Environmental performance of Brazilian general contractors: an overview

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Abstract

This article intends to show the stage of development of Brazilian general contractors, according to the environmental influences of the activities processed on-site, and also organisations' behaviour concerning them. This paper describes the results of an applied questionnaire and some contractors' considerations presented on national and local meetings that have taken place during the author's ongoing research named "Study of environmental management systems' applicability on building contractors". It was found that some Brazilian contractors have shown concern on these issues and have made some advances. However, most of them are not aware, and will remain as that until an external factor pushes them to change.

Keywords

Environmental performance; building contractors; environmental aspects; environmental impacts; environmental management system.

1 Introduction and methodology

The inefficiency of the usual model of development practised by industries all over these years, regarding the environment, is a matter of fact. Their behaviour is currently questioned because the environment must cease to be considered as an endless provider, and it cannot absorb all the waste generated by economic activities. This is also true to construction industry, where organisations are more and more obliged to remain competitive while being sustainable.

In this context, the analysis of the Brazilian general contractors' behaviour appears as an important point to be discussed and is the major objective of this article. Their activities, and also their products, interact with the environment in many different ways. This article considers their major negative environmental interferences, pointing that there are already solutions available to control and to minimise them.

Another point that justifies the necessity to take an overview on Brazilian contractors' environmental performance is the tendency of increasing regulatory demands and financing programs restrictions, in this country.

This article focuses on the environmental aspects of contractors' on-site activities[1], describing them and also the existent pressures to control them.

The contractors' environmental performance analysis results of an investigation concerning two general contractors. The data were obtained throughout an applied questionnaire and considering, also, other contractors' deliberations presented on national and local meetings that have taken place during the author's ongoing research named "Study of environmental management systems' applicability on building contractors".

The questionnaire contemplates the aspects suggested by the ISO 14004 "Environmental management systems – General guidelines on principles, systems and supporting techniques" and probes contractors' existing environmental practices, including their difficulties when attempting them. It also contemplates their performance and maintenance of quality aspects, including documentation, internal communication, legal and other requirements, thus evaluating contractors' basis in case of a potential integrated management system implementation.

The two investigated contractors were chosen as their management system can be considered as "good practices" and they already consider the environmental issues. Contractor A builds non-residential buildings, works in many Brazilian states and has international companies as clients. Contractor B has 5 ongoing construction sites in Sao Paulo and works mostly with residential buildings.

Finally, the information presented here, as well as the conclusions which we can withdraw, concern the Brazilian reality; nevertheless, some of them can be extrapolated to other countries.

2 Environmental aspects of contractors' on-site activities

Contractors' activities developed on sites may cause many environmental interference such as: generation of solid and liquid residuals; consumption of non-renewable natural resources; removal of the vegetation (erosion); generation of noise and vibration; sedimentation of storm sewer or receiving streams; air pollution with dust and particulate matter; wasting of materials, water and energy; inadequate disposal of residuals; disposal of renewable sources; interference on the hydraulic and drain systems.

Among these environmental interference, the large volume of solid residuals disposed on urban environment and the large consumption of natural resources are the most relevant ones and that must initially be taken into account. The interference related to harmful effects like noise and pollution represent a second level of requirements, and they were not treated here. Nor either the aspects related to the water and energy consumption during the construction phase.

[1] The design and planning considerations that can influence the buildings' environmental performance as a product were treated on Degani & Cardoso (2002).

2.1 Solid residual generation

The large amount of solid residuals that have been generated and disposed on the urban environment is the heaviest negative environmental aspect of civil construction activities concerning the construction phase. The characteristics of materials and the applicability processes lead to the occurrence of loss - especially the share that comes from waste. In Brazil, Andrade *et al.* (2001) consider that the residuals generated on building sites represent approximately 5 percent of the finished building, concerning mass.

A list of environmental impacts of the incorrect disposal of construction and demolition residuals on the Brazilian urban environment can be found in Pinto (1999). The author considers as impacts from soil pollution to fuel burning occurred on their transportation to landfills.

These wastes are composed by materials coming from different sources, presenting different characteristics that may cause, also, different impacts on the environment. Despite that heterogeneity, it is noted that their components have great value as aggregates and good mechanical strength, being therefore potential sources for recycled material (Brito Filho, 1999). Pinto (1999) affirms that most of them are composed by recyclable portions and Agopyan (1998) believes that the civil construction sector can absorb almost all of the residuals produced.

Minimising residuals and managing them are the exact points to be under control on the site's environmental management. It is expected that building organisations recognise their stuff being in surplus and the techniques available in order to achieve rationality on the usage of non-renewable sources and other applications for renewable ones.

2.2 Consumption of natural resources

The physical dimensions and the large amount of products produced by contractors, and also the fact that most of the employed materials come from natural resources, makes their consumption another important environmental aspect that must be considered in order to achieve a good environmental performance.

The main environmental impacts that come from the extraction of natural resources concern the exhaustion of the natural resources and the ecological and bio-diversity changes nearby. As it becomes difficult to reduce the volume of materials applied on buildings - except through an efficient waste control - the tendency turns to be selecting the ones that: (a) came from renewable sources; (b) are composed by renewed components; (c) are non-toxic; (d) are extracted under an environmental-concerned methodology; (e) can be recycled, or reused, as a construction material or in some other way; and (f) can be easily monitored during its application, thus avoiding waste.

Even if materials are chosen during the conception phase, contractors should influence the project's specifications. They can join designers during conception or they can propose alternatives during construction, involving new materials and technologies, which can be accepted by the owners.

3 External pressures

Most countries' regulations do not require formal and comprehensive environmental management structures. The same happens in Brazil, where there are a few regulatory demands pushing contractors to move towards sustainability.

Regarding environmental performance, the Brazilian federal law only requires the EIA / RIMA (environmental impact analysis / environmental impact report) and some periodical reports. However, these documents, required by environmental licensing processes, are only applied on those buildings that may significantly modify the environment, such as urban projects of over then 100 hectares and buildings that will be built on natural resource areas, and on heavy construction projects (roads, tunnels, harbours, airports, etc.)[2], where the environmental impacts are quite evident.

It is expected that, in 2003, the CONAMA's resolution #307 could change this scenario. Its proposition aims at putting contractors in charge of their residuals management, which includes characterising, selection, transportation, storage and final disposal, and also to bring to state authorities the responsibility to assure adequate areas to disposal and screening of residuals. That proposition is similar to the one required by PBQP-H[3].

The *Política Nacional de Resíduos Sólidos* is another important instrument to manage residuals. This project is trammelling on the Brazilian Congress and may reinforce the CONAMA's role - although it focuses on solids residual management in general.

Financing programs, mainly using international founds, require more and more an environmental approach of projects. Procurements tend to oblige the presentation of studies concerning project's impacts and the solutions to minimise them.

The results coming from the most important Brazilian's research centres and institutional and private organisations create another external pressure: the known data show how far the contractors' management practices are from the best ones. They are now a reference to contractors in terms of acting efficiently to the environmental issues. The research on recycling and waste reduction matters deserve to be mentioned as the most relevant ones. According to Angulo (2000) the current researches concerning the sustainable development of building construction foster: i) minimisation of waste; ii) improvement on the quality of industrial products; iii) recycling of residuals by re-using construction residuals and other industrial residuals that could also be used in construction; iv) sustainable development focused on project designs; v) increase on the durability of components.

Finally, it is important to mention the existing movement[4] focused on the environmental performance of the contractors' activities and based on environmental assessment methods; they are beginning to influence the Brazilian construction sector. The United States Green Building Council (USGBC) is an example, the LEED™ Green Building Rating System, also adopted in Canada. The Eco-Homes – The Environmental Rating for Homes, from UK, is another example. These assessment methods, as well as similar ones that have been implemented on other countries like Spain, Japan and Austria, are specially based on the Green Building Challenge (GBC) international building environmental assessment tool. They promote the 'building green' philosophy and stimulate the use of recyclable products and environmentally well-fitted projects,

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[2] According to CONAMA resolution # 001/86.

[3] *"Programa Brasileiro da Qualidade e Produtividade do Habitat"*. A federal program that aims to disseminate nation-wide well-succeed civil construction experiments on quality issues. It is a reference oriented to contractors' certification.

[4] Additional data can be found on the United States Green Building Council's home-page; Green Building Resource Guide; Greenbuilder; OIKOS Green Building Source; and other websites. There is also software containing materials data, sources to energy-efficient buildings and tools to assess their environmental performance.

while observing their economic viability and their adaptation to the local community. Another example is the French environmental assessment method, to be applied on educational, commercial and offices buildings and hotels (CSTB, 2002).

4 Contractors' environmental performance

This item presents an overview of two Brazilian general contractors' behaviour regarding the environmental influences of their on-site activities. The information presented here also consider other contractors' deliberations presented at national and local meetings that have taken place during the author's ongoing research. (The full report of these research can be found at Degani (2003)).

4.1 Awareness

The initiative for environmental approaches should come from contractors' awareness and go through to the anticipation for the new requirements that they expect to impact their practices as a market differential.

A genuine case of contractors' awareness is that of contractor A. They have implemented an environmental management system based on the ISO 14001 requirements, already known by the whole staff, which aims to standardise their actions and guarantee their continued improvement on the minimisation of negative environmental impacts. Nowadays they see their system as an advance and a differential, although they do not apply for an ISO certificate.

In their opinion a certificate will not aggregate significant value, once they already have an excellent image for their clients and society, derived from the quality of their products and services, and mostly by their commitment to fulfil clients' needs.

Contractor A does not have major difficulties to implement their environmental management system, as their routine was already aware of environmental issues. Their management system was already used to hearing from customers and other interested parties. And also, they were familiar with the EIA/RIMA analysis, despite the dimension and location of some of their projects.

However, most contractors are not aware of the environmental issues, until some other factor pushes them. Contractors with an ISO 9001/9002 quality management system and also the level A's at SiQ-C (PBQP-H) seem to be the first ones to become part of the 'awareness team'. That may occur due to some factors: (a) the international standard asks for a complete revision of applied regulatory requirements, revealing the need to approach occupational health, safety and residuals management issues; (b) they already have a formed management system and they know how to achieve and measure their performance through it, and also its benefits; (c) they need to be competitive and focused on costs, market and image; (d) there is real awareness.

Contractor B, an ISO 9002 certified, affirmed that they are trying to fit to the market tendencies and to the legal restrictions that start to emerge. Because of that, many other certified contractors have started, first, to fit their processes and activities to the safe and occupational health issue, and then they intend to gradually introduce environmental practices – so that they will have an integrated management system.

Unlike contractor A, those contractors think that a certified management system aggregates value, by formalising their commitment and ensuring their continued improvement – once they are periodically submitted to external audits.

4.2 Construction waste management

The construction companies that have environmental practices are usually the ones that already have some kind of management system – usually a quality management system. For these Brazilian contractors, residual aware issues are usually solved by controlling their execution processes and their disposal. The execution control aims at reducing loss and waste, and their residual management covers: screening, looking for markets for residuals, and controlling the destination of residuals – which can be done by checking the area where the residuals will be disposed by contracted collectors. The aforementioned solutions are not yet formally documented, nor are they properly implemented on all of those contractors' sites.

The measurement of the volume of residuals generated per activity or service is not yet well known either by the contractors interviewed or by the ones that had been contacted during the research period. Although some of them are already planning to do that and look for buyers or even some firm that could collect them if sorted on sites. Contractor A has mentioned that they started to quantify their residuals in three sites according to their classification as contaminant, non-contaminant recyclable and non-contaminant non-recyclable.

In addition, contractor A keeps a list of their residuals, classified according to the presence of contaminants, and including each disposal practice - which may vary in each Municipality's given support. They mention that they do a residual screening according their own classification, but they only know theoretically where their residuals are disposed by collectors. Contractor A intends to implement selective collection also in their office administration, but doing themselves the screening and the disposal.

Other residual-related practices that start to be seen on sites are: washing of vehicles' tires driven inside sites, to avoid dirtying the public ways; and using their residuals on the site itself on counterfloors, fillings and on the infrastructure of the site itself[5].

4.3 Consumption of natural resources

The evaluation of suppliers is also a routine implemented by all the contractors that have a quality management system. So, the adoption of principles on selecting the sources from which material will be bought could be easily included on their selective and evaluate process, but that has not been done. The cost of the new technologies and materials still counts more than their environmental aspects.

Contractor A's supplier department has started to include environmental requirements such as giving preference to wood coming from reforestation and, where it is possible, trying to substitute some materials.

Apart from that, the main point related to the consumption of natural resources that has to be highlighted is the necessity to involve designers. Most impacts observed during a building's whole lifecycle are defined in the design phase, but so far the awareness of architectural designers is limited to minimising or even compensating suppression of vegetation. Despite the fact that installation designers have already started to consider, in their projects, the necessity to minimise water and energy consumption and some aspects of maintenance and durability are still present.

[5] Re-using of residual at some sites is cited in Grigoli (2001).

4.4 Other environmental practices

We can also mention other environmental practices - although observed at only a few contractors – such as: (a) training to minimise water and energy waste – although much more in order to reduce costs and in attendance of federal saving programs than due to proper environmental concern; (b) monitoring vehicle gas emissions during delivery of products; (c) monitoring deliveries to avoid materials damage and spilling on public ways; (d) adoption of some features to minimise particulate emissions, such as sprinkling the outdoor storage of materials or sprinkling the dry soil; (e) conducting noise measurements and establishing time schedules through agreements with the neighbourhood; (f) having efficient means of communication with the community and the neighbourhood; (g) controlling the storage of materials in order to avoid loss and dispersion of particles; (h) maintaining the site in good hygiene and safety conditions; (i) avoiding excessive suppression of vegetation.

More specifically the contractor A has: (a) procedures to identify the impact of the project on the environment during the construction phase (this practice is conducted for each individual project and performed by that project's specified technical team); (b) periodic reports that illustrate the environmental aspects and solutions implemented on the sites; (c) a routine to measure the significant environmental aspects on plants.

Still concerning contractor A, which has an environmental management system (EMS) implemented, there are some relevant facts to mention regarding its implementation: (a) there were hired consultants to guide the implementation and they were responsible to identify contractor A's environmental aspects and applicable regulatory requirements; (b) there was no need to hire additional personnel and neither to create a specific sector; all of the new practices were attributed to the existent functions; (c) no additional costs were necessary to implement their EMS, the only relevant expense was with consultants' assistance; (d) the first EMS presentation to suppliers was done by the directors themselves .

Concerning responsibilities, still on contractor A's system: (a) monitoring the EMS on sites must be done by the safety engineer or technician; (b) all the training and audits are made under the supervision of human resources department; (c) the technical teams of each site are responsible to issue a monthly environmental report; (d) for each new project, the assigned technical team has the responsibility to identify the significant environmental aspects and impacts.

4.5 Difficulties

Brazilian contractors have pointed out some difficulties concerning the implementation of positive environmental actions. Considering residuals, they argue that selecting their residuals on sites is not easy because the supply chain is not well developed in Brazil: is difficult to find someone who could collect, screen, store, recycle and then commercialise recycled products. Most Municipalities do not subsidise those activities and there is no place for residuals storage on sites.

Taking care and being responsible for the final destination of residuals is also not easily achieved, since there are just a few reliable residual removers that actually dispose them on licensed areas. Even the Municipalities could not offer regular disposable areas and the existent ones are usually far from collection points.

Another difficulty is to measure the volume of residuals generated by each service developed on site, in order to commit subcontractors. That knowledge could lead to the

weak points where the preventive actions should be applied, in order to reduce materials waste.

Concerning the consumption of natural resources, its reduction is related to the substitution of materials and techniques used on-site. The difficulties arise from the fact that selecting materials and techniques is conditioned to the project and to whom is going to pay for a possible additional cost.

Another difficulty pointed out as something that needs improvement is service suppliers' culture. They do not yet easily accept new practices. According to contractor B, the hardest target to achieve may be making their service suppliers' personnel aware with environmental issues.

It seems also an obstacle the poor knowledge of the necessary expenses that an EMS requires.

4.6 Performance of contractors' existing management systems

Contractors who own effective management systems already have some records showing that it is necessary to monitor their environmental aspects and also customers' and neighbourhood demands. Contractor B has recorded neighbourhood complaints related to noise and vibration, and some other information related to building environmental performance - provided in their post-occupation assessments.

Some contractors already mention environmental preoccupations on their policies, although they do not yet include them on their established objectives and targets, nor on their specific programmes.

Regarding training, it is already a part of some contractors' routine. They are also planning to include the environmental education on their planning scheme.

Regarding communication, at the investigated contractors, the information flows through their records: nonconformities; improvement evidences; feedback provided by clients and users; and other. However, their dissemination to all of the staff involved is not yet assured, being sometimes restricted to top management reviews. In addition, their external communication is not standardised, except for their post-occupation assistance.

The information related to environmental aspects does not appear on the contractor's systems records. They are not yet included on their monitoring and inspection checking-list.

A deficiency noted on some Brazilian general contractors management systems, which may affect the environment, is the absence of documented procedures related to the identification of potential emergency situations, as fires or collapsing for example. Another deficiency found on sites is that these contractors have good storage identification signs but do not have features to prevent leaking and spilling.

The interviewed contractors have effective operation of their management systems and have started working on their revision. While filling the requirements of the 2000 version of ISO 9001, they are also achieving some ISO 14001 requirements.

The necessity to minimise environmental effects of contractor activities is evidenced when contractors try to guarantee conformity to applicable regulatory demands. Because of that, some contractors first add safety and occupational health procedures – according to the Brazilian rule concerning safety and occupational health on sites, NR 18, and the OHSAS 18001 specification – thus showing the belief on integrated management systems. Relating to CONAMA # 307 resolution and to the *Política*

Nacional de Resíduos Sólidos, they know them, but they are still waiting for their publication and their impacts on the supply chain and the competitors' actions.

It is also important to mention that there are still many certified contractors who have broken their policies' commitment or that do not know the essence of a management system to enhance their activities and results. For those, introducing environmental practices may work partially on some sites, but not in a standardised and continued fashion, as it is desired.

5 Conclusions

In Brazil, the most relevant environmental aspects, as a consequence of contractors' activities on sites, are the large volume of solid residuals disposed on urban environment and the large consumption of natural resources. Some Brazilian contractors have shown concern on these issues and have made some advances to reduce their interference. However, most of them are not aware of this and will remain as that until an external factor pushes them to change.

ISO 9001/9002 certified contractors seem to be the first ones to become part of the 'awareness team'. For those Brazilian contractors, the residue issue is usually solved by controlling the execution processes and the residual disposal, although their environmental practices are not yet formally documented, nor properly implemented on all of those contractors' sites.

Also considering residuals, Brazilian contractors complain that the supply chain is not able to take care of site residuals. Most Brazilian Municipalities do not subsidise the related activities. Another difficulty presented by Brazilian contractors is taking care and being responsible for the final destination of their residuals, since there are only a few reliable residuals removers that actually dispose on the licensed areas – even there are few regular disposable areas offered and they are usually far from the collect points.

Concerning the consumption of natural resources, there are a few Brazilian contractors that are trying to substitute materials and techniques. The difficulties arise from the fact that their selection is conditioned to the project and to who is going to pay for a possible additional cost.

Making their service suppliers' personnel aware of environmental issues is also a target that is hard to achieve, according to Brazilian contractors, and also, the ignorance of the necessary expenses that an EMS requires.

The description of Brazilian contractors' behaviour presented in this article leads to the following classification of contractors:

1. aware contractors that have already implemented some pro-environment practices, but still have difficulties due to the lack of support by Municipality and designers;
2. contractors that have an efficient quality management system implemented, certified or not, that have seen the feasibility to include environmental practices in their existent systems, and also their worthy market contribution; however they have begun by responding to ISO 9001:2000 requirements and to safety and occupational health issues, and they later intend to focus on environmental matters;
3. contractors that are waiting for the new environmental legal requirements to come into force, and to be rigidly supervised, before they start to act;

4. contractors, certified or not, that have broken their policies' commitment or that do not know the essence of a management system in order to enhance their activities and results; for those, introducing environmental practices may work partially on some sites but not in a standardised or continual fashion as it is desired.

It is expected that the legal requirements oriented to Municipalities' commitment, and also the suppliers and designers' environmental awareness, could provide a better scenario to stimulate contractors' action towards sustainability.

Contractors, who have effective operation of their management systems and have benefited from them, are already structured to add environmentally good practices. The tendency seems to be integrating the environmental practices into the existent ones.

Because sustainable development and attitudes aimed at minimising environmental impacts and maximising environmental performance are now a tendency and soon will become a demand by stakeholders, contractors should anticipate them.

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