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An Application Model for Sustainability in the Construction Industry

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1. Introduction

Over the years, mankind's development of a large industrial capacity and its ability to create new technologies that turn easier society's daily life has been a mark of innovation era. In many developing industries, technologies are incorporated into daily life by becoming indispensable to the modern lifestyle. Waste production has been increasingly alarming throughout the world, standing as a major problem to be solved.In order to achieve life quality and be able to provide favorable environmental conditions to future generations, it is indispensable to become conscious about environmental effects of all mankind's production activities.

It is vital to promote and encourage an environmental sustainability culture development: meeting society's demand of industrial and technological products with the indispensable proper disposal of their products at the end of life, that is, discard minimizing environmental impacts on the completion of its life cycle.

Some measures have been taken over recent years, with the intention of minimizing the generation of environmentally hazardous waste in the world, emphasizing the relevance of changes in production processes. In the specific case of construction, begins to be aroused interest from external factors. Among them, there is the availability of solutions to minimize negative environmental impacts identified and applicable management tools.

Methods for evaluating environmental performance of the construction industry and increased competition in the industry and customer requirements are also seen as elements boosters, which come to be added to increase environmental awareness at the part of builders.

Similarly, as many construction companies have implemented quality management systems that have brought them considerable benefits, it increases their interest in introducing environmental elements into existing systems. However, there are few builders that are committed to environmental issues. Still, environmental solutions have begun to be applied in enterprises, although this does not ensure continuous improvement and sustainable development of the sector.

Despite its recognized economic impacts to the country such as: high job creation, income and viability of housing, infrastructure, roads and others; in the construction sector one still lacks a firm policy for disposal of solid waste, mainly in urban centers.

The need to take the RCC not only results in a desire to economize. This is a fundamental attitude towards the preservation of our environment.

The important thing to be improved in this sector is the management process, with the decrease in solid waste generation and appropriate management of the same construction site, building awareness of the actors involved, creating the methodology.
It is noteworthy that is necessary a change of culture among all those involved in the process of IC, indicating the importance of preserving the environment we live.
Therefore, it is notorious the necessity of a mentality change in the aspect of environmental sustainability at the IC sector's stakeholders, in order to fortify and develop a responsible conduct, aware of the relevance of preserving and extracting as better as possible the environment's resources.

2. Construction industry sustainability

The term sustainable development can be seen as a key word this time. As there are numerous definitions for this term, the two most common definitions known, cited and accepted are the Brundtland Report (WCED, 1987) and the document known as Agenda 21. The best known definition of the Brundtland Report, presents the question of future generations and its possibilities. It contains two key concepts: the necessity and the idea of limitation. The first refers particularly to the needs of developing countries and, second, the idea imposed by the state of technology and social organization to meet the needs of present and future.
The question of emphasis on the social component of sustainable development is reflected in the debate taking place about the inclusion or not of social measures in the definition. This discussion appears in the variety of ideas about sustainability that contains components that are not usually measured, such as cultural and historical. Social indicators are considered particularly controversial, since they reflect political contexts and value judgments. The integration of mitigation measures is further complicated because of different and often conflicting dimensions. The definition of the Brundtland Report does not provide a static state, a more dynamic process that can continue to exist without self-defeating logic prevailing. The different forces acting on the system must be in balance for the system as a whole is maintained over time.
According to Pearce (1993), there are different environmental ideologies that make environmentalism a complex and dynamic phenomenon. Inside of environmentalism, the author identifies two ideological extremes: on one hand the technocentrism, and the other the "ecocentrism". Within this continuum one can identify four fields, with particular characteristic.
Pearce uses four classifications: sustainability very weak (very weak sustentability), weak sustainability (weak sustentability), strong sustainability (strong sustentability) and sustainability very strong (very strong sustentability).
You can also find a parallel Naess (1966) makes between Deep Ecology (deep ecology) and ecology superficial (shallow ecology). In ecology the central objective is superficial affluence and health, along with the fight against pollution and resource depletion. Focus on deep ecology focuses on biospheric egalitarianism and the principles of diversity, complexity and autonomy.
Authors linked the trend technocentric believe that sustainability refers to the maintenance of total capital available on the planet and that it can be achieved by substituting natural capital for capital created by human ingenuity. In extreme ecocentric the authors emphasize

the importance of natural capital and the need to preserve it, I value not only for financial but mainly for its substantive value.
Ecological sustainability means to expand the capacity of the planet by using the potential found in diverse ecosystems, while the continuing deterioration in a minimum level.
It should reduce fossil fuel use and emission of pollutants, but also adopt policies for the conservation of energy and resources to replace.
The geographical sustainability can be achieved through a better distribution of human settlements and economic activities. It must seek a rural-urban setting most appropriate to protect biological diversity, while it improves the quality of life.
Finally, cultural sustainability, the most difficult to bring the second SACHS (1997), is related to the path of modernization without the disruption of cultural identity within specific spatial contexts. To SACHS (1997), the concept of sustainable development refers to a conception of the limits and the recognition of the weaknesses of the planet; focuses on both the socioeconomic problem and satisfying the basic needs of populations. Although the starting point of the various approaches is different, there is a recognition that there is a space of interconnection or overlap between these different dimensions.
Achieve progress toward sustainability is clearly a choice of society, organizations, communities and individuals. How covers different choices, change is only possible if there is greater involvement of society.
In short, sustainable development requires the society to think in terms of long-term and recognize its place within the biosphere. The concept provides a new perspective of observing the world, which has proven to be the current state of human activity inadequate to meet existing needs, and seriously threaten the prospect of future generations.
The goals of sustainable development challenge contemporary institutions. They have governed global changes reluctant to recognize that this process is actually occurring. The differences in the concept of sustainable development are so great that there is no consensus on how to measure sustainability. Unfortunately, for most authors cited earlier, does not have an operational definition of minimally acceptable.
All definitions and tools related to sustainability must consider the fact that no one knows fully how the system operates; one can only discover environmental impacts of activities and interaction as human welfare, the economy and the environment. In general, it is known that the system interacts between different dimensions, but do not know specifically the impact of these interactions. All aspects presented show the diversity and complexity of the term sustainable development.

3. Reverse logistics and waste management

The high competition among companies and constant increase in efficiency in the management processes of production, has characterized the current business environment.
Among the many processes present in a company, there is the logistics business, which is geared to ensure the delivery of the product produced correctly in the right place at the moment and want the lowest possible cost. In many industries, logistics has received more attention, mainly due to the globalization of markets and consumer pressure to reduce distribution costs.
The client, in turn, is embedded in consumer culture, which is driven by the cycle "buy-use-disposal", demonstrating that culture is unsustainable and inadequate to perishable

perpetuation of current conditions for survival in contemporary society, because it stimulates the increasing manufacture of new products to the detriment of reuse and recycling of byproducts or waste.

Thus it is observed that actions to boost consumption are not planned with a systemic view, since their products are not useless options, structured reuse, leaving only the landfilling as a solution to dispose of them.

In this scenario, reverse logistics, or more precisely the deployment of reverse logistics gains importance in the supply chain. The structure of the reverse channel is a way to make new use of these products, through a new job or a transformation of industrial processing, in other useful products.

Thus, reverse logistics has a great interface with sustainable development, since the mobilization of the chains allows the reuse of reverse obsolete products, byproducts and waste, reducing the volume of discarded into the environment and the extraction of new resources. It also presents another favorable feature, since the emergence of new business also promotes the social, financial returns and allows companies involved in chains reverses.

Particularly in the construction industry, reverse logistics systems are designed to develop reverse chain for reuse of products and waste generated in production processes and establish the agents working in it, the census of responsibility throughout the product life cycle.

This attitude is shared not only by builders but, especially, by supplying materials for these are in an industrial environment, where there is less variability of the process. Thus, these companies can become drivers of implementation of this concept throughout the production chain construction.

In the construction sector, it is assumed that interest is still incipient and demonstrated by a few industries, as are the Brazilian initiatives for the reuse of industrial waste.

Applying the concept of reverse logistics in IC may occur in several ways. It can form themselves into organizational tool for the flow of aftermarket products, post-consumer waste from the production process of mobilization and demobilization of equipment used during construction of the project, and set yourself up as a new initiative or as an enhancement of existing reverse channel.

Specifically, with regard to flows, the amount and variability of waste composition of the construction industry generate flows of very different characteristics.

IC flows in post-consumption and production (waste) are hardly distinguished, because they occur simultaneously, except when the demolition of a building, a notoriously product stream after consumption.

Flows of products after sale are mainly for returns sent by mail-order and are usually intended for the secondary market, which, for example, donated to charity. Still others come from equipment and transportation as the return and withdrawal of lifts and cranes.

The biggest concern now rests on the post-consumer products or processes, generally named construction waste.

Applying the concept of reverse logistics in IC may also have coverage from a company in isolation, this and its supply chain, as well as sectored organization, or the entire production chain (the reverse supply chain). When the reverse logistics systems of IC are shared by all actors in the chain and these are strategic objectives aligned on the reuse of reverse flow, consolidates the management of reverse supply chain (reverse supply chain management).

The reverse logistics systems are formed by flows, distribution channels, reverse, or simply reverse channels. In this study of reverse logistics systems IC correspond to the flows of waste from construction and demolition-RCD and its reverse channels.
Flows of post-consumer products industry, construction and demolition have their roots in construction sites. In this environment has recently developed some RCD management initiatives.
The analysis of the requirements of laws versus the needs of the construction leads to the conclusion about the actions necessary for the establishment of a reverse logistics system for the RCD.
Quantifying the generation of RCD is complex because it involves the collection of field data, since there are no precise data , nor indicators released. The generation relies heavily on project design and technologies used, the organization of the plot, containers for packaging of the various "bumps" of waste, and vary according to the stage of the work.
Become evident throughout the academic, claims that the IC, as well as other industrial chains, must promote sustainable development, ie, it must develop in order to not compromise the ability of future generations to do it too. Among the many issues involved in policies for sustainable development of the productive chain of the IC in relation to environmental and social dimensions, are responsible for the use of natural resources and disposal of waste from industrial activities.

4. Brazilian environmental legislation general requirements for construction companies

There are several Brazilian environmental legislation aspects that affect the Construction Industry and construction companies operations in Brazil. The Waste Management Program for construction sites and Environmental Impact Assessment Program with respective Report and License are the most important items to be taken care. All construction sites demand waste management attention although this Environmental Impact Assessment Program and Report (*Estudo de Impacto Ambiental - EIA/RIMA*) are only mandatory in special cases.

4.1 The waste management program

This waste management program aims at the reduction of waste production and correct destination of what remains in activities involving in construction, retrofitting, remodeling, maintenance and demolition in all types of construction related activities and subsectors of the Construction Industry.
Table 1. shows Brazilian Construction Waste Classification according to the legislation and its respective destinations.
Reuse is the process of reapply some waste without transforming itself and Recycling is the process of reapply some waste after some transformation. These are possible final destination of A and B waste classes.
Class A wastes, before reuse and recycle, can be stored in Building Construction landfills. In these sites special disposal storage techniques are used having in mind preservation of these segregated materials for its future use or the use of the land itself throughout application of some engineering principles to confine them. The **Construction Industry Waste Management Integrated Plan** *(Plano Integrado de Gerenciamento de Resíduos da Construção Civil)* structured as shown above.

Construction Waste Classification			
Classification	**Characteristics**	**Examples**	**Destination**
Class A	Reusable waste or recyclable as aggregate	Brick blocks and tiles, dirt, concrete, mortar	Reused or recycled
Class B	Recyclable	Plastics, paper/cardboard, metal, glass, wood pieces	
Class C	Not existent technology for recycling	Gypsum	Stored, transported and disposed in conformity with specific standards.
Class D	Hazardous Waste	Coats, solvents, oil	

Table 1. Brazilian Construction Waste Classification

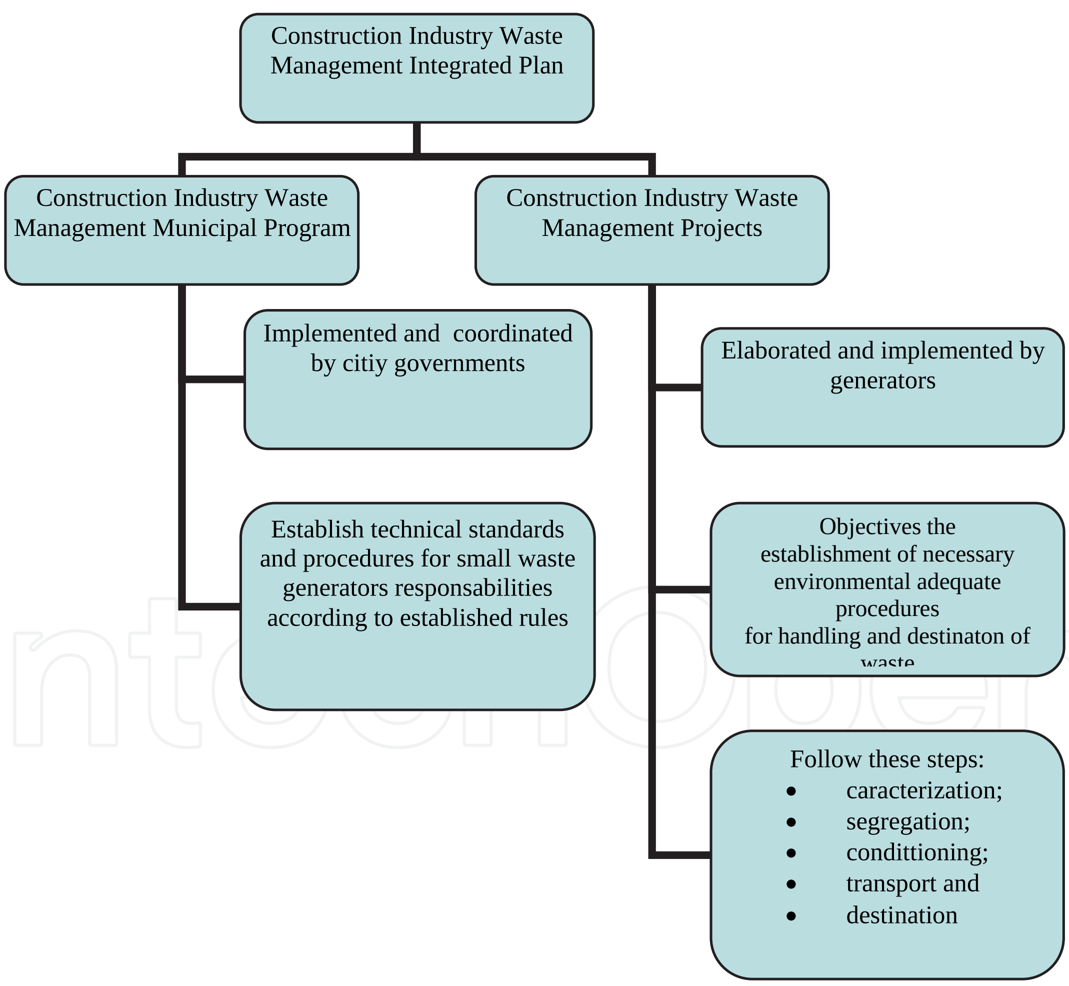

Fig. 1. Construction Industry Waste Management Integrated Plan Scheme.

This plan must have:

- Technical standards and procedures for the Construction Industry Waste Management Municipal Program and the Construction Industry Waste Management Projects, elaborated by large waste generators, aiming the creation of a sense of responsibility by all generators;
- Mapping of public or private areas, suitable for receiving, segregation a temporary storage of small waste volumes, according to urban municipal zoning. This allows further destination for waste management plants or recycling;
- Establishment of licensing procedures for areas of processing and final waste destination;
- Determination of prohibition of disposal in non licensed areas;
- Incentives towards reuse or recycling;
- Determination of parameters and criteria for registration of waste transportation companies;
- Environmental education actions towards waste management of construction waste.

4.2 Environmental impact assessment program and report

An Environmental Impact Assessment Program and Report is mandatory for CC seeking construction licenses for construction sites in which considerable environmental impacts will happen, such as:

- Roads with two or more lanes;
- Railroads;
- Ports and terminals for oil and gas, chemicals products and mining;
- Aeroports;
- All types of pipelines including sewage, oil, gas, mining and others;
- Power lines, beyond 230KV;
- Water resources facilities including Hydro Plants beyond 10MW, irrigation works, sewers, navigation channels, etc;
- Fossil fuels extraction;
- Mining extraction;
- Sanitary landfills, toxic or hazardous;
- Power Plants generating more than 10MW;
- Industrial and agricultural units and complexes;
- Industrial districts and strictly industrial zones;
- Wood exploration in large areas or in some subject to special environmental interest;
- Urban Projects in large areas or in some subject to special environmental interest;
- Any activity use coal from vegetal sources in excess to ten tons a day.
- Canals and Harbour structures

The Environmental Impact Assessment must: I - evaluate all technological and location alternatives for the project including the possibility of non development; II - identify and evaluate systematically all environmental impacts taken place during the implementation and operation phases of the project; III – determine the project directly and indirectly affected area geographic boundaries subject to environmental aspects and impacts of the project (denominated project influence area); IV - consider governmental proposed pans and programs for the project influence area and their compatibility.

4.3 Environmental licenses

The Environmental License is an administrative act by which the environmental agency, establish conditions, restrictions and environmental control actions to be followed by companies and enterprises seeking construction, installation, addition and operation of projects and activities that which to use natural resources, with the potential to harm or affect the environment. The following construction activities demand licensing in Brazil:

- Highways, railroads, subways and waterways;
- Barrages and levees;
- Drainage channels;
- Water courses rectification;
- Opening of channels, enlargement of rivers
- Transposition of river basins;
- Other special works.

ENVIRONMENTAL LICENSING		
License type	**Characteristics**	**Validity**
Previous License Licença Prévia (LP)	•Preliminary or in the planning phase of the project • Approves localization and concept • Ensures environmental availability • Basic requisites and conditions to fulfill in further phases towards project implementation	**Minimum:** according to what was scheduled in the activity or project approved plans, programs and designs **Maximum:** 5 years
Operation License *“Licença de Operação (LO)”*	• Authorizes installation according to specifications from approved plans, programs and designs • Includes environmental control actions and conditions	**Minimum:** according to what was scheduled in the activity or project **Maximum:** 6 year
Installation License *“Licença de Instalação (LI)”*	• Verifies effective accomplishment of previous licenses, conditions and environmental control plans for the operation • Authorizes the activity or project operation	Should consider the environmental control plans **Minimum:** 4 years **Maximum:** 10 years

Table. 2 Brazilian environmental Licenses.

The Brazilian Environmental Criminal Law (Brazilian Federal Law 9.605/98) was an important mark that determined higher attention in licensing activities. It determines that “Build, restore, addition, install or operate, in any part of the country, establishments, construction sites or services potentially hazardous without license or authorization from environmental agencies or against the rules and regulations ins unlawful and is subject to imprisonment from one to six months and fine”.

5. A model for sustainability in the construction industry

The model presented here will apply for technical and economic issues, the major producing areas of waste. These regions represent large urban centers or may result from the formation of a conglomerate or consortium of adjacent municipalities, bringing together the legislation compatible.

Importantly, the current stage of the construction industry in Brazil, already in itself justify the existence of a rigid model of treatment and recovery of debris from the construction industry in all regions of the country This scenario will be aggravated and may even be become untenable, with the advent of achievement, in Brazil, Football World Cup in 2014 and the Olympics in 2016, when major works and demolitions have to be made, generating an abnormal amount of debris. Moreover, the practice of waste treatment of IC is very incipient in the country, and even negligible in the State of Rio de Janeiro, where he will focus the Olympic Games of 2016.

5.1 Principles of motion

Any model to be functional and efficient it has to rely on a set of interdependent and harmonious elements, rules and procedures. In the proposal in focus, we list the main points and actions that should be considered:

- Clear and comprehensive legislation - the recent National Policy on Solid Waste culminating in Brazil in August, 02 of 2010, is a great motivator to take seriously the treatment of waste from the construction industry. But, it is necessary that the state and local public authorities commensurate with their organic laws that policy, clearly and objectively, and promote a public-private partnership, to put into practice the recycling of construction debris in their areas of coverage ;
- Effective supervision - one of the major problems faced by municipalities is the illegal dump sites and on public roads, including transport companies themselves accredited. It is essential to pursuing a proactive surveillance for the balance of the process, using modern technology, such as control by GPS;
- Existence of incentives for products and services involved in the process - is important, for example, that recycled materials are treated with different taxes in relation to new products;
- Existence of penalties for violating a law by service providers and generators of rubble - the penalties should be meaningful in order to promote greater accountability of individuals and companies in the process of disposal of construction waste, in favor of environmental control and panorama of cities;
- Encouraging the use of modern techniques and methodologies for building large projects in order to reduce the debris - debris is often generated by deficiencies in the construction process, such as failures or omissions in the preparation of projects and their implementation, poor quality of materials employees, for losses in transport and storage, improper handling by the workforce, as well as replacement components for the reform or reconstruction. Improved management and control of works, use of modulation techniques and also joint work with companies and construction workers can help to alleviate this waste;
- The whole region should be provided with one or more treatment plants and waste processing, depending on the volume to be processed;
- Strategic location of collection points and disposal of debris (Ecopoints) for small and medium-sized generators of rubble;

- Area of Transshipment and Triage (ATT), which is the equivalent of an Eco Center for the receipt of large volumes of debris, from large generators;
- Location of areas of rubble landfill officials IC;
- Implementation of policies for environmental management and waste treatment in large generators, such as construction and demolition;
- Specialized transportation network;
- Educational campaign at all levels, including the population in general - is to clarify and encourage the integration of the self in the process.

5.2 Operational architecture model

The following Figure illustrates the components involved in the model for treatment of wastes from the construction industry, as well as the flow routing in each of the elements produced at each location.

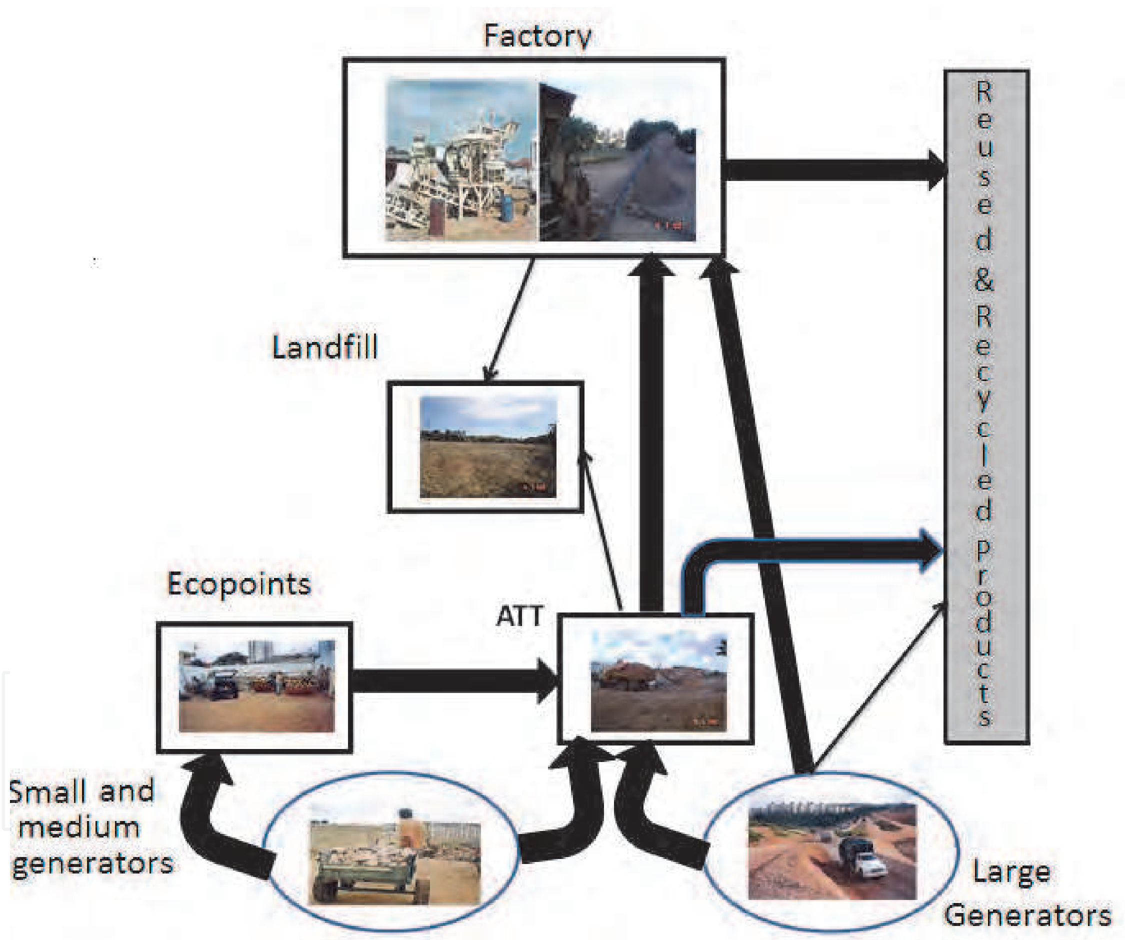

Fig. 2. Management architecture of the rubble IC

5.2.1 Small and medium generators of the debris of the IC and Ecopoints

According to the definition given in Resolution No. 307 of CONAMA, generators are individuals or entities responsible for activities or enterprises that produce construction waste. Constitute small and medium-sized generators, for example, construction projects and reforms implemented in commercial or residential units of small or medium size.

The existence and management of eco-points are essential for efficient control of collection of debris from construction, to avoid dropping these, irregular, illegal or inappropriate points.
Ecopoint sites are provided, usually by public authorities, waste disposal in a voluntary and free basis. They can be made simply by buckets, properly prepared by a land or a house, always located near point of generation potential, and easy access.
Figure 3 shows some examples of existing Ecopoints in the State of São Paulo.

Fig. 3. Ecopoint Bresser and Ecopoint Pinheiros

The process for using these services is simple: just take the waste from construction such as cement, bricks, tiles, plaster, wood and other debris from construction, Ecopoints. It is anticipated with the disposal of debris up to 1m ^{3} cubic volume per user per day, equivalent to roughly 25% of a bucket. If the construction or renovation generates a tremendous amount to be disposed of more than 200 liters, it will be needed to hire a company specialized in the collection services and transportation of debris.
As the debris in Ecopoints received, from small and medium generators are generally very impure, must be carefully separated, to be given the correct destination for each type of material found in them. Therefore, they should be compulsorily transferred to a triage area and Transshipment of Waste (TTA) for treatment.

5.2.2 Large generators of the debris of IC

Large debris generators generate over 1m ^{3} of waste from construction or demolition. Are those that require buckets to carry your trash. Usually they are responsible for construction and remodeling of large, for example contractors, builders and technicians responsible for works. The big generators are responsible for disposal of rubbish they generate. In such cases it is necessary to hire a transport company of construction waste.
In the case of buildings with more than 500m ^{2}, the generator must develop and deploy rubble in building site, a Waste Management Program of Construction and prove that the waste generated was disposed of in an environmentally correct.
The waste in construction site varies according to the execution phase of services. Much of the debris generated during the entire construction can be used as aggregate in various

stages of the building, considering, however, that the mineral fraction (cementitious material and ceramic) is the only one to be recycled and used on the construction, the other fractions as wood, metal, plaster, plastics and paper, should be directed to the appropriate local recycling or disposal of these materials, such as ATT's and Plants. Other components can even be sold or donated for reuse in the case of demolition, such as doors, windows, bathrooms and kitchens metals, etc.

Therefore, it is necessary to be aware of the entire site, followed by pre-established procedures for the use and destination of the waste. First you must establish debris generated separation: ceramic and cement, wood, contaminants, metals, plastics and paper, for example. Each fraction will have its place of deposit in the quarry. This separation plot is not complex, because the debris is generated by separate activities, such as the use of mortars have will only cementitious material and other activities on the debris will only generate carpentry wood. The non-recyclable rubbish is disposed off on site, while recyclable rubbish is processed subsequently disposed.

Fig. 4. Segregation of waste at the construction site

In large enterprises, it is sometimes advantageous and desirable that the machining is done on the construction work. In this case, for crushing are generally used small equipment, with an average production of about $2m^3$ per hour, with power and manual removal of the products. Equipment is simple and easy to use, where: mortar-mill, hammer mill, grinder or plaster jaw crusher.

Besides improvements on the environment, the management of recycling at construction site brings good economic advantages, such as:

- Reducing the volume of rubbish sent to ATT or plant, reducing the cost of removal;
- More organized and clean site;
- Reduced acquisition of aggregate material;

The large main emphasis is to recycle the rubble in the works is the financial aspect: do not waste material already paid and still be able to produce products with low costs are rather compelling reasons. As an example we have that the projected cost per cubic meter of mortar with recycled material is around U$ 36, while a cubic meter of conventional mortar is **US $ 62.00.**

5.2.3 Area overflow and waste segregation (ATT)

Transshipment Areas and Waste Sorting of Construction (ATT) are the premises for the receipt of bulky construction waste collected by private agents, which should be used for screening of incoming materials, processing and any subsequent removal for proper disposal. So are sites used for routing and segregation of waste for disposal.

ATT is typically a business that belongs to the autonomous initiative of collecting small businesses or cooperatives, and are deployed and operated by observing the law of municipal land use and occupation, as well as federal and state legislation to control environmental pollution when appropriate.

As these are areas, in the context of the proposed architecture, are administered by the private sector, generating jobs and revenues for receiving debris from the construction and sale of sorted waste, which could enable an effective overview for the efforts that are being developed in favor of a sustainable environment. This initiative is breaking old paradigms, showing that waste reduction can be combined with cost reduction, combining behavior change in various work to build partnerships with various vendors, abolishing the provision is irresponsible outlaws illegal boot through committed the allocation of each component of sorted waste, so that the responsibility to the environment that anchors the economic activity is exercised. The following picture illustrates an overview of the Transfer Area and Screening.

Fig. 5. ATT in the outskirts of Guarulhos in Sao Paulo

5.2.4 Landfills of waste places

In most cases, the debris is removed and disposed of the work clandestinely in places like vacant lots, riverbanks and streets of the suburbs. The social and environmental cost of this is beyond the control of the calculations, although its consequences are permanently noted. We can see the deterioration of quality of life in urban areas such as transport, flood, visual pollution, proliferation of disease vectors, among others. One way or another, the whole society suffers from the uneven deposition of debris.

The debris is residue from a large volume, occupying so much space in landfills, transportation, depending not only on volume but the weight, it becomes expensive. Recycling and reuse of rubble are therefore of fundamental importance for the control and mitigation of environmental problems caused by the generation of waste.

The existence of authorized local landfill dump in the context of this proposal is due to the fact that some debris from work, or certain residues after machining or segregation from the rubble at the ATT, is not be recovered. Have to be discarded, and this time it is important that they are received at licensed sites and specific for this purpose.

The landfill is now the most widely used solution for its ease of implementation and others. But still has a very high environmental cost, and some administrators end up not respecting the rules or find other alternatives. When implementing the standards are not met, the sanitary landfill is no longer and begins to set up the so-called dump.

A plausible alternative is the separation of waste into inert and non-polluting material (domestic waste, commercial, industrial and hospital) and material (waste derived from construction). This alternative, while reducing costs, since the landfill for inert material is cheaper than landfill, allows it to be used mainly in projects that address the reuse and recycling of such materials. This idea becomes valid once the aggregates are a major source of raw material at a relatively low cost.

Fig. 6. Landfill construction debris (Hall BH)

5.2.5 Treatment plants and processing waste IC

In the current global context is essential to improve the construction processes. However, recycling of rubbish comes as a solution to the materials that are inevitably lost. Recycling allows the reuse of raw materials, reducing the demand for more material, reducing energy consumption and protecting the environment more and more waste, which would take millions of years to be decomposed by nature. Recycling becomes disordered the mountains of building materials, piles of raw material, which serves both as building works for public works. There are two ways to turn losses into profits: one for the private sector and another for local governments.

The process of recycling the rubble for obtaining aggregates basically involves the selection of recyclable materials from rubbish and grinding in their proper equipment. The screening phase of an ATT must proceed independently or integrated into the processing plant.

The recycling of rubble can be done at facilities with different characteristics for equipment used which may be mobile or fixed.

Fig. 7. Plant equipment: a set vibrating feeder jaw crusher + + belt

5.2.6 Logistics of moving the rubble

The debris generated by small works must necessarily be disposed in Ecopoints. Therefore, their transport should be done by an independent group of carriers, using vehicles intended for freight, cars and even wheelbarrows. Optionally, the service of withdrawal of small volumes of debris generated in small works may be offered by the city. In this case, the municipality may dismiss them Ecopoint a neighbor, or even carry an ATT.

The transportation of debris from the ecopoint, should be done by the municipality or by an outside company for her. Should be discarded in an ATT, because it is a very heterogeneous rubble.

For works of medium sized businesses that generate significant amounts of debris, transport must be hired by the generator, companies accredited by the Government, working with the transport of rubble multi cranes using trucks and dumpsters. In this case, the debris must be disposed directly in ATT, because it is a dump, as a rule, heterogeneous, with a disposal cost based on volume, the carrier paid to ATT.

In large constructions and demolitions, debris intended for disposal should be conducted at a plant where have characteristics suitable for recycling at no cost by the receiving plant. When the debris is heterogeneous, an ATT should be discarded with the burden of the cost of disposal by the generator.

The transfer of rubble in an ATT and screened for the disposal shall be transported to a recycling plant to the landfill or dump, depending on their character, on behalf of the Government, that you can do so directly or through third party service .

The waste is not usable in a plant should be discarded in a landfill dump, under the responsibility of the plant.

6. Validation of the model

The economic infeasibility of a CDR of recycling is often a logistical problem results mainly from the high cost of collection and transportation arising from the existence of many points of consumption and few points of waste recovery.

The main objective of the recycling center regardless of whether a, private or public, is to diminish the distance between the product and its potential buyers. Consequently, this reduces the environmental and economic impacts arising from that transport.

Efforts can be properly rewarded by the possibilities of raw material savings - as demonstrated in the analysis of economic viability, partnership with large generators, acting responsibly towards the environment and differential image in the marketplace.

The simulations of economic viability analysis proved that, currently, there are conditions for the economic viability of waste recycling of ICC.

The most appropriate model is the one that would establish co-responsibility, including environmental liabilities, among the managers of plants and ATT, waste generators and transporters. The manufacturer must develop, together with research institutions, appropriate disposal options and the developer must ensure that the flow of waste will be properly addressed to the appropriate places.

7. Conclusions

Government agencies need to establish laws, which define:

- Responsibilities and joint responsibilities of each agent on the management of RCD;
- Forms of surveillance and punishment of its fulfillment;
- A ban on the disposal of certain wastes at landfills, especially those based on plaster;
- Tax on the disposal of certain wastes at landfills;
- Tax on the purchase of certain products that generate waste disposal difficult to manage and / or high negative environmental impact;
- Subsidies for the implementation and operation of recycling plants;
- Minimum and maximum indices of recycled content in certain products;
- The environmental certification of products.

Trade unions should organize their members assisting in the dissemination studies and awareness of environmental responsibility and sustainable construction. The academy needs to develop knowledge about, especially the technical restrictions and new applications of the RCD.

Consumers of recycled products shall also assist in establishing clear and objective specifications and minimum quality and performance required for their consumption.

Despite growing concern for companies of ICC in relation to environmental sustainability, few initiatives have been taken. This finding is confirmed in the case of manufacturers who have a low involvement with respect to the disposal of waste solutions from the works, without taking into account that the generators and transporters do not show any commitment to proper disposal.

It appears that manufacturers should encourage and support the research and take more active role in finding solutions and provision of recycling and take the RCD in a vertical process. This position might provide a differential in the relationship with customers, in particular the construction companies, with more active role in the searching of appropriate solutions for the allocation, since they are the manufacturers who have greater knowledge about the product.

Builders, distributors, installers and ATT should consolidate the processes of performing sorting and packaging accurately and hiring only suitable transport. They may also, through its purchasing power, pressuring suppliers to find solutions for allocation.

Transport, in turn, must meet the stock of transport and disposal under the laws, and even agents of change in the behavior of generators. Finally, everyone needs to establish information system and effective communication between them.

The establishment of reverse supply chain is subject to a strong cooperation between agents, which should be strategically aligned and have a shared vision and holistic environment in which they live, and census of all responsibilities on product life.

We noted also that the consolidation of reverse logistics is a progressive and interdependent relationship between the suppliers and contractors. Efforts of a single side (agent) or scattered efforts tend to produce mediocre results and consequently no spread of its principles.

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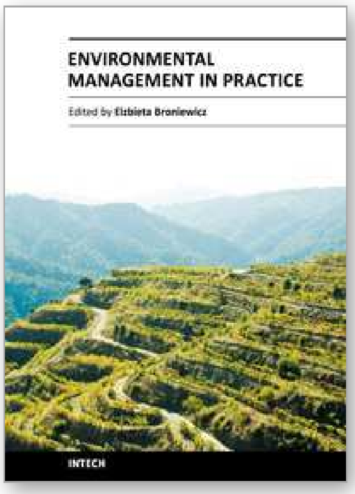

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In recent years the topic of environmental management has become very common. In sustainable development conditions, central and local governments much more often notice the need of acting in ways that diminish negative impact on environment. Environmental management may take place on many different levels - starting from global level, e.g. climate changes, through national and regional level (environmental policy) and ending on micro level. This publication shows many examples of environmental management. The diversity of presented aspects within environmental management and approaching the subject from the perspective of various countries contributes greatly to the development of environmental management field of research.