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FINAL DISPOSAL OF SOLID URBAN WASTE: ALTERNATIVES FOR THE CITY OF SÃO PAULO BY MEANS OF SUCCESS CASES

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Abstract

The article studies public sanitation services - in as much as solid domestic waste is concerned - within the municipality of São Paulo and employs as base year, that of 2010. Highlights include issues related to the current waste management model in the region and solutions are proposed to those deemed most critical, utilizing as benchmarks, adequate treatments conducted at other globalized cities. The bibliographical review seeks to elucidate concepts that are most aligned with the theme under study. Information concerning the management of solid domestic waste and reverse logistics in the private sector was gathered, whilst findings as to impairments observed in the municipality are listed. Local and international success cases concerning waste disposal were studied with views to encountering sources of potential improvements. It is understood that the adequate destination of residues, by means of recycling, composting or generation of fuels, calls

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for the population´s commitment in terms of developing separation and waste disposal habits, municipal administration involvement - in as much as supplying the required resources is concerned to ensure progress of alternatives - and finally, cannot do without reverse logistics actions undertaken by producing companies, in full compliance with existing federal rulings. In the quest to expand discussions concerning solid waste, the article attempts to include this matter - in a more effective manner - within strategic and investment decisions taken by both the public and private sectors.

Key-words: Solid waste. Urban sanitation. Recycling. Reverse logistics. Waste. Sustainability. Environment.

Resumo

O artigo estuda o serviço de limpeza pública dos resíduos sólidos domiciliares do município de São Paulo, Brasil, tendo como base o ano de 2010. Destaca problemas associados ao atual modelo de gestão dos resíduos paulistanos e propõe soluções para as questões mais críticas, tendo como referencial o tratamento adequado dado por outras cidades globalizadas. A revisão bibliográfica procura elucidar os conceitos mais relevantes ao estudo deste tema. São levantadas informações a respeito da gestão dos resíduos sólidos domiciliares e das iniciativas de logística reversa pelo setor privado, listando os entraves observados nesse município. Casos nacionais e internacionais de sucesso no que tange à destinação dos resíduos foram estudados, objetivando encontrar fontes de potenciais melhorias. Conclui-se que a destinação adequada dos resíduos, através da reciclagem, compostagem ou geração de energia, necessita de engajamento da população com hábitos de separação e disposição de resíduos, de envolvimento da administração municipal, provendo recursos necessários para a evolução destas alternativas e, por último, não pode prescindir de ações da logística reversa pelas empresas produtoras, respeitando a legislação federal. Ao procurar ampliar a

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discussão sobre os resíduos sólidos, o artigo busca inserir essa questão, de forma mais significativa, nas decisões de estratégia e investimento do poder público e privado.

Palavras chave: Resíduos sólidos. Limpeza urbana. Reciclagem. Logística reversa. Lixo. Sustentabilidade. Ambiente.

1 INTRODUCTION

Following the Industrial Revolution, urbanization intensified on a global scale resulting in the disorderly growth of cities accompanied by varied environmental impacts. As of the 70´s, perception as to the limitations of this development model leveraged discussions in society concerning themes related to environmental damages. Thus, discussions as to the need to seek sustainable development have been conquering increased notoriety. (Rodrigues, Rodrigues & Rebelato, 2005).

The current position society has taken on – to coexist with the enforcement of consumption standards and rampantly use products that present increasingly shorter life cycles and disposable packaging – has, effectively, produced a large amount of solid urban waste (SUW). Traditional disposal waste system capacities are close to maximum limits, calling for alternatives as to the final disposal of goods once consumed, so as to minimize the corresponding environmental impact.

One of the greatest challenges to be tackled by modern society is precisely the collection and final disposal procedure of SUW´s it produces. The relevance of the theme arises from three major factors: the large volume of SUW that is produced, the financial costs involving the management of the same and the impacts this waste imposes on the environment and the population´s general health.

Given this context, the overall objective of this article is to study the problem concerning the final destination of domestic SUW´s within the city of São Paulo and diagnose issues that hinder it´s adequate re-use and disposal, followed by discussions concerning public and/or private policies with views to overcoming findings as to current impairments.

The article has been structured into three parts. The first covers the theoretical background so as to characterize the most relevant concepts concerning the theme SUW. It further ponders the role of reverse logistics might take on, in as much as inserting private initiatives in the waste re-use process is concerned.

The second part comprises the mapping of all information concerning SUW public management within the city of São Paulo and also includes a set of private sector initiatives that focus on the re-use and reverse logistics of their own products. Next, information is analysed from the levels standpoint as per the model proposed by Gonçalves (1990), in an effort to highlight prime barriers concerning the adequate disposal of SUW in the city of São Paulo.

The third part of the article presents a selection of both local and international success cases involving the management of SUW and emphasizes each studied program´s actions and strong points. Finally, results enabled the proposition of public and private actions that are deemed capable of eliminating or mitigating the encountered impairments, consequently leading to greater recovery of SUW produced, in addition to other benefits that arise from improved management per say.

2 METHODOLOGY

This study is of exploratory nature given that it attempts to generate increased familiarity with the final disposal of SUW issue, with views to clarifying and making the same more explicit (Gil, 1988). The bibliographical survey was conducted based on the consultation of books, articles and studies published in journals. Sources of documental type were also employed such as information provided on São Paulo´s City Hall, companies and institutions that handle SUW management within the city of São Paulo sites.

As to methodology, the four level analysis model proposed by Gonçalves (1990) was employed to assess the SUW system and organize alternatives that posed to solve issues therein found, which in turn were duly pictured in a comparative chart.

The article was bound by limitations involving scarce availability of reliable and updated information as well as of studies that focused on solid urban waste management. By large, current data was collected from press reports and articles found both in newspapers and sites, whether corporate or of City Halls.

3 BIBLIOGRAPHICAL REVIEW

3.1 SUW

Findings indicate that most often, authors of publications involving SUW employ in an indistinctive manner, the terms "garbage or waste" and that of "solid residues and/or waste". According to Grimberg (2004), garbage comprises a mixture of food residues, disposable packages and useless objects. Once separated into dry and wet materials, the useful portion of garbage becomes re-usable or recyclable residue or waste. The remains which cannot be used are rejects or waste per say.

The Brazilian Association of Technical Norms, locally known as ABNT, defines garbage as "leftovers of human activities deemed by those who generate the same as being of no use, unwanted or disposable, (...) as long as the same is not treatable per conventional means" (Monteiro et al., 2001).

According to D'Almeida e Vilhena´s (2000) standpoint, as published in the Integrated Management Manual, garbage is classified according to its origin. This study specifically focuses on domestic SUW which, according to the institution known as IPT-Cempre (2000) is that which arises from daily home life and is made up of leftovers of food, deteriorated products, packaging in general and a vast range of other diverse items.

3.2 SUW RELATED MANAGERIAL ACTIVITIES

Cunha & Filho (2002) state that managerial activities associated with SUW may be grouped into six functional elements: generation, packing, collection, transfer or transhipment station, processing and recovery and final disposal.

According to Amaecing & Ferreira (2008), so as to ensure the success of the collection operation, it is of utmost importance to engage citizens who must pack garbage in an adequate manner and ensure it is made available for collection purposes.

Monteiro et al. (2001, duly mentioned by Simonetto & Borenstein, 2006), understands that the first step to implement selective collection involves the conducting of informative awareness campaigns addressing the population in general so as to convince society of the importance of recycling and provide guidance as to how to adequately proceed with the separation of domestic residues.

The very use of waste picking cooperatives to ensure that selective collection is conducted results in a series of advantages such as those mentioned by Monteiro et al. (2001): the generation of employment and income, the rescuing of waste picker citizenship and the reduction of costs involving collection, transfer and final disposal of waste separated by the city´s urban cleaning system.

One of the main factors that ensure the success of a picker cooperative is the successful sale of recyclable materials (Monteiro et al., 2001). The fewer intermediates in the process, the larger is the margin obtained by pickers. To this effect, selected materials must also present reasonably good quality and there must be a scaled production, storage and regularity, in terms of production in itself.

The purpose of the activity of SUW processing and recovery is to neutralize the raw material´s damaging effects by means of altering its characteristics (Chart 1). One of the processing modalities is incineration which presents advantages such as the reduction of the volume of municipal waste and the use of the energy that derives from the burning process (Cunha & Filho, 2002). However, both installation and operation are often expensive given the need for filters and technological equipment, further to demanding a professionally qualified labour force.

Another recovery method – composting – enables the production of organic composts given decomposition of existing SUW putrescible organic matter promoted by microorganism activities, resulting in an organic mix (humus) for widely acknowledged use in agriculture and gardening in general.

The third mode to reuse/process SUW is recycling. Prime environmental benefits of this option include savings in both raw materials and energy during the production process, the increase in landfill useful life, savings in

transportation, employment and income generation, in addition to enhancing population awareness as to environmental matters (Monteiro et al., 2001).

When incineration, recovery or recycling of SUW are not feasible options, the alternative that remains for final disposal of this waste is that of using landfills and open dumps, deemed most adequate for SUWs that present no recoverable value. Controlled landfills do not demand slurry collection and treatment nor bio-gas drainage and burning (Monteiro et al., 2001). Dumps however, are considered an inadequate form of final disposal (Consoni et al., 2000, mentioned by Cunha & Filho, 2002), given that SUWs receive no treatment whatsoever once deposited at these sites.

Recovery and Processing Activities	INCINERATION	ELECTRIC POWER
		SIMPLE BURNING
	COMPOSTING	ORGANIC COMPOSTS (HUMUS)
	REUSE	REUSE, REMANUFACTURING AND RECYCLING
	CONTROLLED LANDFILLS	BIOGAS AND COLLECTION OF SLURRY

Chart 1: Processing and recovery activities
Source: Prepared by the authors.

3.3 REVERSE LOGISTICS

Of special interest to the industrial sector, reverse logistics depends on the ideation and adequate management of distribution channels, from the point of consumption to that of origin, with views as to recovering the value or conducting appropriate disposal, to collect and treat waste (Rogers e Tibben-Lembke, 1999). Reverse logistics enables the re-insertion of reusable SUWs into the supply chain, deemed as being the most adequate final destination for non-organic residues.

Leite (2003) introduces two fields in which reverse logistics typically operate: post-consumption and that of post-sales. Post-consumption waste as relevant to this study´s purpose, relate to durable or disposable goods which have reached the end of their useful life cycle or used products that may be

reused, both of which may flow thorough reverse reuse, disassembly and/or recycling channels until their final destination.

There are variations involving the type of reprocessing materials might be subject to, depending on the conditions they enter the reverse logistics system. Materials may return to the supplier, may be resold if still in adequate sales condition and/or may be refurbished, as long as there is an economic justification or may be effectively recycled, in the absence of recovery perspectives. (Lacerda, 2002).

3.4 POST-CONSUMPTION REVERSE CHANNEL INFLUENCING FACTORS

Leite (2003) analysed the range of aspects that interfere in the balance between volumes of discarded post-consumption goods and those integrated back into the productive cycle, taking into account the required factors, those that are deemed modifiers and the set of conditions considered vital so as to ensure flow balance, as pictured in Charts 2 and 3.

Factors	Type	Definition
Required	Technological	Material´s suitability for the industrial recycling process is relevant to ensure that it´s reintegration to the productive cycle is economically viable.
	Logistical	Post-consumption products and materials must be made easily available at sites and in adequate volumes so as to ensure the economic feasibility of reuse logistics.
	Economic	Recycled material prices must be lower than that of the raw material it substitutes so as to ensure interest in its very utilization.
Modifiers	Legal	The level of governmental intervention by means of corresponding legislation may alter natural market balance conditions.
	Ecological	The new environmentalist culture that focuses on reduction, reuse and recycling concepts and ecological pressure are present in consumer habits and followed by actions taken by companies that seek to safeguard a sound corporate image.

Chart 2: Reverse flow balance factors
Source: Leite (2003)

Vital Conditions	Recycled material supply	which must inflow in suitable volumes and on a regular basis, enabling adequate economic scales which in turn must present the required industrial regularity.
	Recycled material quality	which must ensure operational earnings (in the industrial process) deemed economically competitive before the raw material the product poses to substitute.
	Recycled material products market	which shall evidently reflect itself in the demand for recycled products.
	Compensation in all reverse phases	to ensure the economic interests of the range of agents involved in the back or return flow process.

Chart 3: Reverse flow vital conditions

Source: Leite (2003)

4 CASE STUDY: MUNICIPALITY OF SÃO PAULO

4.1 SCENARIO – BRAZIL

The Basic Sanitation National Survey (BSNS), locally known as *PNSB*, addresses the urban cleaning subject matter and is conducted since 1983 by the Brazilian Geography and Statistics Institute (IBGE, 2002), an organization which is linked to the Brazilian government´s Planning, Budgeting and Management Ministry and is responsible for local economic, demographic and social surveys.

The Brazilian Association of Public Sanitation and Special Residues Companies (Abrelpe) - which represents companies that are engaged in urban cleaning and solid waste management services – as of 2008 has promoted the so-called Brazilian Solid Waste Panorama. As per Table 1, figures involving the generation and processing of SUW´s in Brazil, pose major concern.

Table 1: Prime SUW data in Brazil

	BSNS (IBGE)	Panorama (Abrelpe)	
	2000	**2008**	**2009**
Generation (kg/inhabitant)	288,4	337	359,4
Collection (tons)	-	46,5 mi	50,2 mi
Selective Collection (% of municipalities)	-	55,90%	56,60%
Destination:			
sanitary landfills	47,10%	-	57%
controlled landfills	22,30%	-	23,90%
dumps	30,50%	-	19,30%

Sources: IBGE (2002) and Abrelpe (2009)

Given that in August 2010 a National Solid Waste Policy was sanctioned, thereafter Brazil has counted on a regulatory landmark in the field of solid waste. This Law holds companies accountable for the collection of disposable goods (reverse logistics), determines the integration between municipalities in as much as SUW management is concerned and deems the entire society responsible for the generation of the same. Furthermore, public management is held accountable for the eradication of dumps and for ensuring picker social inclusion, supporting the formalization and valuation of this profession.

4.2 SCENARIO – MUNICIPALITY OF SÃO PAULO

The municipality of São Paulo is the largest Latin American metropolis and its population and economic sizing is reflected in the dimension of the urban issues it faces. Sustainable SUW management is but one of such matters. According to Limpurb (Urban Cleaning Department) - the entity that manages urban cleaning services provided within the city of São Paulo - the region currently generates, on average, 10 thousand daily tons of domestic SUW (Limpurb, 2010), of which more than 55% comprises organic matter. (Limpurb, 2003). Abrelpe (2009) data reveal an equivalent magnitude: 14.016 tons/day of SUW, i.e., an average of 1,338 kg/inhabitant/day. São Paulo´s organic matter

accounts for over half of the total amount of waste produced by the population, i.e., approximately 57,54% (Limpurb, 2003). Paper and the like (11,08%), plastics (16,77%), glass (1,79%) and aluminium (0,67%) together represent over 30% of SUW gravimetric composition, which effectively means that almost 80% might be reused.

4.2.1 Legislation

Chart 4 that follows summarizes São Paulo´s State and Municipal´s most relevant laws and decrees that rule SUW management.

Law/Decree	Publication Date	Rulings
STATE		
Law Nb. 12.528 (2007)	Jan/07	- Obligation concerning selective collection at shopping centres, large-sized companies, industrial and residential condominiums and government offices.
Law Nb. 13.576 (2009)	Jul/09	- Obligation concerning partial or full recycling/reuse of discarded electronic waste, for electronic products manufacturers.
MUNICIPAL		
Law Nb. 13.478 (2002)	Dec/02	- Authorization concerning the execution of services by means of concessions. - Establishment of the Domestic Solid Waste Tax, locally known as TRSD. - Hiring of private transporters by companies that generate more than 200 litres of garbage/dia.
Law Nb. 15.092 (2010)	Jan/10	- Garbage disposal on streets at most two hours prior to the time of collection, as informed by concessionaires.
Decree Nb. 49.532 (2008)	Aug/08	- Obligation concerning the recycling/re-use of plastic packaging for companies that manufacture beverages, fuel oils, lubricants, cosmetics and cleaning and hygiene products, as applicable to their own packages.

Chart 4: SUW-related São Paulo state laws and decrees

Source: Compiled by the authors.

4.2.2 Selective collection

Seventy four of São Paulo´s 96 districts enjoy selective collection benefits (Folha de S.Paulo, 2009). Furthermore, there are 3.811 Points of Voluntary Rubble Delivery, locally referred to as *PEV* and 38 Eco-Sites operate

within the city of São Paulo. Home, selective and hospital waste collection services are performed by two public concessionaires: Logística Ambiental de São Paulo S.A. (known as "Loga") – responsible for deploying services in the north-western region of the city of São Paulo, covering 13 sub-city halls or districts and for managing the Bandeirantes sanitary landfill and the *Ponte Pequena* transhipment. The other - Ecourbis – on the other hand conducts collections in the south-eastern region of the city, covering the remaining 18 sub-city halls and managing the *São João* landfill and the Vergueiro and Santo Amaro transhipments.

According to São Paulo´s City Hall Municipal Services Bureau, in 2009, only 120 daily tons of a total of 10 thousand tons/day resulted from selective collection in the city of São Paulo. Selectively collected material must be taken to the sorting centres. However, one often comes across news reports denouncing failures in this process, either due to the company not complying with the selective collection and SUWs being taken by the regular collection service directly to the landfill or given excessive truck compaction, which ends up hindering material sorting.

In April 2010, the judge of the 3rd. Public Treasury Court of São Paulo - Luiz Fernando de Barros Vidal – determined that within one year, selective collection ought to be extended to the City´s Government. According to his ruling, the municipality must support the formation of recyclable material picker associations to execute the job in addition to having to grant the same the use of assets and equipment (Granjeia, 2010). Thus, approximately 1500 selective collection containers – locally known as PEV – shall be installed in the city of São Paulo by the end of 2012 where the population may discard recyclable garbage. Until mid-June 2012, there already were approximately 500 *PEV´s* scattered throughout the city. However, few people have effectively started to separate recyclable litter to deposit exclusively at these Voluntary Points of Delivery (Uol Notícias, 2012).

Black marketers are an integral part of the recycling chain – they take advantage of the picker´s fragile organizational structure and seize approximately 80% of recycling income, according to data compiled by the Polis Institute. There are no firm figures but currently estimates suggest that there

are 800 thousand active pickers in the country. Within the city of São Paulo, according to figures provided by the National Recyclable Material Pickers Movement (*MNCR*, s.d) estimates indicate that there are approximately 20 thousand people engaged in the activity. Since pickers do not handle large volumes, they are not in a position to sell directly to industries. Furthermore, given the absence of minimal structure involving aspects such as packaging scrap or presenting invoices, pickers become dependent on the black marketers which act as intermediate dealers.

By 2010, 18 Sorting Centres, each comprised of 40 pickers, had been built to cover the entire city of São Paulo (Limpurb, 2010). São Paulo´s Municipal Services and Works Bureau - locally known as SSO - had initially set as goal the formation of 31 Sorting Centres by December 2004. This fact reveals the absence of alignment or better, the effective mismatch, between that which is planned and what gets done in terms of public management. Formally, São Paulo´s City Hall reasons that costs are far too high when it comes to maintaining selective collection sorting, to the extent that, in 2007, for instance, R$ 2,5 million per month were spent on the rental of sheds, trucks and to maintain equipment (Grimberg, Tuszel & Goldfarb, 2005).

In 2008, the Federal Government allotted R$ 6,2 million to the Growth Acceleration Program (*PAC*) with views to the installation of ten picker cooperative sorting sheds. This amount that would be released once the City Hall submitted shed building projects. Before this action was taken, City Hall claims involved difficulties in identifying adequate sites given limitations as to the minimum area sheds had to have, to then be implemented (O Estado de São Paulo, 2010b). Currently, reports inform that the capacity of cooperatives to receive materials has reached a point of saturation thus driving approximately 10% of SUW collected by Ecourbis, for instance, to be dumped at regular landfills. Material collected by Loga, on the other hand, remain in standby until such time as the Centres are in a physical space condition to actually receive the material (Bizzotto, 2010).

4.2.3 Landfills

Within the municipality of São Paulo, there are three landfills in operation and one Waste Treatment Centre: the landfill in Caeiras, the *São João* Landfill (undergoing deactivation), the Pedreira WTC (locally known as CDR) which is privately owned, and the Eastern Waste Treatment Centre (CTL) which was built by Ecourbis to substitute the *São João* landfill, deemed saturated (O Estado de S.Paulo, 2010a). Although the Bandeirantes sanitary landfill was closed down in March 2007, it still does capture gas.

The Eastern Waste Treatment Centre comprises a total area of 1.123.590, 00 m², whereby 389.500 m² (34%) are allotted for the final disposal of SUW. It receives domestic waste generated in the Southern and Eastern regions of the city of São Paulo and therefore addresses over 6 million inhabitants (Quartim, 2011).

4.2.4 Recycling and the private sector

According to Cempre (2009) currently, the most known aspect of corporate action involving recycling is that of fostering selective collection and picker cooperative formation programs. Herein under, Chart 5 presents some of the major private sector programs that focus on recycling with views as to presenting initiatives handling different materials.

COMPANY	INITIATIVES
Klabin	- Responsible for recycling the largest volume of papers in the country, capable of handling 325 thousand tons/year of paper residues. - Largest market generated supply volume, via wastepaper wholesalers. - One of the largest world recyclers of **Tetra Pak packages,** capable of recovering 32 thousand tons/year which corresponds to 1 ton of plastic and aluminium, per hour. On an annual basis, the unit manages to produce 6,4 thousand tons of paraffin and 1,6 thousand tons of aluminium.
Philips	**- Philips pilot Sustainable Cycle Program:** launched in 2008, it covers 25 Brazilian cities and collects all kinds of electro-electronic equipment and domestic appliances of its own brand. - Products are received through the company´s after service network and then are forwarded to a partner - Oxil – accountable for both disassembly and adequate component disposal. - Participates in the global **Solving the e-Waste Problem (SteP)** initiative which

	poses to standardize recycling processes on a worldwide basis, so as to collect valuable components in electronic waste, increase product life cycles and harmonize legislation and world policies that deal with the subject matter.
Saint-Gobain	- Positioned amongst the largest Brazilian recyclers handling approximately 10 thousand tons of glass shatters/month. - Implementation of the **Scattered Caption Program** at over 50 recyclable material picker cooperatives in São Paulo, resulting in the cleaning of more than 350 tons of glass shatters per month. - Conducts presentations at schools covering themes such as the recycling of glass, selective collection and separation of recyclable material followed by correct disposal, with views as to increasing the useful life of sanitary landfills. - Via the **Ecova Project**, the company developed a high quality bottle using 15% less raw material which in turn enabled a 15% reduction in CO^2 emissions to produce it and a 6% reduction in package transportation.
Pepsico	- As of 2009, **partnered** with **TerraCycle –** an American company – by means of using plastic Bopp (salty snacks) packages to produce new products such as backpacks, note pads and even car bumpers. - **Salted snack packages** are also reused in the manufacturing of disposable pots and diapers, in addition to product displays for points of sale. To produce each unit, material equivalent to 675 salty snack packages is required. The goal was to reuse, by the end of 2010, 13,5 million packages.
Coca-Cola	- Reduction of the weight of PET packages; support the **Bottle to Bottle** *project* using recycled PET resin to produce new bottles; promotional T-shirts and displays; limitation as to the use of pigmented PET bottles that hampers recycling; partnership with Wal-Mart – a supermarket chain store – to install Recycling Stations. - **Recycle, Win Program:** operates in 24 of Brazil´s states, whereby schools, resident associations and other entities collect packages for recycling purposes in exchange for items that are relevant to the institution such as didactical and technological materials. - **Fixed points of purchase** of aluminium cans (R$ 0,85/kg) and empty PET bottles (R$ 0,14/kg) have also been installed in several districts of Brazilian cities. - Development of the ***Plant Bottle™***, a 100% recyclable package made up of up to 30% of plant material which derives from sugar cane juice or molasses produced in Brazil.
Pão de Açúcar Group	- 110 ***PEVs*** for recyclable materials, placed at the *Pão de Açúcar* stores, in partnership with Unilever and more than 78 recycling stations at the *Extra* stores in partnership with Pepsico´s "H2OH!" brand to the benefit of tens of collection and recycling cooperatives. In addition to collective selection, 20 units of the chain store accept cooking oil disposal in PET bottles which is then forwarded for the production of biofuels. - **Green Checkout Program** – for the time being, the client may discard packages in special containers during checkout. The program was implemented in 38 stores under the Pão de Açúcar brand name and in 10 of the Extra chain store and to date has collected more than 450 thousand packages. - **Taeq Green Cycle** – the program focuses on the reuse of paper, using material collected at the Pão de Açúcar Recycling Stations, to transform it into carton paper and manufacture new packages to be used by this brand name.

	- **Hello Recycle Program** - a partnership with Nokia do Brasil – proposes to collect mobile phones, accessories and batteries for recycling purposes. There are collection stations at 41 stores of both the Pão de Açúcar and Extra chain stores.

Chart 5: Private company reverse logistics programs

Source: Prepared by the authors as of corporate sites

4.2.4.1 Thermoelectric and composting plants

Although electric power may be produced as of SUWs, in Brazil there are but a handful of private companies that operate considering this possibility. Within the city of São Paulo specifically, not one single registry of the existence of a thermoelectric power plant producing energy as of SUWs was found to be in operation despite the fact that there are thermoelectric plants that use methane and natural gas as power generators.

Within São Paulo, the two existing composting plants were closed down: São Matheus in 2003 and that of Vila Leopoldina, one year later. Together, both received 11,4% of domestic or sweep related SUWs (Jacobi, 2006).

Given that the cost of a processing plant is higher than that of setting up a sanitary landfill, understanding deems it essential to aggregate power generation to SUW incineration station projects as a means of balancing off costs.

4.2.5 Concessions

Chart 6 provides a summary of concession contracts history comprising the period between 1989 and 2008.

Period	Mayor	Major events
1989-1992	Luiza Erundina	Launched a new call for bid involving a differentiated model that grouped routine collection/sweeping services and those of the so-called work fronts (Jacobi, 2006). Hiring of a company for each type of service and for each regional management. Greater access to bids offered to smaller companies, disrupting the cycle involving the three large garbage collection companies, in São Paulo: Vega-Sopave, Enterpa and Cavo.

1993-1996	Paulo Maluf	Return to the former model, regrouping collection to services of various kinds, reinstating cartel practices. First denounces hired concessionaires fraudulent activity in terms of both weighting and over-billing.
1997-2000	Celso Pitta	Collection continued to be paid on a per ton basis. The four companies hired to conduct activities shared nine contracts. In October 1999, a new call for bid that divided the city into 27 areas was cancelled. Further scandals sprung and came to light such as the so-called "mafia of inspectors" and of exchange of interests between sanitary cleaning companies.
2001-2004	Marta Suplicy	Emergency contracts for general services were signed in January 2001 with 16 chosen companies, involving contracts that totalled almost R$ 19 million yet covered three months' worth of services. Signs of irregularities involving the granting of a R$ 1 million worth contract to Tercopav - a company that was constituted one month before the call for bid - which, in it´s by-laws, informed to hold an equity capital of R$ 210 thousand *reais* and to have, as shareholding partners, a former blacksmith or general metalworker and a 21 year old student. (Jacobi, 2006)
2005-2008	Marta Suplicy	Consortium "Ecourbis" manages the South-eastern region of São Paulo and Consortium "Loga Engenharia Ambiental" is responsible for that Northeast. At the time, the governor of the State of São Paulo - José Serra – tried to cancel, yet failed, this R$ 10 billion contract. *FIPE* – the University of São Paulo´s Institute Foundation of Economic Research – recalculated the costs of litter collection services and suggested that payment might could have been 17,31% less than that contracted.

Chart 6: History of concessions in São Paulo, per municipal government
Source: Calderoni (2003)

At the time of 2008 elections, both Marta Suplicy, of the Workers Party (PT) and her adversaries - Geraldo Alckmin, of the Brazilian Social Democrat Party (PSDB) and Gilberto Kassab, of the Democrats Party (DEM) argued in favour of the current cleaning services hiring system. By 2009, the two concessionaries received, every single month, approximately R$ 41 million to daily collect 9.500 tons of domestic SUW in the city (Corsalette, 2008).

4.2.6 Fostering sources

The National Economic and Social Development Bank (BNDES) is currently the main long term funding instrument that enables investments in a range of economic segments, including social, regional and environmental domains. Given that this institution - BNDES - is linked to Brazil´s Development, Industry and Commerce Ministry, its mission is to support enterprises which contribute with the development of organizations and of private citizens, according to criteria that prioritizes development with social inclusion, generation of employment, income and of foreign exchange.

There is another economic development project fostering instrument – the ancient "Paulista" or São Paulo´s Fostering Agency – that belonged to the "Nossa Caixa Desenvolvimento", which in turn is linked to the São Paulo States´Treasury Bureau. This entity´s priority is to financially support initiatives that promote growth within the State, contributing with the generation of employment, income and its impacts in terms of social development.

The most relevant financing lines offered by these two fostering institutions are described in Chart 7 that follows:

Institution	Financing line	Destination
BNDES	"Finem" – Support Environmental Investments	Environmental projects fostering local sustainable development.
	"Finem" – Support Energy Efficiency Projects	Projects that contribute towards improved power efficiency
	"Proplástico" – Socio-environmental	Investments involving rationalization of natural resource use, clean development mechanisms, environmental liability management and recovery.
	Hydric Resources and Environmental Sanitation	Investments involving water supply, sanitary sewage, drainage and solid waste, amongst others (public clients, including consortiums).
"Paulista" Fostering Agency	"FIP" - Environment	Improvements in the production and service rendering processes to address environmental rulings and reduce enterprise and project impacts on the environment.
	"FIP" – ENERGY	Power consumption reduction and use of alternative sources of energy
	Waste sanitation, treatment and reuse	Electrical power generating projects or thermal power generating projects as of landfill biogas, sewage system treatment adaptation to anaerobic processes with methane recovery and burning, and inclusively, installation of waste recycling centres.
	Renewable power	Renewable power production equipment purchase and installation such as biomass, landfill biogas and other waste boilers of the kind; installation of biodigestors to treat waste which nevertheless also ensure the use of energy thereby generated.
	Waste management	Biogas burning at landfills; power generation as of waste; organic waste combustion; reduction of waste production at origin; composting for fertilizer production and recycling.

Chart 7: Environment and solid waste-oriented financing lines

Sources: BNDES and "Nossa Caixa Desenvolvimento – Agência de Fomento do Estado de São Paulo" sites

4.3 PRIME ISSUES MAPPING

Surveys involving the most relevant points of disarrangement within São Paulo´s urban cleaning system and the proposition of solving actions are ground on Gonçalves's (1990) doctorate thesis that offers an analytical framework for organizational process interdependency analysis. This study concludes that any other analysis/intervention process involving organizational networks must jointly take into account four levels, so as to obtain successful results: identity and relations, players in the psychosocial domain, and processes and resources, considered under a technical domain.

The level of identity is the key factor towards building the identity of a system, project, organization or supply chain and comprises the identification of values to be pursued, the rites of passage imposed by social group players, shared beliefs and the "principles" of the existing wisdom.

According to Gonçalves (1990), the relational level is:

> responsible for making psychological contracts established between the various players involved explicit, in as much as established behaviours and attitudes, shared expectations and existing relationship "psychosocial" barriers are concerned, and also comprise, protocols, rulings and regulatory instruments in general, in addition to organizational management formats.

The process level considers the definition of the flow of activities, including all stakeholders and pertaining performance indicators, in addition to understanding systems and documents that formalize transactions deemed components of every single process.

Finally, the resource level comprises all assets and competencies required to generate results, amongst which fixed and working capital, people, premises, available credit, available technologies, equipment and so forth, in addition to the sizing or adequate scale required so as to add competitive value.

The network subject to study is that of São Paulo´s urban cleaning and its prime participants include: inhabitants addressed by the collection service, municipal, state and federal governments, picker cooperatives, waste treatment industries and the private companies that produce consumer goods.

4.3.1 Level of identity

Problem 1: *Insufficient inhabitant ecological awareness and environmental education*

Findings indicate that São Paulo´s population has not bought-in and join, on an integral basis, selective collection in itself nor do inhabitants bother to separate waste into those of organic or recyclable nature, at home. This overall matter of concern, in turn drives other results: reduction of the supply of these materials for recycling industry use; absence of demanding public sector stance for investments in waste treatment; reduction of the demand for products that comprise recycled materials thus discouraging all parties involved in the chain from investing in general.

Problem 2: *Picker marginalization*

Pickers are players that present unique characteristics which are quite different from other system stakeholders. In some situations, because they live on the outskirts of society, they are perceived as homeless people by other citizens who thus relate the litter gathering activity to one that represents degradation.

Thus, integrating pickers into a cooperative work process is by no means an easy challenge since people of the kind find it difficult to deal with rules and hierarchy. This problem can also be perceived from a relational perspective, in as much as it represents an existing psychosocial barrier between the relationship with pickers and society and with pickers themselves.

4.3.2 Relational level

Problem 1: *Cleaning services cartelization*

Concession organizational formats to manage SUW in the city of São Paulo are characterized by "fixes being in". Concessionaires that hold whatever level of political power are often favoured in bids, whether in view of direct or indirect relationships partners have with public administrators and respective

political parties, or given the financial ability contractors hold as to bearing election donation regimes.

This concentration of cleaning services has impaired innovation implementation and the adoption of sustainable SUW management systems in the city. Both the City Hall and society should ensure concessionaire contract compliance but this is not performed in an adequate manner, thus giving rise to numerous exposures involving reported fraud.

Problem 2: *Absence of partnerships with cooperatives*

Picker participation in the collection of recyclable material has been remarkably under-utilized. According to data collected by this study, there are currently 20 thousand pickers in the city of São Paulo but only one thousand are sheltered by the selective collection program via cooperatives and associations.

Sometimes, given differentiated work conditions involving the granting of institutional City Hall support –which contrast with deficiencies many picker groups face – conflicts, between stations and other associations, arise, pick up and shape.

4.3.3 Process level

Problem 1: *Insufficient processing capacity at sorting centres*

Centres that partnered with the City Hall face material reception capability depletion issues whilst picker associations – excluded from public support – further face the challenge of reverse logistics in their activities, taking on the responsibility for the entire process and thus limiting their ability to capture advantages sprung from both scale and efficiency.

Problem 2: *Non-significant organic matter treatment investment*

In as much as organic matter processing alternatives are concerned there is a clear absence of incentives in terms of composting. São Paulo offers a small number of financing options to support the high cost of setting up a plant of the required size and lacks the political will to face the pressure exerted by large

urban cleaning groups. If the so-called damp leftovers were to have an exclusive destination, there would be a drastic reduction in the volume of material that is dumped at landfills.

4.3.4 Level of resources

Problem 1: *Small scale of materials sorted for recycling purposes*

The current approach based on small scale cooperatives is a poor fit and consequently, two thirds of generated profits end up in the hands of intermediates and industries. The absence of investment in large scale collection and sorting, shapes yet another barrier towards fostering the growth of correctly treated waste figures and thus expansion to significant shares.

Problem 2: *Lack of fostering policies*

Financial resources in São Paulo also serve as an obstacle towards progress on the study´s subject matter. This is mostly due to their being scarce alternatives to finance projects that favour waste reuse, hampered access to credit offered by the existing programs in addition to the absence of tax benefitting policies that might otherwise promote projects of the kind. BNDES programs and those of São Paulo State´s Fostering Agency are not promoted in a widespread manner and remain restricted to those who are already within the urban cleaning industry, thus undermining innovative initiatives.

Problem 3: *High cost for governmental management*

One of the key elements of SUW management is the amount of resource São Paulo´s City Hall allots to the activity. In the country as a whole, the billing issue involving SUW collection and treatment is still scarcely discussed, hindering financial sustainability of the urban cleaning system.

5 SUCCESS CASES

Henceforth, a set of cases involving cities and countries that found solutions for SUW management and became noteworthy in terms of reuse efficiency and adequate disposal of domestic solid waste are presented.

5.1 JAPAN

As of 1997, the Japanese Environmental Ministry decided to take as measure, the determination of a set of laws with views to introducing new cultural habits to their population related to mandatory procedures for SUW disposal.

In Japan, waste must strictly be separated into organic, recyclable (plastics, foam and so forth), glass, ceramics, tins and aluminium; once sorted, they are collected once a month. Plastic PET must be set aside as non-incinerable waste and separated from other recyclable items. Newspapers and magazines must be tied together and discarded on the same day as that set for organic waste.

In 2001, the Japanese government enacted the Food Recycling Law demanding a 20% increase, by the end of 2007 in food reuse rates at food manufacturing companies. This law recommends four alternative recovery methods: composting, animal feed production, oil and fatty product manufacturing and fermentation derived methane gas usage to produce energy. Local level governments are required to grant subsidies for the purchasing of organic waste treatment and for composting purposes.

Via the energetic recycling process, non-recyclable SUWs are transported to incinerators where they are burnt and can generate electric power using incineration-derived heat. Building and operational costs of plants of this kind are high and they are not as yet self-sustainable with the sale of the electric power and of composts. All plants are in operation thanks to government subsidies.

5.2 BARCELONA

Barcelona´s metropolitan area treats collected urban waste via recycling, incineration and composting, the remainder being disposed of at controlled landfills.

Prime waste management financing sources include the Metropolitan Environmental Tax, locally known as TMTR, and earnings collected by the Packaging and Packaging Waste Law (Lere), to ensure value is added to waste management in itself. This Law also finances a portion of the selective collection of paper and carton, glass and packages.

As of the early 1990´s, the so-called pneumatic collection - developed by Envac, a Swedish company – transformed waste management in Barcelona. Over 70% of SUWs gathered at Catalonia´s capital, is already collected following this procedure. However, in view of terrain irregularities that characterize some of the city´s districts - hindering the installation of pipelines - 100% of Barcelona will not be covered (Bonfiglioli, 2010).

The collection structure comprises garbage discharge sites or mouths, that have been installed throughout the city and are connected to a pipeline system which rests at no less than five meters below the surface. It´s a suction driven vacuum network that literally draws, on an hourly basis, waste produced by the population and disposes the same at a storage centre, most often set up on the outskirts of the city. From this site onwards, waste is directly stored and transported to a sorting plant where recycling or incineration stations operate. Organic waste is processed into fuel that powers turbines which in turn generate electricity.

According to Bonfiglioli (2010) the system in itself is efficient yet nevertheless, expensive and US$ 156 million have already been invested in Barcelona. The installation of a network, capable of addressing the needs of 18 thousand families, on average, costs US$ 50 million. In Barcelona, there are two financing modalities: in new or recently urbanized areas, the private sector funds 57% of amounts equivalent to 57% of costs whilst in consolidated areas, public financing may cover as much as 92% of total costs. Public investments also derive from European Union funds.

5.3 GERMANY

At the end of the 80´s, approximately 30% of German SUWs in terms of weight and almost 50% in terms of volume comprised packages. That´s why as of 1990, rulings began to hold package manufacturers accountable for both collection and final disposal, in compliance with the Polluter-Payer Principle, holding these industries responsible for receiving the material back and recycling it.

This ruling developed a successive stage-based plan and, as of January 1993, distributors were obliged to receive all sales packs back. Since the burden of SUW rests on companies, deposition and recycling costs are included in product prices.

In as much as glass bottles are concerned, an additional deposit system was introduced to the sales price. If bottles are returned, the deposit is likewise returned to the consumer (15 to 70 DEM cents). As of January 2002, another decree extended this system to comprise all other types of glass, PET and aluminium cans.

Given that industries deem the collection of their own packages far too complex, many pay outsourced companies to collect and recycle their products. The largest organization of the kind is Duales System Deutschland (locally known as DSD and stands for Dual German System). DSD was set up in 1990 and is a non-profit fusion of several recycling companies. This organization has been responsible for the independent collection and recycling covering almost 100% of German homes, except for the city of Munich.

Currently, manufacturers pay a license fee to the organization and upon payment, producers may use a seal that pictures a Der Grüne Punkt (the Green Point) logo on their packages, which in turn enables DSD to collect and recycle their products.

Thus, the procedure shapes a system developed to finance, hire and organize several waste collection, sorting and recycling companies and ends up

becoming a non-tariff-related entry barrier for foreign companies that export packaged goods to Germany.

Over the last decade, the till then manual sorting procedure progressed into one which applies top technology. Improved systems of the kind, by 2001 for instance, reduced plastic recycling prices by 20% as compared to those of 1996.

5.4 CURITIBA

The Brazilian city of Curitiba which is the capital of the state known as Paraná, is widely acknowledged throughout the world for having intensively marketed urban planning and life quality standards. Waste separation is thus embedded into the city´s culture. Partnerships are often employed as a means of contributing with the improvement of the city´s selective collection system.

Curitiba´s selective collection program - known as "Lixo que Não é Lixo" (Garbage that´s not Garbage) - has been in place ever since 1989 and covers almost 100% of the city´s area. Furthermore, the SE-PA-RE (separate) campaign has remained in force for more than five years and is displayed on the city´s buses and urban properties, motivating inhabitants to separate residues (Agência de Notícias da Prefeitura de Curitiba, 2010).

Once collected, materials are sent to what is known as UVR – Reject Valuation Plant – managed by Curitiba´s Pro-Citizenship Institute (IPCC). Once sorted, waste is compressed and sold to recycling companies of varied segments. Income obtained from sales are allotted to social programs that the same institute – IPCC – develops and used to maintain the plant itself.

The plant´s (UVR) site is also used as source of information and shelters environmental education and awareness activities that welcome visitors to the importance of recycling. To this effect, there is an environmental educator who guides visitors and clarifies all eventual doubts. At a specially prepared room, children take environmental education classes, thus testifying the city´s concern and seriousness as to the matter of issue itself.

The Waste Purchase Program was implemented at the same time that the "Garbage that is not Garbage" program was introduced. The City Hall installs a stationary collection container at previously determined sites and supplies the local Resident Association, on a fortnightly basis, garbage packs for the collection and packaging of waste.

For every 8 to 10 kg of waste deposited at the collection container, participants receive a transportation voucher which is substituted for green market goods such as greenery, fruits, poultry and dairy products, thus in-feeding the so-called Green Exchange Program. Resident Associations receive 10% of the amount paid for each garbage pack or bag that is deposited at the collection container and it is used at works and services that the community itself defines.

6 ALTERNATIVES FOR THE CITY OF SÃO PAULO

Given analysis of cases of the kind, sample initiatives may be extracted which might come to solve problems encountered in São Paulo.

The municipality´s prime impairment is the bleak involvement of inhabitants in matters associated with the environment and disposal of SUWs. There are two alternatives to tackle this obstacle: awareness campaigns following Curitiba´s example and the enforcement of laws that shape an appropriate waste separation and disposal culture, transforming this into an obligation that is subject to monitoring and the application of fines, as per actions taken in Japan.

Awareness campaigns must cover both public and private schools, by training teachers and establishing specific disciplines to further the subject matter and include visits to sorting centres and recycling organizations. In addition to understanding the importance of separating SUWs at home, children have the power to influence their respective families, multiplying awareness and grow up into a more ecologically responsible generation of adults.

As far as the adult population is concerned, the government ought to inform the location of PEVs (selective collection containers), the days and times of selective collection and how to execute both separation and disposal at these sites, via massive, widespread and outreaching campaigns. On the other hand,

from an incentive perspective, initiatives offering some sort of monetary benefit in exchange for compliance, are more effective than awareness campaigns. That´s why actions such as those taken in Germany – where fees in cents are charged at the time products are purchase and allows the same to be reimbursed once the package is returned - would do well on a large scale basis.

The second problem to be faced is the underuse of picker cooperatives. City Hall´s obligation to support the formation and operation of recyclable material picker associations and resources granted by the PAC program to build more than 10 sorting centres can effectively accelerate the delivery and activation of the 31 promised stations. Rules as to location and construction of these centres must be revised and renegotiated to no longer obstruct the processes' progress.

The City Hall ought to use the existing physical space and structure of cooperatives that are already in operation but not as yet linked to the selective collection program. Picker professional qualification must also be conducted, enabling the negotiation of improved prices and exterminating the black marketer or intermediate as a player altogether. As per Curitiba´s Reject Valuation Plant (UVR) example, by paying employees fixed salaries, turnover rates might also decline.

One of the most sensitive issues to be solved is that involving the cartelization of urban cleaning services. This calls for inhabitant active action in terms of both monitoring and engagement. Given that competition with large contractor´s is a tough challenge in itself, alternatively, contracts should rather contain specifications not only as to services and deadlines, but also comprise quality and required structure requirements. Monitoring should be incorporated into the chosen management model, enforcing a close relationship between the institution held accountable for services and São Paulo´s inhabitants. This might be achieved by means of campaigns focused on making communication channels popular.

High waste reuse costs – particularly those related to recycling – is a problem that might be partially solved via the application of City Hall administrative taxes, reinstating the charging of the former TRSD duty. Much like Barcelona, the establishment of a specific and efficient charge for urban cleaning

services would not only ensure the sector´s financial sustainability but would also enhance inhabitant awareness as to the need to reduce waste generation and of correctly disposing of the same.

The solution Germany implemented, forcing companies to incorporate package return and recycling costs proves to be the most feasible alternative, given mandatory reverse logistics legislation, as will be discussed further on. Even if this cost is effectively passed on to the consumer, it would almost be "invisible" as compared to direct charging of the duty.

In an indirect manner, other actions proposed also support operation cost reduction. Investments in environmental education and in the operation of more sorting centres allows selective collection to work with larger volumes, diluting fixed operational costs at the stations and at recyclers, reverting the current logic of poor earnings.

Furthermore, still taking the high cost of services into account, door to door collection is one of the activities that concessionaires perform that most endears contracts, as is the case of sanitary landfill management. With the vacuum collection system employed in Barcelona for instance, expenses involving collection and transportation would be avoided in addition to those associated with fuels and human resources involved in the process.

Nevertheless, the issue must be studied in a more detailed manner since São Paulo´s geophysical terrain characteristics – in addition to sizing being far greater than that of Barcelona – might pose difficulties in terms of system implementation. Despite being very expensive, the project does effectively generate savings on a long term basis.

Finally, given the new Solid Urban Waste National Policy, in the future, greater fostering of corporate initiatives and of reverse logistics activities ought to be attained. Expectations include companies seeking alternative ways to manage the reverse cycling of their own products. This can be conducted by outsourcing these services, hiring companies that take on the same role as that of Duales System Deutschland, in Germany.

Private sector participation might be useful in as much as organic waste reuse is concerned. Given that composting and incineration require sizeable investments, in this case, legislation ought to take on a fostering role, as was the

case involving the Food Recycling Law ruled in Japan. Companies would further be able to charge a fee from the City Hall for receiving waste, as if subsidizing the initiative.

7 CONCLUSION

Improved SUW use solely brings about positive results. These include the fact that this is an alternative source of energy and of income generation via selective collection, in addition to no longer overloading landfills, contaminating both soil and water, and, in some cases, could effectively serve as a source of resources if sold and re-inserted into the supply chain.

This study revealed that one of the greatest challenges involving the adequate disposal of domestic waste in São Paulo is of an institutional nature, emphasizing the need for the shaping of an environment concern-oriented culture, via environmental education, to promote changes in the current society´s values and habits.

Several urban cleaning services related financial aspects were found to be limited, primarily in as much as final disposal is concerned. To enable final disposal advancements, the availability of specific financing lines to support required investments and the implementation of systems that charge inhabitants so as to ground initiatives in an economically sustainable manner, are virtually mandatory.

So that recycling in itself may emerge in a strengthened manner, residential separation, sorting at the centres and recycled product manufacturing must occur on a massive scale. Furthermore, both participation and strengthening of picker nuclei and associations – via partnerships with not as yet registered cooperatives- must be taken into account.

To ensure that the proposed actions are implemented in whole, a cycle that brings together companies, consumers and market – via participation and joint accountability of several players in as much as solid waste management is concerned – must be established. Thus, the consolidation of a culture that is associated with sustainability, allied to factors such as consumer and society pressure, changes in public policies and productive segment economic feasibility, may translate into waste treatment progress.

Should urban cleaning, in the short term, be perceived as a sector worthy of financial investments, São Paulo city´s situation as to final waste disposal shall improve in a significant manner, thus contributing with improved local inhabitant health and overall well-being.

Findings confirm there is room for the preparation of a more detailed action plan for the city of São Paulo, simulating costs involving the implementation of prime solutions proposed. These can further be compared to the City Hall´s current urban cleaning expenses and lead to decisions concerning the adoption of all the herein proposed measures as being, from an economic standpoint, effectively feasible and one which also takes into account deriving indirect savings.

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