responsibility - EPR and Product Take Back (PTB).

All the manufacturers are held accountable by the organization of reverse channels after its cycle of lifespan. Nevertheless, in many countries there is no legislation or programs related to final consumers. Besides that, many consumers are unaware of their responsibility towards society and environment (Pereira *et al.*, 2013).

## METHODOLOGY APPLIED TO STUDY

As the nature, the present research encompasses, at the same time, qualitative perspectives (interviews) and quantitative ones (questionnaires), aiming qualify better the quantitative part of it, adopting both strategies. Both in collection as in data analysis a quali and quantitative approach were accomplished to subsidize that analysis.

On account of purposes, this research concerns to exploratory category, for, as elucidated by Vergara (2009, p.42), the investigation was carried out in the study sector, "an area on which there is little systematized knowledge". In Manaus, there is a lack of studies about SWC management in the context of reverse logistics. The research was also descriptive, there was na attempt to describe how logistics as an aid in environmental education, can contribute to reduction, recycling and reuse of domestic electronic waste in Manaus.

In respect to means of investigation, it is a bibliographic research, a document search and a field research. The bibliographic research was carried out on the basis of scientific works, published and cataloged, through detached publications, journals, periodics, books, monographs, dissertations and thesis, as well as virtual libraries on the internet.

In the ambit of direct research method, which seeks data directly from the origin, making possible to know reality in practice, it is adopted the research field with questionnaires applied to waste collectors from association of waste collectors in the city of Manaus.

The research individuals (population) were: the Technical Scientific Advisor Jaqueline Gomes de Araújo, server of Municipal Department of Cleaning and Public Services (SEMULSP, in Portuguese acronym); Mr. Alessandro Dinelli, owner of *Descarte Correto* company, and 16 (sixteen) recycling waste collectors from *Aliança* Cooperative, situated to Frei José dos Inocentes Street, N°403, in the Center of Manaus city. The criterion used to include the waste collectors to the smple was the fact that they were linked to *Aliança* Cooperative.

From a universe of 60 (fifty) waste collectors, 16 (sixteen) participated from the research field, what correspondes to 26,67% of the total population, finding support on criteria of level of trust and basic statics representativity presented by Toledo and Ovalle (2010), when they affirm that a research reaches, at minimum, a sample of 20% of total population to have representativity. This sample number gave reliability to the characteristics of the research universe, meeting the requirements of the level of established trust, maximum error allowed and percentage with the phenomenon is seen.

The results were presented as tables and graphics of frequency and percentage distribution, and in sequence analyzed, by using bibliographic research raised about the theme, also by the knowledge of the researcher in respect to the theme and studied institutions. The qualitative data, colected by the answers from the interviews were transcribed on an account. The visit to those companies and the conduction of interviews was only possible on account of and by the term of consent and authorization to data collection necessary to the carrying out of this research. All the recycling waste collectors linked to *Aliança* Cooperative and who participated in the research, signed the Informed Consent Form (TCLE, in Portuguese).

## PRESENTING THE RESULTS AND DISCUSSIONS

The Directive Plan for Solid Waste (PDRS, in Portuguese acronym) of Manaus (2010) consists of a instrument of planning, in favor of the improvement of solid waste management, in which it is sought to be compatible to diagnosis with the prognostication and incorporate the results of meetings accomplished with public Power and with communitary leaderships, as well as with the consequent contributions from Public Hearings which took place on 01/16/2010 and 02/18/2010. The PDRS (2010) aggregates the information of the diagnosis, from the propositions for operation and management of solid waste systems, as well as with legal aspects correlated and the studies of economic feasibility. This document still presents a programation of interventions with the hierarchical indication due to the needs and local possibilities, despite of defining strategies of short, medium and long term, respecting the horizon programed in a course of 20 years.

In PDRS is expressively foreseen the elaboration of a Management Waste Solid Plan with the general strategy of Municipal Executive Power for the management of that material, to protect human health and the environment yet to specify measures which stimulates the conservation and the recovery of natural wastes, besides of offering the conditions to the suitable disposal of waste.

And with focus on the concept of integrated management of solid waste with a new paradigm of urban cleaning, in PDRS (2010) were adopted as goals the reduction of solid waste generation, as well as reuse and recycling of what generated, established still the universalization of the provision of services, spreading them to all the population, the promotion of the treatment and of the final disposition environmentally healthy and the socioeconomic inclusion of recycling materials collectors, concepts which orientate the Nacional Solido Waste Policy.

The Plan of Integrated Management of Industrial Solid Waste (PMGIRS, in Portuguese acronym) of Manaus, in accordance with to what determines the Decree number 1.349 of November, 9th, 2011, in its Art.2º, cites the review of the Plan every four years, carry out for the technical group Municipal Administration of Manaus represented by the Municipal Department of Public Cleaning (SEMULSP, in Portuguese acronym).

Due to of local needs and possibilities it compounds Pmgirs (2015), a programation of O PDRS contemplates and foresee expressally the elaboration of a Management Plan of Urban Solid Waste (USW) which has the general strategy of Municipal Executive Power for the management of this material, in order to protect human health and environment and yet to specify measures which motivate the conservation and the recovery of natural waste besides to offer conditions to the final suitable destination of waste (Ecogerma, 2014).

Nevertheless, in the State of Amazonas appropriate technological roots were not yet developed for the collection and treatment of USW. The state does not have any collection operation in high level of technological differentiation. In Manaus, the collection is carried out with compaction equipments of 17m<sup>3</sup>. The sorting units belong to the organized groups of collectors who do not have conditions of the production line. The material is segregated manually and stocking in big-bags or piled up to be pressed in bundles. The composting is still little present and, in general, the dumps are the units of final destination (Ecogerma, 2014).

The SEMULSP, currently, support around 200 waste collectors, distributed in about 16 entities, between groups and associations. And with basis of the National Solid Waste Policy, Municipal Department of Manaus, has already enabled the rent of 4 sheds to accommodate the associations and improve the conditions of work and the life of these professionals. In 2015, it was enabled 3 more sheds to rent with the same aim. Nevertheless, it is still foreseen the sale and the build of 2 more spaces to the collectors. The aim is to accomodate all the professionals who are registered in the Municipal Department (SEMULSP, 2016).

On the site of SEMULSP (2016), it is available a list with 16 (sixteen) entities, among associations of collectors, cooperatives, groups of collectors and independent groups, with their respective names (corporate names), addresses, responsible people, contact data and VDP by which are responsible.

With basis in information released by SEMULSP and presented by Felipe (2014), since 2005, The Municipal Department of Manaus, by means of SEMULSP, enables the program of Selective Collection in 11 boroughs of the city, to know: Adrianópolis, Aleixo, Compensa, Coroadó, Dom Pedro, Flores, Japiim 1 e 2, Nova Esperança, Parque 10 de Novembro, Planalto and São Jorge.

VDPs of Manaus are the result of a partnership between SEMULSP and Environment Court and Land Affairs (VEMAQA, in Portuguese acronym), whose sentences to environmental criminals include alternative sanctions like the building of Voluntary Delivery Points (VDPs) for recycling waste. VDPs are managed by associations, groups and cooperatives recycling waste collectors, registered to SEMULSP, which offer logistics support to all them, as determined the Law nº 12.305/2010 – National Solid Waste Policy. Once collected waste of VDPs and from boroughs, they are sent to the groups of recycling collectors whose workers make the separation and the commercialization of them (Felipe, 2014, p.39). there are VDPs and selective collection door-to-door in 11 boroughs. There is still special collection in the

Center of Manaus and the work of collectors who take part of cooperatives and associations who keep partnershi with SEMULSP as shown in Table 1.

Table 1 - VDP locations at activity in March/2015.

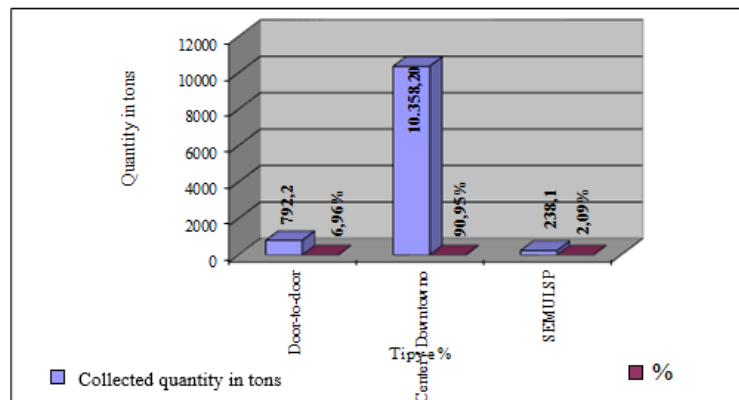
Nº	Location	Cooperative/Association	VDPs situation	Net weight
1	Dom Pedro	ARPA/with collector	Running	12,600
2	Bilhares Park	CALMA/with servitor	Running	-
3	Japiim Lagoon	Waste and citizenship/ with servitor	Running	734
4	Mindu Park	ECO RECICLA/ with servitor	Running	-
5	CEDOLP	CSL PORTA A PORTA (Marquise/Tumpex)	Running	69,290
	<b>Total</b>			<b>8,2624</b>

Source: The author, 2016.

The monthly average of waste generation in the Historical Center of Manaus is of 1,583 tons of generated waste, per inhabitants, visitors and shoppers of the Center of Manaus. This waste now is divided into recycling waste which goes to associations of collectors and normal waste which goes to Sanitary Landfill of Manaus, as monthly quantitative with tax of recycling materials recovering which reached the range of 1,2% (Semulps, 2016).

In 2014, the Selectiva Collection of Public Cleaning System of Manaus em 2014, was responsible by the collecting of 11,388,5 tons of recycling materials in the following percentages of distribution: door-to-door collection (6,96%); Center (90,95%) and SEMULSP (2,09%), as shown in Figure 1.

Figure 1: Statistics Graphic of selective collection from SEMULSP 2014.



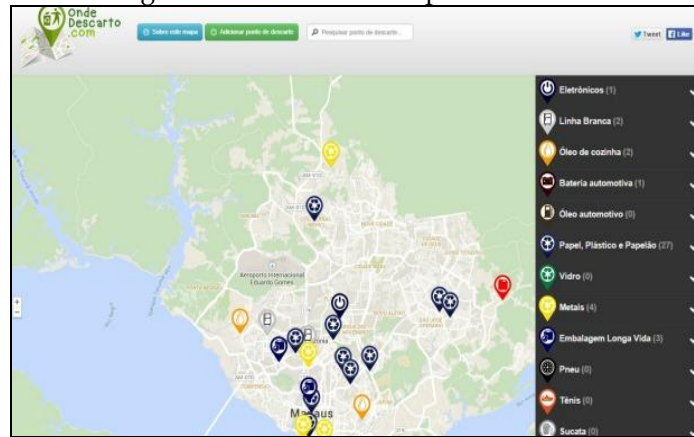
Source: The author, 2016.

The system of collection covers the busiest streets taking the organic waste to throw into containeers instaled in Banana's Fair (where it is taken in the determined time and the recyclable waste which will release in *Aliança* Cooperative). To implement the system in Important the Center of Manaus, PMM made a campaign of awareness with the store owners there so that the social example of taking care of waste can come from them too. The average of waste produced by the population of Manaus is of 2,654, 5 tons a day. In 2014, SEMULSP collected 966,923 tons of solid waste from the city of Manaus, a raise of 2,4 % comparing to the year of 2013. The daily average of 2014 came to 2,654,5 tons. Per Day each manauara produces at average 1,315 k of waste (Semulps, 2016).

As it reaches, through environmental education, to implement SWC in rsidences, it is possible to inroduce the collection every other day: in a day the dry waste is collected, the other the wet waste, another to

electronic waste with suitable containers installed in boroughs. And it was thought to inform where to discard correctly the electronic waste by a group of nine young people, students and professionals from several fields of knowledge created a site *Onde Descarto* – Where can I discard, in English (<http://www.ondedescarto.com/>) which offers a map of free collaborative (Figure 2) with the location of points of collection present in Manaus. The main objective of the site is to bring to reality SWC, reverse logistics to everyday life of population. It is a tool by which the citizen, company or association can register their point of collection and the type of waste which receives and also can research and find the right place to discard the waste (Portal Amazonia, 2015).

Figure 2: Collaborative Map *Onde Descarto*.



Source: <http://www.ondedescarto.com>, 2015.

Actions like these combined with environmental education which can make the difference, today, for example, of the citizen from Manaus to select his waste and know the place where he should dispose it correctly, contributing with the questions related to environment, contributing for reducing environmental impacts caused by waste, and in a particular way the electronic waste.

To the secretary of SEMULSP, Paulo Farias, Manaus still needs to advance more in the field selective collection. The equivalent to less of 1% of all collected waste (the average monthly of 72 tons) is able to recycling. An awareness of society is still an obstacle to be overcome. Beyond the awareness of population, the cost of the programs of recycling with funds exclusively from urban cleaning, in disagreement to what is provided by Brazilian legislation is other distortion which needs to be corrected, in Manaus (Bezerra, 2015).

Marquise and Tumpex companies are responsible for the selective collection in Manaus, acting with six routings of collection each one, when each day, distributes the selected material, from Monday to Saturday, to one of the seventeen associations for them to make the sorting and market the product. In 2014 11,388,5 tons of recyclable materials were collected by the Public Cleaning System of Manaus. The estimate is that, in the course of 2015, 966,923 tons of solid waste have been collected in the city, a daily average of 2,654,5 tons. Each manauara produces, a day, about 1,315 kg of waste (Semulsp, 2016).

The amount of industrial waste from Manaus Industrial Pole (PIM, in Portuguese acronym) intended to recycling is estimate in 47%. According to Manaus Free Zone Superintendence (SUFRAMA, in Portuguese acronym), there is a register of 600 factories distributed across PIM. In a study accomplished with cooperation of Japan International Cooperation Agency (JICA) was made an inventory of industrial waste of PIM, identifying opportunities for Scientific and Technological Institutions (ICTs, in Portuguese acronym).

In this context, it is important to clarify that, on the basis of Article 230, XI, to the State Constitution of Amazonas, and it is up to the control of industrial activities which cause pollution in any of its manifestation, mainly those which take place at areas near watercourses (Silva, 2006).

In accordance with the PMGIRS-Manaus (2015), the management of Industrial Solid Waste (RSI, in

Portuguese acronym) involving the functioning of three systems: responsibility, authority and information systems which correspond to three dimensions: operational and commercial, regulatory and of management and governance. Although such systems are similar, they are totally different questions in terms of responsibility of agents and dynamics in the administration and management. The RSI should take account of provisions at Integrated Management Plan of Industrial Solid Waste (PGIRSI, in Portuguese acronym) developed by SUFRAMA to Manaus Industrial Pole (PIM) and the requirements of Law N 12.305/2010, Art. 20, which depicts about the elaboration of the Management Plan of Solid Waste (PGIRSI, 2015).

In addition to the control and inspection advocate in good practices of the RSI management, the companies which use as input the secondary raw material should be register and include Municipal Information System of Solid Waste (SIMUR, in Portuguese acronym) to make possible the access to information by associations and cooperatives of recyclable material collectors, and their subsequent insertion recycling markets. The management plans of specific waste, besides providing the suitable management, is important to point out that control and inspection of waste flows generated in the industrial activities are fundamental and complementary (PGIRSI, 2015).

Subsequently it is presented a brief description of the process of electronic waste disposal and treatment collected in the city of Manaus. The SEMULSP is responsible for the collection of solid urban waste which cover five modalities as shown in Table 2.

Table 2 – Collection services carried out by Concessionaries and Authorised Companies.

SERVICES	DESCRIPTION	EXECUTORS
Domestic collection	Pick up waste from residences, small industries, trade, banks, schools and other places following well defined itinerary.	Concessionaries
Mechanical disposal	Waste which cannot be picked up manually and which are not domestic. Accomplishment of cleaning crowds.	
Manual disposal	Pick up quantities of waste deposited out of regular collection schedule and from small waste points located in the city.	
Pruning Collection	Activity executed after the services of pruning and hoeing. Such waste, when in landfill, is conducted to composting to be transformed into organic compound.	
Selective Collection	Such activity uses two light trucks, with body enclosed by bars, and it passes by residences picking up recycling waste (paper, plastic, glass, metal), which, after sorting, are sent to collectors' associations which commercialize them in the recycling market of the city.	
Third party	Collect waste from service companies, such as disk waste, builders, industries, among others, which call authorization to waste disposal in the landfill.	Authorised Companies

Source: Available in: <http://semmas.manaus.am.gov.br/wp-content/uploads/2013/05/Paulo-Ricardo-Estado-da-Arte-dos-Res%C3%ADduos-S%C3%B3lidos-em-Manaus1.pdf>. Acesso in March, 2016.

The present data as follows were collected in interviews with the Technical Scientific Advisor Jaqueline Gomes de Araújo, server of SEMULSP.

Currently there is no special type of electronic waste collection of domestic origin in the city of Manaus. The action of SEMULSP in the context of domestic electronic waste collected in the city of Manaus: concerning to waste of electronic equipments often they enter the landfill mixed up with waste from domestic collection and other part from mechanized removal. There is no moment for special collection for that specific waste but in accordance with of Pmgirs updating, this waste will have a suitable environmental disposal. There is door-to-door selective collection and VDPs which receive recyclable

materials, as well as the partnership with associations and cooperatives of recyclable materials which work with SEMULSP. The associations/cooperatives of recyclable materials receive materials, make the sorting and later commercialize them (Araújo, 2015).

About duly registered data existence, as well as estimatives of domestic electronic waste collected in the city of Manaus and whether SEMULSP uses some kind of software to the management of these data related to domestic electronic waste in the city of Manaus, it was highlighted that, at SEMULSP there is not that control of electronic waste mixed in the domestic waste but there are studies of local researchers who estimate the quantity of that type of waste. There is specific software for the management data of electronic waste. There is only a software of the landfill scale which register the weight and origin of waste which is disposal in the landfill (Araújo, 2015).

About the knowledge concerning to the investments at the management/or at domestic electronic waste management in the city of Manaus and the future proposals of SEMULSP to solve and/or minimize the problem of electronic waste from domestic origin in the city of Manaus, Araújo (2015) answered that, specifically for electronic waste there were no financial allocations in the of 015. As a proposal SEMULSP includes the application and monitoring of the National Solid Waste Policy, Law N 12.305/2010, improvement selective and incentive to the application of reverse logistics once for Manaus was already approved packaging sectoral agreement what can come to contribute for actions of proper environmentally disposal of electronic waste in the city of Manaus.

Concerning to the difficulties and the challenges in electronic waste collection from domestic origin in the city of Manaus, it was highlighted that the major difficulty is the fragility are the actions of the private sector to provide collection points of their electronic products in the city which with no option they are disposed of along with their domestic waste what hinders the sorting and subsequent reinsertion in the productive chain (Araújo, 2015).

About the improvements which can be implemented at the management of electronic waste collection and in the fields of reverse logistics, from domestic electronic waste in the city of Manaus, it was emphasized that for a collection and an efficient disposal of electronic waste is of great importance the participation and commitment of all actors who take part of those equipments' cycle of life, thus it would be possible to avoid that this kind of waste had as final destination the sanitary landfill, creeks and/or common land. As to reverse logistics, it could be implemented collection points and means which can facilitate the return of that waste by the users (consumers), then restore to manufacturer who would give a proper destination, in such a way that the present materials at equipments came back to the productive chain (Araújo, 2015).

From this moment, the results collected through the interview carried out with the owner of *Descarte Correto* company, Mr. Alessandro Dinelli, are shown. The company through its commercial sector receives calls from companies which need the collection of electronic waste, when it sends a collection form to the client, where the client will register all types of material which he wants to be collected in his company. The client informs to *Descarte Correto* company through that form which gives origin to a client's proposal service which corresponds to the following steps: collection, receiving, sorting, weighing and classification. After the steps of sorting and classification, the product has two destinations: reuse 1 (production area of reuse and maintenance); and reuse 2 when the product goes to recycling and to the manufacturing of a new product (area of reverse manufacturing) where also takes place the disassemble of all, separating plastic, iron, technological waste (boards), clean copper, mixed copper and aluminum.

*Descarte Correto* company innovated on its process of separation where it repasses each primary input to be reused as secondary input of a product of a recyclable partner company specialized in its field, for example: companies specialized plastic recycling, of boards, among others. Concerning to the field of Information Technology (IT), many of the equipments which would be obsolete for some companies are not for low-income people or for microentrepreneurs.

At some time in the future, *Descarte Correto* company intends to improve some reverse manufacturing processes with the aim to eliminate some intermediaries of the process and resell separated input (plastic) direct to industries. Improving would mean to clean the input, crushing and extrusion of it, aggregating value to this secondary raw material and becoming thus a supplier of secondary input (plastic, metal,

copper). Nowadays the company only works with IT and Telecom but in a very near future the company will enter the white line segment initially with fridges and air conditioners and an electronic product which is hair straightener.

Nowadays, the company still does not receive products from white line as a result of lack of space but soon they aim to receive that post consumption of domestic products. All of the process of collection of a product has price and this varies as the degree of environmental impact which it causes. For example, in a TV monitor the company charges R\$ 18 of the client. In relation to a printer toner it costs about R\$ 30. Concerning to selective collection, in Dinelli's opinion (2015), it could only exist two types of collectors: dry and organic waste. This idea he listened from a collector who told that colors only serve to confuse people. The place of separation should be done at VDPs.

The site *onde descarto.com* belongs to the company *Descarte Correto* and the site *Soluções* is a site which informs where should have been disposal all types of waste not only electronic waste. The people responsible for *Soluções* site asked for an authorization to *Descarte Correto* company to spread the name of the company on the site in terms of electronic waste. Nowadays who receives electronic waste is *Descarte Correto* and the company called *Lorene da Amazônia*. *Descarte Correto* sells all types of boards collected for *Lorene Company*. *Descarte Correto* has all the environmental certificates necessary to make the collection of electronic waste. The company understood that to start their new operations, the environmental education was and is primordial because here whether a paradigm is broken, a culture of linear economy to make to happen the circular economy circular. After the service was executed by the company, a reverse manufacturing report is emitted.

In the context of environmental benefits which the company provides stands out the campaigns of Environmental Education and the collection of electronic waste in the city of Manaus. In the year of 2011, it was created and presented a new project to *Amazon Print* company, which already had a partnership with Dinelli since the Project of Digital Inclusion, making clear for them that this new project would not consider only the receiving of computers but the process of recover and leave them poor communities, advancing in terms of reach and social impact.

*Amazon Print* fits the category of companies which should attend to solid waste policies therefore this partnership would disseminate and construct concepts and paradigms, motivating the two companies take initiatives related to campaigns of Environmental Education. So, from that, it was created the first campaign pioneer in the State of Amazonas called *Campaign of Proper Disposal* which happened from 12/05/2011 to 12/11/2011. The campaign of *Descarte Correto* company was spread still to the years of 2012 and 2013. In 2012 it was created other campaign called *Discard and Win* which was a pioneer not only in the State of Amazonas but also in Brazil. That campaign was created with the aim of benefiting the final consumer, by giving him coupons of discounts at discarding his domestic electronic waste. Currently, that campaign always takes place the period of 06/05 to 06/09, in accordance with Environmental Week, at all shops of *Amazon Print* company, being carried out the years of 2012, 2013, 2014 and 2015. Nowadays, *Amazon Print* company uses in its 6 shops, spread in strategic areas of the city of Manaus, as collecting point of electronic waste of *Descarte Correto* company. The consumer when buying a product in *Amazon Print* is properly informed and enlightened by the seller of the company's practice and meets standards referent to reverse logistics concerning to domestic electronic waste in the city of Manaus.

Also currently, in addition to *Amazon Print*, *Descarte Correto* company still has collectors at companies like Amazon Sat and at Regional Accounting Council (CRC, Brazilian acronym/AM), as both last ones, through exchange process. *Descarte Correto* company can offer this kind of service to any other company, but this service cannot be free, considering that there are several embedded costs in this service, such as: transportation costs and storage too; labor costs; and costs for certification. The company does not open a free collecting point unless it is a punctual action of a company. Since the beginning of 2012 up to the end of 2015, *Descarte Correto* company and its partners, in the collection of electronic waste, already collected around 300 tons of electronic waste in Manaus.

The present data as follows were collected in the field research carried out with 16 (sixteen) recyclable waste collectors from *Aliança* Cooperative. The variables are: sex, age, marital status, level of schooling,

borough where they live and the time for work, they were collected only to characterize the profile of recyclable waste collectors, not object, therefore of detailed analysis.

Concerning to recyclable waste collectors' profile the following results are highlighted: there was prevalence of females (56,25%); concerning to age, there was a higher incidence of people at the same age, from 40 to 50 years of age (31,25%), followed by people from 51 to 65 years (25%); about the marital status, there was a prevalence of single among the collectors (68,75%), followed by a percentage of 12,50% of married. Concerning to level of schooling, half of collectors (50%) completed the primary schooling, followed by a percentage of 31,25% who completed high school; about the borough they live, the downtown area of Manaus and eastern zone boroughs have the same results (12,50%), followed by equals proportions percentage 6,25% for other boroughs; concerning to time of working, 56,25% of collectors work in that area, between 1 and 3 years, followed by a percentage of 25% who work between 4 to 6 years in that area.

The recyclable waste collectors work individually or collectively, collecting material which can be reused. They conquered their recognition as a professional category formalized in Brazilian Classification of Occupations (CBO) in 2002. At CBO's classification, the collectors are registered by number 5192-05 and their occupation is outlined as recyclable waste collectors. In accordance with summary description of their activities, the collectors "collect, select and sell recyclable materials as paper, paperboard and glass, as well as ferrous and non-ferrous materials and other recovered materials" (Medeiros e Macedo, 2006, p.65-66).

Researches of Almeida *et al.* (2009) and Silva (2007) reveal the profile of collectors and highlight that the majority of them are women and have low level of schooling.

When questioned about the motivation to be recyclable waste collectors, 75% answered that it happened on account of need, followed by a percentage of 18,75% which answered it was the only opportunity they have gotten. As well observe Ribeiro *et al.* (2014), beyond the economic and environmental benefits, there the social aspect related to workplace pay developed by recyclable waste collectors. Actually, the insertion of collectors in the market chain of recyclable should still take an account the creation a policy related to social inclusion social and recognition for fair remuneration. Studies of Medeiros and Macedo (2006), Carneiro and Correia (2008) and Bortoli (2009) demonstrate that the activity developed by the collectors have been and is considered as an alternative of generation of work and income.

On the other hand, researches of Silva (2007), Bosi (2008), Castilhos Júnior *et al.* (2013), demonstrate that the collectors face extensive working hours and that the majority of them commercialize the production at a symbolic price. The activities exerted with handcarts become yet more distressing on account of distances to be covered and the excess weight being transported. These researches still reveal that the associations, cooperatives or groups of work have presented an advance because they allow the mechanization of some steps of the process and eliminate, in part, the need of using handcarts, to consider that the material is collected by the public power.

Concerning to the relationship with coworkers, 62,50% of collectors classify as good; 31,25% classify as excellent and only 6,25% classify as regular. The research of Medeiros and Macedo (2006) highlight that the work of collectors, as any other labour activity, occupies a central place in life of whom carries it out. In this context two factors are focused: the fact that it is a means of survival and the time of life to it dedicated, it is important a good relationship among coworkers after all the work besides being a means of survival, it is also a means of social integration because makes it possible the relationship, the social inclusion and the sense of belonging to a group.

In terms of relationship with waste receptors: 87,50% of collectors classify as good; 6,25% classify as regular and in equals proportion (6,25%) classify as regular. Adding the percentage goods and excellents concerning to relationship with waste receptors, there is an expressive percentage of 93,75% which denotes a healthy relationship revealing therefore a positive result. According to Medeiros and Macedo, (2006) the collectors are building up a history, as well as defining areas of acting, having also their importance as a professional category.

About the acceptability of collection by the community of Manaus: 81,25% of collectors classify as good and equals proportion (6,25%) classify as terrible, regular and excellent. Concerning to acceptability of the

activity of a collector along with the community, added to percentages of good and excellent, there is an expressive percentage of 87,50%, which reveals a good acceptability of the activity of collector along with the community, treating, therefore, of a positive result positivo. According Meirelles and Gomes (2008) the collectors develop a still socially rejected activity, by being this an example a social exclusion process.

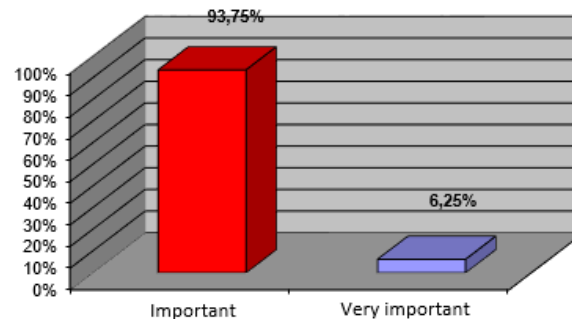
When they were questioned about the acceptability of collection by companies in Manaus: 87,50% of collectors classify as good and in equals proportion (6,25%) classify as terrible and excellent. Adding the percentages of good and excellent, there is an expressive percentage of 93,75%, which reveals a good acceptability by the companies. According to Neto *et al.* (2007), the contemporary companies, in particular the industries are slowly aware of the great importance of the activity of collectors of recyclable waste for the companies, for the environment and for the society as a whole. About the acceptability the collection by the companies in Manaus: 87,50% of collectors classify as good and in equals proportion (6,25%) classify as terrible and excellent. Adding the percentages of good and excellent, there is na expressive percentage of 93,75%, which reveals a good acceptability by the companies.

At being questioned whether they know if the work that they develop can affect the health: 56,25% of collectors answered partially; 37,50% answered yes and only 6,25% answered no. Adding the percentages of partially and no, there is na expressive percentage of 62,50% of collectors who do not a good knowledge of risks about these activities for their health, what reveals a negative result.

When questioned whether it was to improve the work conditions on the landfill of Manaus, what they would like was to improve, only two collectors answered: 1) "to make a good selective collection to reduce the waste in the landfill"; 2) "to make a good selective collection in the city because this way there would be less waste for the landfill".About the health of collectors and the conditions of their work in dumps and in public places, RIBEIRO *et al.* (2014) highlight that, in general, these places do not meet the minimum condition to work, what contributes for a situation of great social vulnerability and of health of collectors.

When requested to evaluate the importance of their activity for the cleaning of the city: 87,50% of collectors answered important and 12,50% answered very important. By the results, it is possible to perceive that, the collectors are aware of the importance of their activities for the cleaning of the city.

At being requested to evaluate the importance of their work for less polluted creeks: 93,75% of collectors answered important and 6,25% answered very important. Again, these results reveal that the collectors are aware to the importance of their activity to guarantee less polluted creeks.



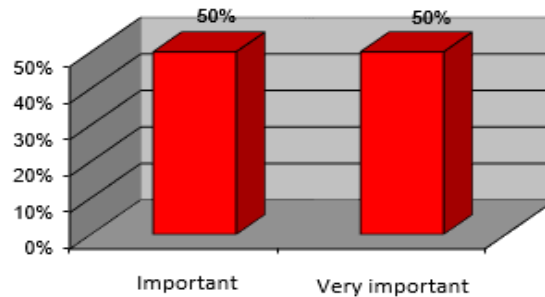
Graphic 1 – Assessment of collectors as recycling and recovery of materials.

At evaluating the importance of their activities for recycling and reutilization of material as demonstrated in Graphic 1: 93,75% of collectors answered important and 6,25% answered very important. The results reveal that, the collectors are aware of the relevance of their activities in the context of processes of recycling and of reutilization of materials.

Concerning to the evaluation of the importance of their activities for the preservation of the planet: 75% of collectors answered important and 25% answered very important. By the results, again it is possible to observe that, the collectors are aware of the importance of their activities for the preservation of the planet. As to evaluation of the importance of their activity to reduce the visual pollution: 56,25% of the

collectors answered very important and 43,75% answered important. By the results presented, it is possible to highlight that, the collectors are aware of the importance of their activities to the reduction of visual pollution in the city of Manaus.

Concerning to evaluation of the importance of their activities to the reduction of the volume of waste left to dumps and landfills (gráfico 2): 50% of collectors answered very important and 50% answered important. The results reveal that, the collectors are aware of the importance of their activities to the reduction of the volume of waste left to dumps and landfills of the city of Manaus.

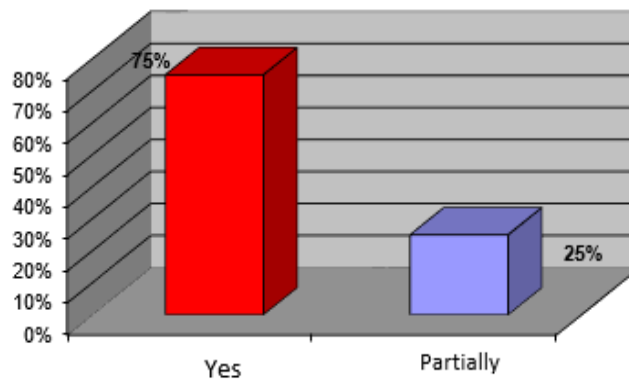


Graphic 2 - Assessment as the reduce of waste volume dumps and landfills.

Source: The autor, 2016.

The results presented reveal the importance of the activities developed by the collectors of recyclable waste for the cleaning of the city, for less polluted rivers and creeks, for recycling and reutilization of materials, for the preservation of the planet, to the reduction of visual pollution, to the reduction of the volume of waste left to dumps and landfills, giving this way a great and important contribution to the common well-being. Nevertheless, Ribeiro *et al.* (2014) highlight that the society still do not recognize as it should the given contribution of the collectors of recyclable waste to common well-being and in a macro sphere for the preservation of the planet. Besides factors like low level of organization of cooperatives, associations and groups, the adding value to the production of cooperatives, as well as market structure contribuem para uma situação de grande vulnerabilidade social. Na visão de Medeiros e Macedo (2006) a the contribution of this class of workers is unquestionable under the environmental perspective and to besides this the results of their work configure as the start point to the supply, with raw material, of industries of recycling and to those which practice reverse logistics. Rosado (2007, p. 7) complements highlighting that the collectors, aware or not, "have a fundamental hole in the insertion of post-consumption to productive chain, refeeding it, but also contributing to the economy of energy and avoiding the removal of natural goods, known as increasingly rarer".

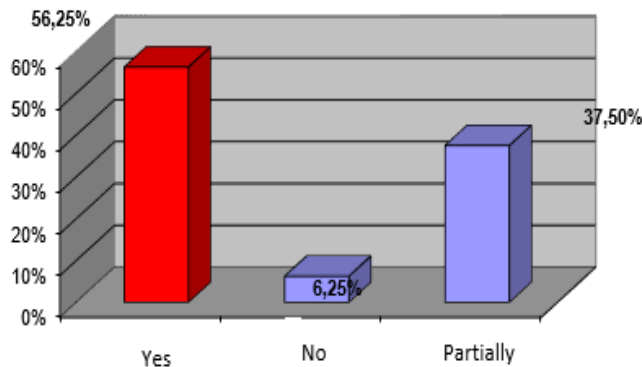
The results collected revealed that 43,75% of collectors who made part of the research would change the work if they had other opportunity and 31,25% suffer discrimination on account of the work. The research of Velloso (2004) revealed that the collectors suffer humiliation, prejudice and contempt of the population. The results also reveal that 12,5% of collectors are not satisfied with the current situation they live and 6,25% did not answer this question. The research of Porto *et al.* (2004) highlights that the collectors have difficulties in daily life and have dreams, as having the own house and have a formal job.



Graphic 3 – Knowledge of collectors about selective collection.  
Source: The author, 2016.

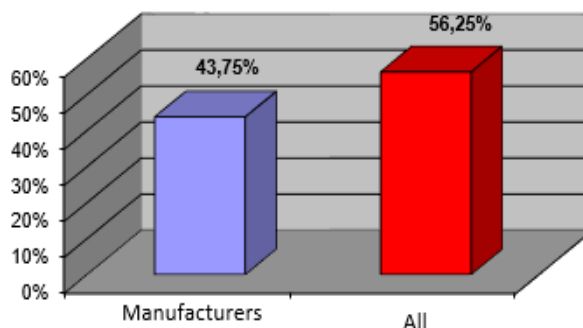
When questioned whether they have knowledge about what is selective collection (Graphic 3): 75% of collectors answered yes and 25% answered partially. The results are positive presenting an expressive percentage of 75% of collectors who have the knowledge about SWC.

At being questioned whether where they live there is recyclable waste selective collection: 43,75% of the collectors answered they do not have the knowledge; 37,50% answered no; and only 18,75% answered yes. About the fact whether there already was a request for selective collection where they live: the same percentage of collectors (31,25%) answered there never was any request and yes but up to that moment it was not attended; 25% of the collectors answered they do not have knowledge of it; and only 12,5% answered yes and it was attended rapidly.



Graphic 4 – Knowledge about what is Voluntary Delivery Point (VDP).  
Source: The author, 2016.

When questioned whether they have knowledge about Voluntary Delivery Point (VDP) (Graphic 4): 56,25% of collectors answered yes; 37,5% answered partially and only 6,25% answered no. Adding the percentages of yes and partially, the results are positive presenting an expressive number of 93,75% of the collectors who have knowledge of VDP.

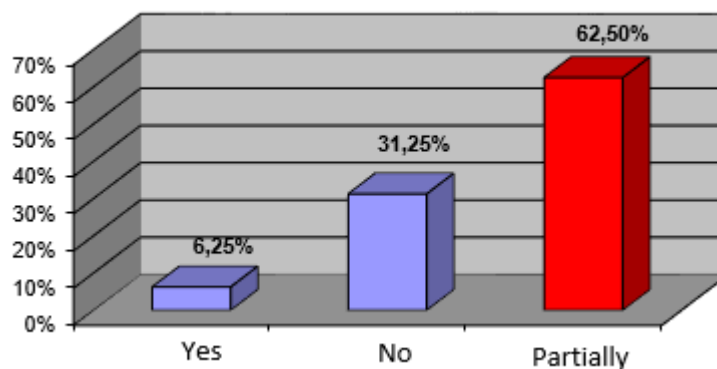


Graphic 5 – Opinion about the main responsible for electro eletronic waste.  
Source: The author, 2016.

When invited to give opinion about who is the main responsible for electro-electronic waste (Graphic 5): 56,25% of the collectors answered that all and 43,75% answered the manufacturers.

At being questioned whether there is any VDP next their houses: 62,5% of collectors answered no; 31,25% answered they do not have knowledge; and only 6,25% answered yes. At being questioned whether there was any place that received and routed the electronic waste to proper disposal, whether they would leave waste, the collectors who participated the research were unanimous to answer yes, that is, they would leave it to proper disposal.

At being invited to give opinion whether in the city of Manaus there is support for the full functioning of activities of the cooperatives of collectors (Graphic 6): 62,5% of the collectors who participated the research answered partially; 31,25% answered no and only 6,25% answered yes.



Graphic 6 – Opinion whether in Manaus city there is support for full operation of cooperative activities of collectors.

Source: The author, 2016.

When requested to highlight what are the greatest difficulties of associations and cooperatives of collectors of recyclable waste in the city of Manaus, only 3 (three) collectors manifested themselves, presenting the following answers: 1) “support of the government, recognition of the profession, right to retirement”; 2) “lack of conditions, space to stock the material and companies to buy the recyclable material”; 3) “doesn’t have company to buy the material”.

Concerning to the opinion about what actions can be implemented to improve the functioning of the associations and cooperatives of collectors of recyclable waste in the city of Manaus, again only 3 (three) collectors manifested themselves about, presenting the following answers: 1) “including the collectors in the selective collection, contracting the associations and cooperatives as service providers”; 2) “implement

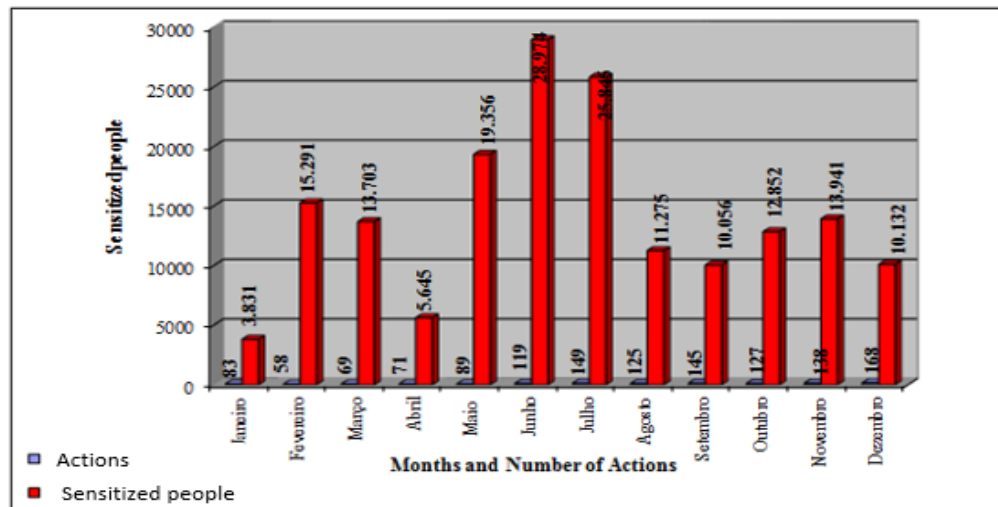
the selective collection in all boroughs of the city, with inclusion of collectors making making the work of selective collection and being paid by the provided service”; 3) “implementing the selective collection in all boroughs”. According to Medeiros and Macedo (2006) the main aim of the cooperatives and associations is to give opportunity of work and increase the income of workers, avoiding the dependency of a unique buyer or middlemen.

The research of Viana (2000) reveals that among the reasons which leave the collectors to sell their production from the collection of middlemen are highlighted the following: problems with transportation to deliver the collected material in the industries of recycling and the advantages which the industries offer to middlemen, impair the condition of the collector who does not take part of the cooperative or the association.

In such a scenario, Dias highlights (2002), the premise is that the collectors are respected as citizens, from the moment they organize themselves in groups, forming cooperatives, associations and groups. On the view of Miura (2004), currently the problem is at recognizing the right of the collector to dignified conditions of work and life, far beyond of survival.

Going down into the question of the environmental education and of domestic electronic waste produced in the city of Manaus in the context of reverse logistics, as well clarifies Waldman (2010), to minimize the generation of waste of the integration of a general strategy of nature conservation, there is no way to negate the renowned merits of recycling, in reality, better than recycling waste it is imposed with more certainty the need to reduce the generation of waste. Not with reason recycling is the last of the four attitudes begun with letter “R” and only when before Rethink, Reduce and Reuse that Recycle would make any sense. A sense that, to be full, request to evaluate critically and deep the expectations of life and the consumption of human beings. As highlighted previously, in the context of selective collections and of recycling waste, the environmental education assumes great relevance, by being an indispensable tool, inclusive to reduce the environmental impact (Figure 3).

Figure 3: Environmental education and people sensitized in 2014.



Source: The autor, 2016.

As the data of Figure 3, in 2014, were carried out 1,341 actions of environmental education and were sensitized about 170,901 people (Semulsp, 2015). Felipe (2014, p.32) highlights that public cleaning in Manaus “gained new forms since the year of 2009, when a number of unique initiatives started to transform a stagnant framework at decades into a truly municipal public cleaning policy”. It should be highlighted yet that “this policy contemplates all the elements from the provision of services organization, environmental preservation, supervision of postures and, on a large scale the sensitization and environmental education of the population”. At this new posture of public cleaning, was created in 2010, Special Commission of Disclosure and Guidance of Public Cleaning Policy (CEDOLP, in Portuguese

acronym), which nowadays is the “spearhead” of SEMULSP. Municipal Department of Cleaning and Public Services (SEMULSP, in Portuguese acronym) created the Special Commission of Disclosure and Guidance of Public Cleaning Policy (CEDOLP, in Portuguese acronym), to act specially with environmental awareness of the population.

The actions of environmental education developed in the city of Manaus left information about the disposal of the domestic solid waste, giving much importance to the participation of the community through schools and guidance groups. According to Art. 01 of the National Council of Environment Resolution (CONAMA) N 001, of January, 23rd 1986, the environment impact is any alteration of the physical, chemical and biological properties of the environment caused by any form of mass or energy resulting from human activities that direct or indirectly affect: health, security and well-being of the population; the social and economic activities; the biota; the aesthetic and sanitary conditions of the environment; and the quality of environment resources (Pereira *et al.* 2013).

Under the perspective of this presupposition, the work identified as potentialities capable of allowing the structuration of strategies of environmental education with the aim of demonstrating how the waste scenario produced in Manaus can be used as a motivation to present a proposal based on environmental education with focus on the domestic electronic waste produced in the city of Manaus in the context of reverse logistics. A priori the potentialities (Figure 4) identified in its respective strategies will be worked within the ambit of schools only with the school community. Subsequently the same strategies should be promoted to the society counting with the support of municipal and state departments of education to be carried out actions of awareness about the proper disposal of electronic waste by using environmental education as a tool.

Figure 4: Potentialities of Environmental Education in the context of SWC and of Reverse Logistics.

Potentialities	Strategies
Environmental problems with waste and pollution	- Promote lectures aiming the recognition of the complexity of environmental problems.
Electronic waste in the city of Manaus	- Promote lectures aiming the recognition of the complexity of electronic waste. - Encourage in students the practice of drawing and painting of panels at schools, as well as produce texts addressing the problem.
Selective Waste Collection (SWC) and Reverse Logistics (RL)	- Promote lectures to inform about how SWC and of RL work and their importance. - Insert the environmental message of preservation which the concepts of SWC and RL bring into program contents from the number school subjects through written works.
Songs and environmental movies	- Reflect about the messages of songs and movies and their commitment to the Environment and with life in all its fullness.
Organization of school environment on account of SWC and correct disposal of electronic waste	- Adapt the approach of Environmental Education from SWC to strengthen a critical view of reality and an effective engagement with the school population and all the society with a more direct participation and as a creative an critical individual, for the benefit of the improvement of world quality of life.
New habits: SWC at school and at residence and the correct disposal of produced electronic waste	- Trigger a critical view of the reality, projecting capable citizens to intervene and transform the place where they live.

Source: The author, 2016.

Leaving from the presupposition that the solution to the problem of waste in Manaus passes by environmental education of the population, SEMULSP, through actions, the Special Commission of Disclosure and Guidance of Public Cleaning Policy (CEDOLP, in Portuguese acronym), prioritize the integration of activities of awareness about the selective waste collection (SWC), as a vector of environmental conservation and social inclusion. And based on the premisses of electronic waste produced can constitute an important bias to promote the development of the educational process of the selective collection of waste and reverse logistics aiming the reflection and the commitment of the society around the contemporary environmental question, this work seeks support in the theoretical tripod “EE, SWC and RL”.

The goals of the proposal can be enabled in a short and medium term stimulating the capacities of responsible social participation and the active intervention into the local issues of the community and it constitutes an aim of long term the potentiation of free personal development of the future society. The complexity of contemporary environmental questions associated to electronic waste allows effectively that studies can be developed in order to incorporate the selective collection of waste, make a commitment with a system of basic values which favor a more human life in society.

Under the perspective environmental education, the identified potentialities by the proposal are configured as the basis to the themes which can be developed by means of an interdisciplinary viewpoint and with a motivation pertinent to the pleasure from where emerges the local reality of Manaus, on account the problematic question of electronic waste, based on a pedagogy on which the individuals, with basis on their interests, aspirations and desires of social change, meet the conditions to belong to a reality that allows a critical analysis in its objective conditions and subjective existence.

The potentialities of environmental education in the context of SWC aiming to reverse logistics were emphasized in this item of the present chapter, by its point of view of its production and/or its incorporation to the educational system of Manaus, projecting and assessing strategies of actions of Environmental Education to be worked at schools and with the community, in relation to awareness to the issues of contemporary environmental problems, like the electronic waste.

Besides other tools should be put together to the task of EE, as at school, as in the community, and among business partners (manufacturers, wholesales and retailers) as demonstrated on Figure 5, after all, society is responsible for this process as a whole. Allied to this, the family behavior, as well as the information conveyed by media exercise a great influence in the driving of a proper environmental behavior of people.

Figure 5 – Actions among business partners

Actions	Operation
Creation of the Loyalty Card	That card would provide a discount to the final consumer by having a new product the same brand of the manufacturers. The card should function as follows: the final consumer when acquiring a new product would register that product on the manufacturer's website, thereby generating the number of his loyalty card. After the useful life of that product or the defect of it, the consumer could leave that product to the center of collection, created by the own business partners, with the aim to evaluate that product and receive credit on his loyalty card to acquire a new product in any establishment of the wholesale business partners or retailers. On the acquisition of other new product of the same brand, the final consumer could use his loyalty card to receive a discount at that new acquisition. The most important of all this would be to create the loyalty to the brand of manufacturer for the final consumer, generate new sales to business partners and give the proper destination for the products.
Criation of a Center of Collection	Here it would be applied the shared responsibility, which is one of the main objectives of PNRS. All the costs to the creation, implementation and maintenance of the center of collection would be shared by manufacturer business partners, wholesalers and retailers. The center of collection should have specialist technicians to evaluate and provide credit to the loyalty card to the consumer and it can function as follows: after the receiving the product which was done by the center of collection, the product would pass by a sortinf in order to detect whether it still could be used or part of it to use it or to recycle. If it is positive, it would be made the reutilization of the product and this product could be provided to poor communities as social responsibility of business partners. If it is negative, this producto would have other process, of decomposition. In this process, first it should be made the gravimetry (qualitative and quantitative analysis of these supplies). Next, this information would be passed to the competent organs on the federal level, state and municipal through Management Plan of Solid Waste of these companies. After the gravimetry be carried out some raw materials could be reused making them come back to the manufacturer (Reverse Logistics), diminishing thereby the costs of acquiring of these supplies by the manufacturer, in relation to their suppliers and the waste of these products could be destined properly to the sanitary landfills.

Source: The author, 2016.

## CONCLUSIONS

From the theories of the research field carried out by a case study at *Descarte Correto* company, the research accomplished at SEMULSP, as well as the application of questionnaires to the recycling waste collectors of *Aliança* Cooperative in Manaus, it was possible to observe that in Brazil the initiatives to the resolution of problems related to waste from electronic sources are still incipient. In Manaus so the initiatives are almost nonexistent. Actually in local level, what exist are some initiatives, like the ones developed by *Descarte Correto* company and some cooperatives. Nevertheless, manauara society is not still awaked as it should, for the issue of electronic waste and to the importance of SWC and of RL. Therefore, some actions have proven, depite of being incipient, by being individual or business, which occupy with the problem of electronic waste which assumes great relevance to the contemporay society. To find solutions to the domestic electronic waste of the city of Manaus is necessary that can be carried out the selective collection and posteriorly the recycling of recoverable waste with basis of reverse logistics.

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