

Voluntary building certification schemes in São Paulo

Strengthening the LEED certification process for existing buildings

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Abstract

The building sector is one that can be accounted for numerous impacts on the environment, both by extremely high consumption of resources, and by emitting green house gases to the atmosphere on a large scale. Retrofitting existing buildings tackles energetic and emission related issues and one way to go about such projects is through the process of high-performance building certification, within which the Leadership in Energy and Environmental Design (LEED) scheme is establishing itself as the trend to follow. Although LEED certification is now a worldwide common practice, its regional adaptation is still debatable and the opportunity to further strengthen the voluntary scheme is then possible.

LEED's adaptation to the Brazilian reality is already an undergoing process, nevertheless only at the criteria level, thus leaving unattended the entire application process and tools that follow. As such, for this study a research structure was developed, which has its pillars on the perception that retrofitting project owners/managers have on different decision-making factors, the four tiers – Operations & Maintenance, Productivity, Corporate Image, Environment & Economy. Through this approach it is possible to identify areas in which LEED's application process can be strengthened, in the Brazilian context, as well as allowing two distinct projects – one LEED certified and one unregistered – to come side-by-side in order to identify similarities between them.

From the performed analysis it was possible to identify several issues. Amongst them is the fact that between two distinct projects, the perception of the proposed aspects is relatively the same. Additionally, from the analysis of the available voluntary schemes it was possible to identify tools and processes that hold the potential to have a positive impact on LEED projects, both on project itself and on the overall certification scheme. At the same time, in regard to the unregistered project, it is concluded that there is room for taking in procedures from the available certification systems in order to consolidate practices.

Keywords: High-performance buildings; certification; application process; LEED; São Paulo

Executive Summary

The **building sector** is accountable for a great part of all emissions of greenhouse gases in the world while at the same time being very resource intensive (Khasreen, Banfill, & Menzies, 2009). Still, it is a sector that has high potential for in coming years to make a turn in a direction that will allow the sector to grow in accordance to the current, and future, environmental reality (IEA, 2011).

Retrofitting projects applied to already existing buildings is one of the possible manners to tackle such issues related to the sector. One of the ways to go about retrofitting existing buildings is through the **certification** of the building itself. As is pointed out by a report prepared by Pike Research LLC (2010) the total spaces around the world opting for certification have been growing and are expected to continue doing so in coming years.

Leadership in Energy and Environmental Design is the certification system with most expression in the city of São Paulo and throughout Brazil, nevertheless the debate on whether its adaptation to the country – having in mind that it was developed for the North American reality – is the correct one (Albrecht, Griffith, & Carvalho, 2009; Librelotto, 2010; SINDUSCON, 2011).

It is then important to assess in which manner can tools and features from other existing voluntary building certification systems be used in order to strengthen the above mentioned tool (SINDUSCON, 2011; Fonseca, 2009). As such the aim of the thesis is to answer to following research questions:

RQ1: How can LEED EB in Brazil be strengthened, by means of integrating features from other voluntary certification schemes?

RQ2: How can non-registered projects – in Brazil – benefit from using available building certification schemes to achieve higher performance levels?

In order to attempt to answer these questions, the **scope** is set to encompass the city of São Paulo, as this is one of the major cities in Brazil and one of the biggest in the world. At the same time the decision was to include in the research solely existing office space buildings, and certification schemes that could be adopted by the owners of such edifications. As such, the main **audience** the thesis is addressing are the building owners/managers, but it is acknowledged that the research and learnings from this exercise can also be valuable to certification schemes promoters and academia as well as current office space buildings' tenants and tenants-to-be.

The use, within the designed research structure, of an adapted **framework** first used by Johnson (2000) allowed for a good overview of the perception that building owners/managers have on the costs and benefits of the four tiers addressed in the framework – Operations and Maintenance, Productivity, Corporate Image, Environment and Economy. All these four tiers have a potential impact in decision-making within the sector, still it is acknowledged that from tier 1 to tier 4, Operations and Maintenance to Environment and Economy respectively, it gets harder to be able to pinpoint the actual costs and benefits that can be derived.

As to gather data, several **research methods** were applied such as interviews, literature reviews and data analysis. In respect to the conducted interviews, they were all in-depth interviews as they were thought to be able to produce data that otherwise would not be possible, and also they were mostly presential in the city of São Paulo. The literature reviews – on the current state of the real estate market in the city of São Paulo and also the existing

policy measures applicable to the sector – were conducted having in mind the topic at hand and the proposed research questions as they were thought to be of great importance to the aim of the thesis (Johnson, 2000).

At the time of the development of the thesis, the **real estate in São Paulo** – one of the cities in the world constructing most office space buildings (UK Trade & Investment, 2010) with emissions and resource consumption that mirror the world's sector situation – was passing by a time of scarcity in terms of available office spaces, and rent values were reaching very high figures. The lack of space to build in locations that are considered to be of great value – Faria Lima, Avenida Paulista, Itaim – is pushing building owners towards retrofitting already existing buildings.

Both the Brazilian government and the state government are keeping up, and driving, the demands that need to be requested to the building sector, as such there are several **policy measures** – regulatory and informative – either dedicated solely for the building sector or more general in scope. The information on these policy measures is of public knowledge as they can be consulted either by assessing government websites or by making use of several governmental or non-governmental information campaigns. These campaigns are of the sector's knowledge and are appreciated for their capability to synthesise all the relevant applicable policies in one single space, thus allowing for easy consulting.

Important to refer is the growing presence of **voluntary measures**, such as the ones this thesis dedicates itself to, directed to the building sector. Examples of such measures are: 1) Leadership in Energy and Environmental Design, 2) Alta Qualidade Ambiental and 3) Selo Casa Azul. The first was introduced in the country by the Brazilian Green Building Council, the second is was adapted to the Brazilian reality from the French Haute Qualité Environnementale certification system, by the Fundação Vanzolini. Finally the last, third, measure was fully developed in Brazil by Caixa Econômica Federal.

Voluntary measures as the ones above are known for having a few **drawbacks and benefits**. Amongst the benefits is the ease of use of such certification systems that address sustainability issues in a manner much broader than one single regulatory or economic policy measure could. This reason is also considered to be one of the downfalls of the systems (Gomes, 2008). It is also recognised, even though with little support, that such systems can eventually lead to economic benefits for the party involved in the certification process (Valente, 2009). The **voluntary measures presented above differ** in terms of their project applicability, application process, tools, criteria, but are all directed at improving the state of the building sector.

The São Paulo Business Centre and the Administrative Complex Rio Negro were the analysed projects. Being that the latter one represents a certified building project, while the first one stands for an unregistered building project. They are both office space buildings, which also have in their complexes space for convenience shops and also are proportionally comparable in size. One of the differences between both, apart from the certification, is the age of the buildings as São Paulo Business Centre is from the late 70's and the certified case from the first decade of this century.

While performing the analysis of the gathered data it was noticeable that **both projects owners/managers shared almost the same perceptions of costs and benefits** on all four tiers. An example of such agreement is the identification of marketing and retrofitting as a combination that cannot stop working together. One further example of similar perception in both the LEED certified project and the unregistered projects is related to the

acknowledgement that tenant perception – its understanding and involvement in the overall project – is of great importance for the success of retrofitting projects.

One of the conclusions from this thesis, and prior to answering to the proposed research questions, is the fact that choosing **which building certification scheme to engage** is not a straightforward process. It was possible to notice contradictions in relation to the referred motives behind the decision to start a certification process, thus influencing the choice of certification scheme, which is performed at times without consulting all the available options.

LEED projects in Brazil are definitely leading the way in terms of registered and certified projects, nevertheless, it was concluded that such certification system has room for improvement. Integration in its application process features from both Alta Qualidade Ambiental and Selo Casa Azul, such as including a requirement to **conduct social and environmental assessments** before choosing which criteria to engage, opens up possibilities in terms of strengthening LEED. By mirroring, both Alta Qualidade Ambiental and Selo Casa Azul, LEED also has the potential to improve if change comes to the proposed criteria, not in the criteria itself, but in the need to address them or not. In other words, introducing **criteria** that are now voluntary as being mandatory can also prove to enhance the effectiveness of the tool.

Unlike LEED, both the Alta Qualidade Ambiental and Selo Casa Azul, make use of an approach that is similar to that inherent to environmental management systems, the **Plan, Do, Check, Act loop**. It was recognised that introducing such an approach to LEED, has the potential to bring benefits to all involved in certified retrofitting project.

In respect to the second proposed research question, it was concluded that there is **the opportunity for unregistered projects to benefit** from taking in features and tools from certification schemes, even in cases where a dynamic Operations and Maintenance department, led by an environmental champion, is already performing splendidly. Adopting a set of criteria, and consequent guidelines, to be tackled in the retrofitting projects, would allow such projects to better be compared to certified ones while permitting a more complete, and tailored, approach to its retrofitting projects.

The thesis author proposes several **recommendations** for further research. This is related to several findings and conclusions drawn, as is the issue of **multi-tenancy**, as such it is important to develop in the future, certification schemes that are able either to solve or work their way around such difficulties. One further recommendation is related with **the role of the Green Building Council Brazil**. It is recommended that further research is performed in order to assess if the tool by them promoted can be strengthened if the council has more power over it.

It is also recommended to address the **lack of quantitative data**, which is, perhaps, the root of all uncertainty therefore it is important to conduct further research on it. Finally the defined scope of the thesis that it is solely directed to São Paulo and its current real estate market makes it difficult to compare the outcome to different cities in other parts of the world. Consequently it would be of interest to **apply the used research to other major cities** worldwide in order to develop broader conclusions on the subject at hand. The author of this thesis also recommends that further studies should be conducted in respect of the LEED EB Criteria and the possibility to alter its requirements and open the possibility to make some of them mandatory.

Table of Contents

LIST OF FIGURES	II
LIST OF TABLES	II
ABBREVIATIONS	II
1 INTRODUCTION	1
1.1 PROBLEM STATEMENT	1
1.2 RESEARCH QUESTION.....	3
1.2.1 <i>Definitions</i>	3
1.3 METHODOLOGY	4
1.4 SCOPE AND DELIMITATIONS.....	4
1.5 AUDIENCE.....	5
1.6 LIMITATIONS	5
1.7 OUTLINE OF THE THESIS.....	5
2 THEORETICAL BACKGROUND AND METHODOLOGY	7
2.1 JOHNSON’S THEORETICAL FRAMEWORK.....	7
2.2 ADAPTATION OF JOHNSON’S THEORETICAL FRAMEWORK	8
2.2.1 <i>Operation and Maintenance</i>	9
2.2.2 <i>Productivity</i>	10
2.2.3 <i>Corporate Image</i>	11
2.2.4 <i>Externalities</i>	11
2.3 RESEARCH METHODS	13
2.3.1 <i>Data gathering</i>	13
2.3.2 <i>Data analysis</i>	14
2.4 RESEARCH STRUCTURE.....	15
2.5 LIMITATIONS	16
3 BEHIND THE BUILDING SECTOR	18
3.1 OVERVIEW OF THE SECTOR	18
3.2 SÃO PAULO’S REAL ESTATE MARKET	18
3.3 TWO APPROACHES TO ACHIEVE A HIGH-PERFORMANCE BUILDING.....	20
3.3.1 <i>LEED EB Certified Project</i>	20
3.3.2 <i>Unregistered Project</i>	22
4 POLICY AND THE BUILDING SECTOR	24
4.1 REGULATORY NORMS.....	25
4.2 FURTHER REGULATORY MEASURES.....	26
4.3 INFORMATIVE MEASURES	27
4.4 VOLUNTARY BUILDING CERTIFICATION SCHEMES.....	27
4.4.1 <i>Leadership in Energy and Environmental Design</i>	28
4.4.2 <i>Alta Qualidade Ambiental</i>	33
4.4.3 <i>Selo Casa Azul</i>	37
5 CONNECTING I-BEAMS	41
5.1 TWO PROJECTS AND FOUR TIERS	41
5.2 ROTTEN BEAMS IN HIGH-PERFORMANCE RETROFITTING PROJECTS	46
5.3 WITHIN CERTIFICATION SCHEMES	46
5.3.1 <i>Application process</i>	47
5.3.2 <i>Schemes’ Criteria</i>	48
5.3.3 <i>Valuable Documents</i>	49
6 DISCUSSION AND CONCLUSIONS	51

6.1 RECOMMENDATIONS.....	54
BIBLIOGRAPHY	56
APPENDIX.....	67
APPENDIX I – LIST OF INTERVIEWEES AND INFORMAL TALKS CONDUCTED.....	67
APPENDIX II – LEED EB PROJECT CHECKLIST.....	68
APPENDIX III – AQUA’S CATEGORIES AND SUB-CATEGORIES LIST.....	72
APPENDIX IV – SELO CASA AZUL CRITERIA LIST.....	74

List of Figures

Figure 1-1 Certified Green Building Space by Segment, World Markets: 2010-2020.....	2
Figure 2-1 Author’s adaptation of Johnson’s Theoretical Framework – Perception of Cost and Benefit.....	8
Figure 2-2 Research Structure	16
Figure 3-1 Administrative Centre Rio Negro	21
Figure 3-2 São Paulo’s Business Centre.....	22
Figure 4-1 LEED Projects in Brazil.....	31
Figure 4-2 LEED Professionals in Brazil.....	32
Figure 4-3 Fictitious example of a BEQ profile.....	37

List of Tables

Table 3-1 LEED EB Point Based System.....	29
Table 3-2 LEED EB Prerequisites	33
Table 3-3 AQUA’s Topics and Categories.....	34
Table 4-4 Evaluation Limits and Locations for the SCA Bronze Level	38
Table 5-1 Summary of both cases’ perception of costs and benefits associated with the different tiers.....	45

Abbreviations

AP – Accredited Professional
AQUA – Alta Qualidade Ambiental
BATN – Brazilian Association of Technical Norms
BCSC – Brazilian Council for Sustainable Construction
BEQ – Building’s Environmental Quality
BGBC – Brazilian Green Building Council
BMS – Building Management System
CARN – Centro Administrativo Rio Negro
CB-02 – Brazilian Committee of the Building Sector
CEF – Caixa Econômica Federal

FV – Fundação Vanzolini
GBC – Green Building Council
GBCI – Green Building Certification Institute
GHG – Green House Gases
IEQ – Indoor Environmental Quality
IIIEE – International Institute for Industrial Environmental Economics
LCA – Life Cycle Analysis
LEED – Leadership in Energy and Environmental Design
LEED AP – LEED Accredited Professional
MUCD – Maintenance, Utilities and Construction Department
O & M – Operation & Maintenance
PDCA – Plan Do Check Act
SCA – Selo Casa Azul
SPBC – São Paulo’s Business Centre
TCO – Total Cost Ownership
USGBC – United States Green Building Council
USP – University of São Paulo

1 Introduction

1.1 Problem statement

The building sector is recognised for its significant impacts on the environment worldwide, and also directly on society. It is accountable for large-scale resource consumption, air emissions, in the form of green house gases (GHG), and waste production in all parts of its lifecycle – such as construction, use and demolition. The sector is responsible for 50% of the total carbon dioxide emissions worldwide, 40% of the consumed materials that are traded in the world, and half of the world total of GHG emission while it stands for 7% of total world employment, which ranks the sector as number one employer (Khasreen, Banfill, & Menzies, 2009).

The above figures show not only the significance of the building sector that definitely has plenty of margin of progress towards a direction that is more compatible with the current requirements for a more sustainable state of amongst others the environment (IEA, 2011). As Vorwald (2011) refers, green building technologies are already present in the market, the knowhow is widespread, and a good deal of excellently skilled professionals that are able to implement such technologies already exist worldwide. As Kats, Braman and James (2010) refer, high-performance retrofits can come to represent up to 75% of total retrofits by the year 2030, which will allow for great changes in the current state of the building sector as is the case of the possibility to reduce energy consumption in the use phase.

Building owners and developers should not take retrofitting existing buildings to become high-performance buildings light-hearted, where such projects are known to be of greater difficulty than those relating to new buildings, as the integration of high-performance features is already performed from the design stage (Miller & Buys, 2008). It is also important to recall that currently the high-performance retrofit market is still considerably lower than that related to new construction (Kats, Braman, & James, 2010). This fact could draw away companies wishing to engage in such projects. One further difficulty in relation to the achievement of high-performance buildings is related to the lack of qualified labour force, which slows the development and market entry of such retrofitting projects (Amorim, 1996; IBDA, n.d; Ventura & Araújo, 2007; Brito, 2010). High-performance building retrofitting is then a challenge in many different spheres – social, technical, economical, and environmental – as such, making use of a tool as a voluntary building certification scheme can help project promoters to deal with such issues (Bardaglio, 2011; Kats, Braman, & James, 2010).

Building developers/owners which sought after high-performances for their assets can engage the Leadership in Energy and Environmental Design (LEED) certification in order to achieve the desired functional level, either if it is a new or an existing building through retrofitting projects (Bardaglio, 2011). Such certification scheme, even if broad in scope, does focus a great deal of attention to energy consumption and emissions to the environment, integrating these aspects in an overall approach which attempts to tackle the referred issues within the building sector.

Today in the world there are nearly 11,000 LEED certified commercial projects and around 32,000 registered ones, and these numbers are expected to rise (USGBC, 2011). In Brazil, a country that LEED reached in the year of 2007, the figures are also on the rise. 383 projects are registered and 38 have already reached certification, out of all the projects, nearly 70% of them occur in the state of São Paulo (GBCB, 2011).

Even if LEED certification in the city of São Paulo is leading the field in terms of voluntary certification projects – both registered and certified – there are other options available such as the Brazilian Alta Qualidade Ambiental, Selo Casa Azul amongst others. Nevertheless they differ amongst themselves in respect to the nature of candidate projects under their scope, and their application process. Despite of leading in numbers, LEED has been and still is discussed as not being completely adapted to the Brazilian reality as it was designed in accordance to North American cultural values and standards (Albrecht, Griffith, & Carvalho, 2009; Librelotto, 2010; SINDUSCON, 2011). Such concerns are already recognised and currently being addressed by the Brazilian Green Building Council that has established several committees to deal with such issue (GBCB, 2011).

Still, what is being addressed is the adaptation of the categories and credits within the system, while the application process and requirements remain untouched and possibly unadjusted. Such situation influences how a system is perceived both by those that are already engaged and those that could be in the future. **It is therefore important to realise which features from other existing voluntary systems could be adopted by LEED in order to further strengthen this building certification tool** (SINDUSCON, 2011; Fonseca, 2009). Such exercise is then needed in order for LEED to lead the way both in project numbers – as it does already – but also on the potential benefits that can be drawn from it if correctly adapted to the Brazilian reality.

On the opposite direction of the growing trend of building certification are the owners/managers that do not wish to pursue certification for one reason or another – either consider it too expensive to tackle or find it to cumbersome or even suspect that it might not yield the expected outcomes (Newsham, Mancini, & Birt, 2009; Scofield, 2009). Nevertheless, such projects can and should make use of the tools and processes presented by the voluntary building certification schemes (Bardaglio, 2011).

Nevertheless, the use of voluntary certification schemes is widely spread and growing. According to the work developed by Pike Research LLC (2010) the cumulative spaces that will be certified – under high-performance building certification schemes – will grow from 2010's 6 billion square feet up to about 53 billion square feet worldwide in just 10 years. Also, according to Pike Research LLC (2010) in 2020 commercial buildings will most likely represent 80% of the worlds green building certified spaces.

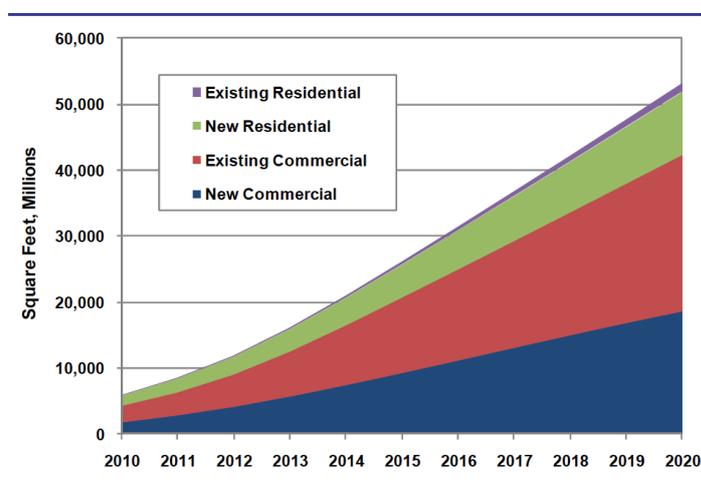


Figure 1-1 Certified Green Building Space by Segment, World Markets: 2010-2020

Source: (Pike Research LLC, 2010)

This study contributes to the research on the perception of actors on the implementation and benefits, in respect to decision-making aspects, of certification schemes. While doing so, it also contributes to the research on the adaptation of international voluntary building certification schemes to a regional context.

1.2 Research Question

The current state of the building sector is a delicate one, consuming and emitting much more than it should. Several voluntary certification approaches and tools – such as Alta Qualidade Ambiental and Selo Casa Azul– are available to tackle this issue. One of them is the subject of this thesis: LEED EB (Existing Buildings). The fact that this scheme is not native to the country, allied with other characteristics, makes it susceptible to criticism and distrust amongst the building sector’s professionals and academics. Projects that are not certified, and do not intend to become so, feed on the referred suspicions in relation to the certification schemes; at the same time, however, sharing the common goal with certified projects that is to achieve the highest performance possible. Recognising the problem of the adaptation of LEED to Brazilian circumstances as well as the perception of different actors – project owners/managers, scheme’s proponents, consultants – on the implementation of the scheme, this thesis proposes the following research questions:

RQ1: How can LEED EB in Brazil be strengthened, by means of integrating features from other voluntary certification schemes?

RQ2: How can non-registered projects – in Brazil - benefit from using available building certification schemes to achieve higher performance levels?

1.2.1 Definitions

In order to avoid any difficulties in understanding some terms and concepts in the thesis, it is important to clarify them.

This thesis will adopt the term ‘**high-performance buildings**’ instead of ‘green buildings’ or ‘sustainable buildings’ in order to avoid the confusion related to these latter two concepts. According to Building Science Corporation (2008) the most common definition for ‘green buildings’ is the one that relates back to its design and construction phase and aims at producing a building that stands out of the crowd in terms of its impacts on the environment. On the other hand a ‘sustainable building’ even though referring to the same stages – design and construction – differs in its goal to have no net impact on the environment, as stated by Building Science Corporation (2008) which also summarises the differences between these two concepts as follows:

Green building, then, focuses on incremental steps to solve known and measurable problems with our current practice, whereas sustainable building seeks models for an unidentified future state of society.

High-performance buildings is referenced throughout this thesis, and the adopted definition is the one proposed by Crosbie (2000)¹:

¹ Michael J. Crosbie – Doctor of Philosophy, Architecture – is currently Chair and Associate Professor with the Department of Architecture of Hartford University, a Contributing Editor at ArchitectureWeek and also Editor-in-Chief of Faith & Form (Crosbie, Michael J. Crosbie | LinkedIn, 2011)

...a high-performance commercial building is energy efficient, has low short-term and long-term life cycle costs, is healthy for its occupants, and has a relatively low impact on the environment.

Another set of concepts that, in the author's point of view, need some clarification is the state of being **certified/registered**, or the opposite, **uncertified/unregistered**. These concepts are used in voluntary schemes and referring to which state the project is in the process of certification. The difference is made between the two sets of concepts in terms of their affiliation to any of the referred voluntary schemes. Furthermore, it is also evidenced that the state of already being certified or still an on-going project thus being just registered – in the process of achieving certification – as there are projects that take many years in order to become certified.

1.3 Methodology

In order to answer the research questions a policy review was undertaken and a research structure developed. The structure focuses on the perception of selected actors and through that investigates different areas of high-performance building certification such as operation and maintenance, productivity, externalities and corporate image.

Making up the designed research structure are key interviews, thorough relevant literature review which are then passed through a sift – in this case through an adapted already existing theoretical framework – which helped to gain more understanding on the potential improvement of the LEED certification scheme and thus how it could contribute to improve the level of building performance. Such structure, its interactions as well as the used methods are presented in details in Chapter 2.

1.4 Scope and delimitations

This thesis covers voluntary building certification schemes, available in the city of São Paulo; therefore the study is focused solely in the options already available within the city.

In brief, the geographical delimitation was set as to encompass the city of São Paulo in Brazil and the real estate market in that particular city. This delimitation was set for a number of reasons: the size of the country, the time frame and funds available for the thesis, the differences in terms of the country's real estate market, the fact that the city is the one in the entire country with the highest number of registered green building projects going for certification. The focus of this thesis is then on office spaces, this delimitation, as the one referring to the geographical location was chosen to perfectly adapt the timeframe available with the nature of the thesis project. Also the fact that the city of São Paulo holds most of the largest office spaces in the country was one of the main decision factors behind this delimitation. Important to note is also the fact that the focus is made solely on existing buildings. This delimitation was set in order to scale down the number of projects within the city of São Paulo.

Additionally, the green building rating systems that were taken in to consideration refer to those that are accountable for most of the city's certification projects, and in the case of LEED and Alta Qualidade Ambiental there was facilitated access to the responsible institutions for such systems which made it possible to have access to information that otherwise would be difficult to obtain. In the end, the main focus of the thesis is put on LEED, which is the most popular certification scheme within the city of São Paulo.

In respect to the voluntary certification schemes it is important to highlight that the scope of this thesis is the process towards achieving certification. The criteria of each system may be referred to and compared at times, in order to aid to the overall objective of the thesis, however it is not under the scope of the research exercise.

The thesis also attempts to reach conclusions and recommendations built on the perspective of owners and managers of the referred type of buildings, as these were the contacts that acceded to participate in the interviewing process. The tenants' perspective was then not gathered and as such is not part of the scope of the thesis.

The delimitations in this research exercise were set so as to make it possible to clearly reach the intended subject and actors, and to keep a strong focus on the topic at hand.

1.5 Audience

Within this thesis, building owners as well as developers and operators can find information that can guide them in the choice of the certification tool to be used, or just be better informed, if their decision is not to certify but still achieve great performances.

The conclusions of this thesis are also of good use for all the Green Building Councils (GBC) and other institutions that promote green building certification schemes, as it can provide a good basis for improvement, and development of such tools.

In addition, tenants and tenants-to-be of office space buildings can also benefit from the conclusions and overall work of this thesis. In the author's perspective it is important for this group to be better informed on the issues referred to in this thesis, in order not to be caught unaware if a certification process comes their way.

Finally, researchers can also benefit from the work performed and conclusions drawn, which can give way to further research on the topic at hand.

1.6 Limitations

Even though most interviewees were contacted with some time in advance, in some cases it was impossible for them to conciliate their agendas with either the on-site research in São Paulo, and with a future telephone or online meeting. Some of the contacted interviewees who were not able, for one reason or another, to take part in the research were thought to hold a potential good contribution to the data gathering. Still, this is not seen as a flaw in the research process as the contacts that did participate in the research process contributed with valuable information for the outcome of the thesis.

Also playing a role, that is not to be underrated, is the fact that data collection, through the interview process, was in most times difficult due to the fact that the actors in the sector are pretty closed in terms of releasing information due to confidentiality reasons. As such, some information that could have been important to gather in order to better proceed with the analysis and consequent conclusions and recommendations was not attained. Still it is believed that such impediment does not greatly influence the overall outcome, as some of the interviewees did not express the need for high levels of confidentiality.

1.7 Outline of the thesis

The *current Chapter's* aim is to provide background information to the topic at hand as well as to outline the research questions the thesis will attempt to answer, while briefly touching upon the used methodology. *Chapter two* further develops the already referred methodology and at

the same time presents the thesis limitations. In *Chapter three* the reader can expect to encounter a brief overview of the building sector and real estate market in the city of São Paulo. Also, both analysed projects are described in Chapter three. *Chapter four* presents a detailed review on the building policies, particularly those applicable to the city of São Paulo, and also the three voluntary building certification schemes are described in details. *Chapter five* makes use of all gathered data – both from the performed interviews and literatures reviews, and according to the proposed analytical framework – to carry out the analysis and further elaborate on the issues in the discussion part. The final *Chapter, the sixth*, presents to the reader the drawn conclusions and recommendations that arise from the previous chapter. Here the research questions are answered.

2 Theoretical background and methodology

Decision-making in the building sector is dependent of several factors and according to Johnson (2000) there are a few of them that should not be overlooked. These are operation and maintenance actions, productivity, corporate image, economy and environment. An overview of the overall competitiveness factors that drive the sector is then naturally of great importance. That is in order to define the current real estate market and to produce a clear picture of the current and future trends in the sector.

Such approach, will allow to pinpoint which areas of the certification process should be tackled in order to boost project owners/managers perception of the referred factors when retrofitting actions are in place.

In order to be able to attempt to draw answers to the proposed research questions, an adaptation was performed to an already existing framework. The process is described in the following Sections, accompanied with a description of the research structure, which was put in use through the course of the thesis.

2.1 Johnson's Theoretical Framework

In his work, *The Economic Case for "High Performance Buildings"*, Scott D. Johnson refers to his framework which intends to better define the economic benefits behind high performance buildings, while keeping it consistent with current decision-making terms, processes and metrics (Johnson, 2000).

The framework structure is developed around four tiers, which represent potential costs and benefits of facilities, in respect to the project's owners/managers. The four tiers, from the first to the fourth, are: 1) Traditional Total Cost Ownership (TCO), 2) Productivity, 3) Corporate Image, 4) Economy & Environment (Johnson, 2000).

According to Johnson (2000) the first tier, representing TCO includes both initial costs (design and construction) of the building and Operation & Maintenance (O&M) associated costs throughout its lifespan. It is important to mention that during the life of a building – taking in to consideration a thirty year period – its owner spends three times more on O&M than he does on the so-called initial costs – design and construction (Johnson, 2000). Such high costs are associated with the impossibility to run buildings at peak efficiency without serious efforts in those specific areas (National Institute of Building Sciences, 2010).

The first tier, and the costs/benefits, is closely linked with the other three tiers, as a high performance building should in theory be designed and maintained in order to achieve the highest possible benefits on all tiers (Johnson, 2000). Still, as referred by the author it is increasingly more difficult to assess, and keep under control, the cost/benefits figures associated with tiers two to four.

In order to strengthen the importance of aspects related to productivity (tier 2) it is referred by Romm (1994) that, again over a thirty-year period, TCO (tier 1) costs are accountable for just eight percent of the total of both tiers, thus leaving tier two liable for the other 92%. In relation to corporate image (tier 3), as referred, it becomes increasingly more difficult to establish the costs and benefits related to it. Still, it is acknowledged that the potentials related to it are quite considerable (Johnson, 2000).

Tier four, *Economy and Environment*, are the externalities for project owners/managers. According to Johnson (2000) this tier is the most difficult to quantify, thus most companies

do not take them into consideration unless they are specially decided to include such costs – and the consequent benefits – in decision-making processes.

The framework is laid out in order to assess economic benefits for engaging in high performance building projects, while at the same time referring which are the existing tiers and showing that it is possible not to have them all in consideration, but it is vital to be aware of their presence at all times (Johnson, 2000).

2.2 Adaptation of Johnson's Theoretical Framework

The defined scope redefines the above-referred framework, in a path that is thought to be the best in order to achieve the overall purpose of the thesis.

The fact that the thesis deals with retrofitting projects alone eliminates the need to allow in the analysis the costs and benefits of the initial expenditures – such as major building construction – even if some retrofits do involve major reconstruction. It is of course recognised that such projects do have an initial cost attached to it, even replacing one light bulb carries cost, but in terms of its relative importance in the overall scheme of the framework it was deemed as of minor importance, thus being left out from the adaptation. One further reason behind the choice of leaving initial expenditures out of the framework is related to the current state of the real estate market in São Paulo. At the time of development of the utilised framework, the market was going through an abundance period, in terms of funds to invest, as such costs were not seen as a factor in terms of decision-making (Kochen, 2011).

In brief, and as can be seen in Figure 2-1, Johnson's first tier – TCO (Total Cost Ownership) – was then altered to reflect solely Operation and Maintenance, leaving the remaining tiers as they were originally.

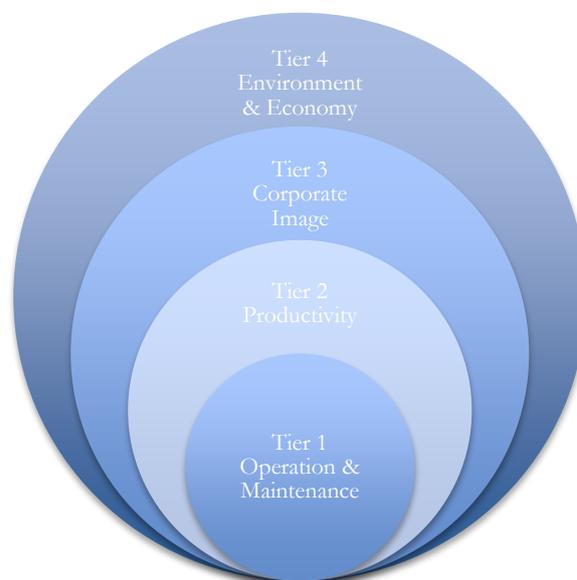


Figure 2-1 Author's adaptation of Johnson's Theoretical Framework – Perception of Cost and Benefit

Source: Adaptation of the Economic Case for "High Performance Buildings" by Scott D. Johnson (Johnson, 2000)

Furthermore, it is important to mention that since such framework was used with qualitative data, the increased difficulty in measuring costs/benefits was not seen as a limiting factor – thus not represented in Figure 2-1 – as the main gathered data of the study refers to project owners/managers *perceptions* of the costs and benefits associated with the referred tiers.

As such, the referred costs are associated to the capital that needs to be spent in order to achieve a certain retrofitting project goal, for instance to automatise lift systems, or substitute the lighting system. These examples are clearly inserted on tier 1 perceptions, still by using such framework it is possible to go further and analyse how such projects are translated in the remaining tiers, by analysing the perception of the building owners. On the other hand, the perception of benefits refers to the owners' or managers', perspectives on the outcomes of such retrofitting projects.

Considering the above, the four tiers analysis will then be used in order to allow comparison between the cost/benefit perceptions of both certified and unregistered projects. Furthermore, it will allow recognising in which area the voluntary certification scheme is missing and where it can possibly be improved.

This adapted framework will be used in conjunction with the results of a literature analysis and a set of interviews, which mainly comprises qualitative data. It is known that qualitative and quantitative methods do work quite well in conjunction (Morgan, 1998), and can at times produce even stronger results (Malina, Norreklit, & Selto, 2011). The author believes that the taken approach of integrating both data types will allow for a more accurate and precise analysis and consequent conclusions and recommendations.

2.2.1 Operation and Maintenance

As to give prior notice to the reader, first the concept behind Operation and Maintenance is defined. Throughout this thesis the **definition** behind O&M that should be kept in mind is the one referred by FEMP (2010), in which:

Operations and Maintenance are the decisions and actions regarding the control and upkeep of property and equipment.

Some of the actions and decisions are also mentioned and include amongst others, activities directed at optimisation and procedures; carrying out several actions of different nature in order to achieve higher efficiency, reliability and safety records (FEMP, 2010).

Both the proponents of LEED (especially the certification dedicated to existing buildings) and of AQUA, refer to operation and maintenance as an area in retrofitting that cannot be overlooked. LEED proponents refer that by acting in such area it is possible to lower operating costs and aid the increase in productivity of the occupants, as such the proper dedication is given either in the form of actual demands for certification or by developing guidelines (USGBC, 2011; Fundação Vanzolini, 2007).

O&M methods and practices already existed before any certification schemes came to the real estate market, thus concerns on effective and efficient O&M are not novel to the sector (Arditi & Gunaydin, 1998).

The concept of high-performance buildings (see Section 1.2.1) is very much dependent on the procedures and investments made towards operation and maintenance operations. As such, even if a building has state of the art equipment and technological systems, the lack of proper maintenance and operation skills and practice renders them all useless, thus the building presents high levels of performance (Danks, 2010).

In order to improve the overall performance of a building, it is known that its owners, developers, managers should all work closely together. Furthermore, it is also accepted that involvement of tenants needs to be addressed as soon as possible in order to allow them to

better know their property and fully comprehend both the operation and maintenance requirements inherent to it (SCI, 2011).

2.2.2 Productivity

It is difficult for a project owner/manager to quantify the amount of benefit such a retrofitting action has had on its own productivity. Still, if there is an open communication between owner/manager and workers/tenants, and also a reasonable set of specially designed indicators, these difficulties can be minimised.

It is accepted by an increasing number of researchers that high-performance building design is closely linked with office – employee – productivity and its improvement (Preston & Bailey, 2003; Kats, Braman, & James, 2010; Kozlowski, 2003; Lucuik, 2005). Also, it is accepted that if companies' budgets are mostly directed to addressing salaries and health-care costs, it is then important that any improvements in productivity and health-care will produce significant financial impacts, which can be comparable, even surpassing, those related to O&M operations (Kats, Braman, & James, 2010; Clements-Croome & Baizhan, 2000).

Although high-performance building design does influence productivity, as seen above, it is not the only way productivity can be increased. It is recognised that if the *office layout* matches the work patterns of the occupiers, gains in productivity can be achieved (Haynes, 2008; Haynes, 2007).

Still productivity can be affected by a larger variety of aspects that go well beyond office layout, one of which being the *Indoor Environmental Quality* (IEQ). This aspect is closely related to workers' productivity within office buildings as sickness claims and the consequent absence of the workers are the main complaints (Kats, Braman, & James, 2010). Absence leads to a diminished productivity and worker efficiency thus having big implications in the loss of great deals of money (Caccavellia & Gugerlib, 2011). There are many factors influencing the IEQ, among them, temperature and availability of natural light play an important role. Most of these factors can be object to retrofitting projects, and correct O&M procedures (U.S. EPA, 2010). Improvements in IEQ can lead to greater productivity in terms of work accomplished, increased worker retention, reduction in absenteeism and in hospitalisation times. Such Benefits will then be translated in terms of added value to the property owner and also to the businesses running in it.

People working within a building environment relate one of the most common reasons attributed to the decrease of productivity in an office building to the perception of *thermal comfort*. The situations where it is perceived to be too cold or too hot – thermal discomfort – are both linked to decrease in productivity, even though peak performances are linked with slightly cold environments (Lana, Wargockib, & Lian, 2011).

It is important to keep in mind that solutions to improve work place productivity at the same time need to be economically viable, such as the use of *daylight*. Solutions that were commonplace many years ago and got lost along the way are now making their comeback; one example is the concept of daylighting in office buildings (Reinhart & Selkowitz, 2006). It is referred that it was a common place many years ago, in the early 1900s, and that later it was left aside in a post-war era, as the energy was cheap and fluorescent ruled the market. The oil crisis of the 1970s marked the first comeback of the concept and nowadays several actors of the building sector, owners and architects included, seek it (Reinhart & Selkowitz, 2006).

2.2.3 Corporate Image

In regard to this aspect – tier 3 – it is worth mentioning that *corporate image* is addressed in the owners/managers perspective, as is in all tiers. This meaning that the costs and benefits are associated with the company that is performing the retrofitting action and not to the tenants of such spaces. Having in mind that companies often deal directly with their corporate image, and almost everyday indirectly (Keller, 2003), the perception of the related costs and benefits is therefore present.

In their work, Veljkovic and Petrovic (2011) refer that:

...image represents a useful instrument that can and should be actively managed.

According to Veljkovic and Petrovic (2011) and Iwu-Egwuonwu (2010) in corporate image one can find a mirror of everything a company does. The same authors also point out that a company's image, a set of factors, is defined by the perception the general public has of the company's actions – thus, company actions, or inactions, are sure to produce results in either boosting or downgrading its image.

The public perception of a company image is aided if there are clear signs of observable product quality, packaging, colour and logo. These symbols are easily identifiable and start to play a more important role as the market becomes more competitive. Thus companies place more emphasis on the role and influence of their own image (Veljkovic & Petrovic, 2011).

To (Keller, 2003) there are four major elements essential to maintain a strong corporate image: 1) products and/or services (attributes and benefits for consumers), 2) people and relations (the company's interaction with the consumer), 3) values and programs (ecological and social responsibility), 4) corporate credibility. Amongst these, focus is made on values and programs, especially in terms of the ecological responsibility values in boosting corporate image, as the public is promoting more and more programs associated with this area of concern (Veljkovic & Petrovic, 2011).

Furthermore, the need for a company to make strategy decisions in terms of how to develop a good corporate image building on the above referred ecological responsibility is very much present as it is possible to start from within the company by changing business processes or externally, by choosing to address a known problem – which is linked to the company's business and related to the mentioned element – an making a commitment to solving it (Veljkovic & Petrovic, 2011). While referring to strategic decisions related to corporate image, Iwu-Egwuonwu (2010) adds times when companies only took into account tangible assets as drivers for sustainable competitive advantages are long gone, thus being more and more important to keep on a good track all the above mentioned elements.

2.2.4 Externalities

The building sector is an indivisible part of the systems of society – environmental, economic and social – thus it is impossible for it to run indifferently to what is happening around. Consequently the way a building functions, affects more than just the people that own, manage or work in it (Choi, 2009), it has an impact on and affects the system around it. This alone should be more than enough for project owners/managers to be careful, and knowledgeable, in respect to all measures and operations being put in to practice. Nonetheless, if this is not enough reason to pay attention to such issues, the fact that it encompasses costs and benefits that should be internalized in order to fully account the impact that a given project, and its operation, has on the ones that own/manage it.

During the 1990s the combination of issues relating ecology and economics began taking place, and with it the development of ecological economics (Costanza, Ecological economics, 1991; Costanza, An introduction to ecological economics, 1997; Daly & Townsend, 1993; Jansson, Hammer, Folke, & Costanza, 1994). The new discipline included environmental damages and excess usage of resources as part of the full cost accounting. According to ecological economics, only in this way it is possible to assess profits; thus damages to the environment were no longer considered free of charge to a given individual, but for that to happen the costs must be internalised (Shu-Yang, Freedman, & Cote, 2004).

Nevertheless, according to Preston and Bailey (2003) and Wilson, Atlee and Webber (2008) the value that is intrinsic to externalities – both positive and negative – within the sector, specially in high-performance building projects, can be of great importance to society as a whole but might not affect a company's decision-making processes as most of the times these are not incorporated in the sector's accounting. It is not that they do not affect the project owners/managers, because they do as they represent costs/benefits to them, but by not internalising such figures it is impossible to make them part of a crucial exercise as is decision-making. The difficulty referred by Johnson (2000), in terms of the quantification of the cost and benefits, in respect to the building owners/managers, help to move building sector related externalities away from decision-makers table, as they are not often internalised in the accounting exercises.

According to Kwong (2004) there are difficult choices to be made in terms of which sustainable features that should be taken in to a given project, by its owner/manager. Kwong (2004) goes further to refer that in order to make such hard options – e.g. should resources be redirected in order to increase energy efficiency to get outdoor air pollution levels lowered? – accurate pricing of cost and benefits should be present, even considering that pricing such environmental externalities is still difficult.

Furthermore, it is then referred that in order to be able to keep a good control on strategic management of both environmental costs, and benefits, it is imperative that full costing approach becomes the common practice of a given company (Anderson, 2007).

In order to perform accordingly, and factor in the externalities associated with the sector a more and more common practice is to conduct life-cycle assessments (LCA) to either materials or equipment, in order to aid the understanding how these influence the company using them. Dimitrokali, Hartungi and Howe (2010) refer that the methodology behind LCA can be applied in many different manners – from one to several buildings, big and small, products and components – in order to be able to correctly assess the impacts to the environment. Nevertheless, there are several hinders to a precise LCA of a given building, such as the uncertainty in terms of the building's life span, the intrinsic heterogeneity of the building, amongst others are all factors that limit the LCA, thus driving the need to further gather data that will allow for more accurate methods (Dimitrokali, Hartungi, & Howe, 2010).

Life cycle assessments are no strangers to office buildings, even if focus in recent years has been on residential dwellings, and it points out that the use phase in such buildings surpasses all other phases in terms of energy consumption, as such bringing the concern back to O&M matters as attention is needed on the systems in place and the technology that comes with it (Dimitrokali, Hartungi, & Howe, 2010).

2.3 Research Methods

In the thesis several research methods were applied, among them are interviews – both in-depth interviews but also informal talks – as well as literature reviews of topics that are thought to be of great importance. These will be further discussed in subchapters to come.

The qualitative data analysis performed will also be subject to a thorough description, as it plays an important role in the outcome of the thesis in allowing for supported conclusions and recommendations.

2.3.1 Data gathering

This thesis consists of research and analysis based mainly on qualitative data.

2.3.1.1 Interviews

This research method was employed in order to gather primary information from relevant sources within the building sector in São Paulo. With it, there was the aim to obtain data regarding their perception of the aspects previously described – the four tiers – and also open the door for further information to be gathered, that could strengthen the thesis in general.

The first contact was made with the Brazilian Green Building Council (BGBC), which was performed still prior to the official thesis development period, as it was a vital part for the development of this work. In an initial meeting a stratified random sample was supplied from the BGBC, this way it was possible to obtain a first random sample from a clearly identified group – on-going retrofitting projects actors. By starting off with such contacts it was possible to guarantee that the specific group was represented, that the sample was proportional – by this it is meant that not all were just owners or developers – still, it is acknowledged that this kind of sampling is risky in comparison to a simple random sample (Black, 1999).

From the contacts made, through the above referred sample, approaches were made and from them it was asked to refer to one or two more contacts that for them had a relative importance in relation to the work being developed. This sampling technique – snowballing – allowed contacts to be made with actors that were not part of any initial cluster. Still, one disadvantage of this method that is fully recognised is that it allows contacts to be made with actors that are not relevant to the subject at hand (Black, 1999; Biernacki & Waldorf, 1981).

All the conducted interviews were **in-depth interviews** – fitted for situations when there are a small number of respondents to be interviewed individually in order to get their view on a specific matter – as this would better fit the scope and delimitations of the thesis (Boyce & Neale, 2006). It is recognised that with such type of technique, it is possible to gather information that otherwise would be very difficult to gather; information that would be much more detailed than what is possible with the normal surveys and questionnaires, while at the same time allowing for a comfortable interview environment between both parties (Boyce & Neale, 2006). Still, the cons of such technique were also present, as the duration of the interviews at times became very lengthy. During the interviews, there were a few points that were made clear from the start, which were to strengthen the message already delivered while making the first contact. The main topics were put on the table for discussion: retrofitting projects, high-performance building certification and voluntary certification schemes. All questions were laid out in an open fashion and also as factual as possible before jumping into more opinion-minded questions, for example *How was the retrofit project carried out before* *What is your opinion on the retrofit project*. Also, whenever there was the need, probes as *Could you give me an example* or *Is there anything else* were used.

During the time frame available to research for this thesis, several conversations were also undertaken either with colleagues or other individuals – through **informal talks** –, regarding the topic at hand. Even if these are not pinpointed in the thesis they helped, in a subtle way, shape the direction of the work, as well as provide good input in terms of structure.

2.3.1.2 Literature Review

In order to start the research process, and to serve as a support for the thesis contribution for a possible new insight on the topic at hand, several literature reviews were conducted. They will, in a synthetic manner, summarise previous ideas and arguments of other researchers and recognised experts.

These reviews support the topic in question and were also directed towards good harmonisation between the interview data and the used theoretical framework. The subjects reviewed were all thought to play an important role in the research development as well as during the wrapping up of the work – conclusions and recommendations. The gathered information revolves around issues that were thought to have a direct correlation with the needs and decision-making in the building sector, such as the subjects addressed by the theoretical framework and also current voluntary building certification schemes.

The reviews use data consulted and gathered from several sources, being that the major contributors were peer-reviewed journals – primary literature. These journals were accessed throughout the thesis time frame, by using several databases that were made available to be used as was Lund's University LibHub, EBSCO, Scopus, Web of Knowledge, amongst others. While performing the search on the databases, the same queries were performed in order to come to terms with which one would present the most results and from those, figure out which of them would be the most relevant. By acting this way it was possible to search more journals than what could have been possible only by using one of the referred databases.

Other literature, besides primary, was collected for the reviews. This was possible by consulting non-peer reviewed journals, general books and also the Internet. When using the Internet special attention was given to the credibility of the website in question, being preferred those related to educational/research institutions and also independent consultancy companies.

There was also special attention given to the age of the gathered information, as an effort to attempt to gather information as recent as possible was endeavoured. Only in cases where no other option existed, or the relevance of the work in question would justify it, *old* – 10 plus years, from the research period – literature would be used.

For this thesis, documentation available through the network of the building sector in Brazil proved to be very useful. The sector's union – both on a national and state level – the academic departments dedicated to the construction industry and finally state owned and non-governmental organisation devoted to sustainable construction proved to be a good source of information. From these sources it was possible to access reports and information campaigns that were thought to be valuable to the completion of the thesis.

2.3.2 Data analysis

The performed analysis process can be divided in to 5 distinct parts, in order to better allow for replication and overall understanding of the data, those being: 1) acquaintance with data, 2) focusing, 3) categorising, 4) pattern and connection identification and finally 5) interpretation (Taylor-Powell & Renner, 2003).

Feeding this analysis process is the gathered information through the conducted interviews in conjunction with the literature review – mainly the data referring to the voluntary building certification schemes. The process described below allows for such data to be analysed as one and to accurately prepare the final chapter – conclusions and recommendations.

The first step – **data acquaintance** – is of great importance as it is then that the understanding of the gathered data is fully grasped. This is possible by reading and re-reading the notes from the interview and data from the literature reviews. During the process of getting acquainted with the data, all the impressions that come to mind about the subject at hand are noted down, as they might be of use later on in the process. Furthermore, in the first step is possible for to identify what data can be used and what possibly will be left out.

In the second step – **focusing** – it is of great importance to start by having in mind what the thesis aims for in terms of research outcome, as this will shape the analysis focus. Even though it would have been possible to focus the analysis strictly by the topic at hand or solely by the research questions, the decision is made to focus on situations being observed – certified/unregistered projects and also voluntary certification schemes – as it is thought to better suit the gathered data and overall aim of the thesis. Also, there is a clear focus made on the different voluntary schemes as they too, play an important part in the outcome of this thesis.

To **categorise** the information – the third step – special attention was given to the chosen theoretical framework, which was adapted to the purpose of this thesis. Still the categorisation of the data is performed according to the situations studied – certified/unregistered projects, voluntary certification schemes tools and processes. Important to refer is that this categorisation is not inflexible as categories outside the ones deriving from the framework might come to light. In brief, a mix between pre-set and emergent categories was put to use.

Once all the data has been categorised the fourth step in the data analysis, the **pattern and connection identification**, is performed. Here, the action is done both within the categories, across categories and also between certified and unregistered projects, and it looks for relationships between data and relative importance of gathered information. Again here, it is important not to be inflexible to the point of only considering data that falls directly into one of the accepted categories, as new insights might be possible.

Interpretation – the final step – follows the above as it makes use of all the previous steps in order to deliver significance to the analysis exercise. It is performed by reflecting on what is learned in a synthetic and meaningful manner.

2.4 Research Structure

An analytical framework was developed and applied in this thesis as represented in Figure 2-2, the framework is developed for the sake of achieving the best possible outcome, through all stages – data gathering, data analysis and final considerations (conclusions and recommendations).

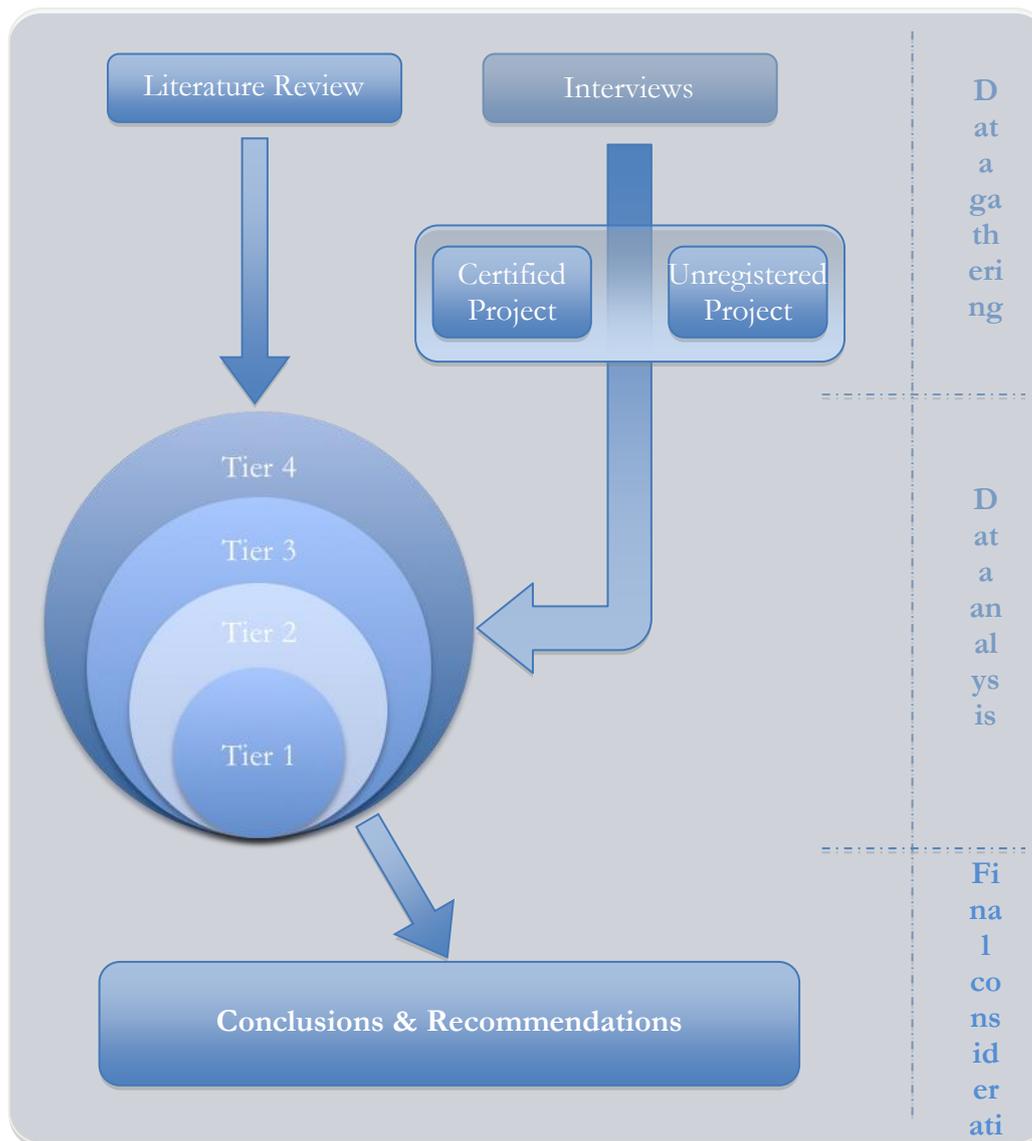


Figure 2-2 Research Structure

The set tiers, fed both by the literature reviews and the information gathered during the interviews, will allow the gathered information to be analysed in a coherent and meaningful manner, as is describe below.

2.5 Limitations

In respect to the used methodology, there are a couple of factors that can hinder the process. The first one is the lack of data from office space tenants, as it was not possible to undertake interviews with such actors. Nevertheless, it is not seen as a significant limitation as the research structure was designed in order to address mainly data in respect to the owners/managers side.

Additionally the fact that only one person was interviewed with regards of unregistered projects could have been a drawback, nevertheless, the contact made proved itself to be quite a valuable source and very much representative of such projects. Still in this line of thought it is important to be stated that there was not the possibility to interview anyone involved in an AQUA certification project, as such the only person interviewed in respect to such rating system was a technical manager from the Foundation that administrates the tool.

The same is applied to the Selo Casa Azul (SCA), in respect of which there was not the possibility to interview any of the actors involved, as the only contact was through email with the scheme proponent. Nevertheless, the information gathered on the scheme itself – even though not replacing primary information – is considered to be quite relevant to the thesis and thus minimises the overall limitation.

3 Behind the building sector

3.1 Overview of the sector

The building sector is characterised by its interactions with the natural environment; it contributes to the change of environment by taking resources and land from it as well as by emissions to air, water and land. All these interactions cause environmental degradation. It is reported that the building sector, by weight, answers for nearly 50% of all materials coming out of the crust all over the world (WBCSD, 2010). When referring to the entire built environment, buildings last longer than other constructions – such as a road as an example – thus extending its environmental impact through longer periods (Femenías, 2004). Also, the sector is amongst the higher employers throughout the world (Khasreen, Banfill, & Menzies, 2009) and if taken into account the fact that national economies are partly driven by the sector, one can realise the extent of the impact of the sector to go beyond the environmental sphere and placing itself on a sustainability level.

Brazil is no exception to the trend; the entire construction sector is accountable for nearly 40% of the total national consumption of natural resources, it represents between 60% and 70% of the total waste and garbage production in the country, and also it is responsible for 25% of the national greenhouse gases emissions (BGBC, 2011). Furthermore, both energy and water consumption within the sector is one that cannot be overlooked; it represents, respectively, 43% and 21% of the total national consumption (BGBC, 2011). It is referred that in the city of São Paulo, the building sector consumes around 70% of the total national wood consumption – being that 15% of it comes from the Amazon forest (SindusCon-SP; WWF-Brasil, 2011). According to the same report, around 80% of the wood used by the sector comes from replanted forests, while only 20% from natural ones. In respect to the construction waste, it is estimated to be close to 55% of the total waste produced in the city of São Paulo and being translated into around 17 000 tons/day (SindusCon-SP, 2005).

The Brazilian construction sector can be divided into three main sectors: building sector, construction materials sector and heavy construction sector. The building sub-sector, including solely buildings, is accountable for nearly 2.1% of the national GDP and for 40% of the entire construction sector's GDP (Mello & Amorim, 2009).

The building sub-sector is characterised by its low productivity, overall unsatisfactory quality, high adversity to change, use of low-skilled manpower, as well as high rotation of staff (Mello L. B., 2007).

As the building sector is being asked to become more functional, more environmentally friendly through minimisation of its overall impacts, according to CIB Task Group 35 (2001), deep changes are leading the construction industry to new paths. It has also been noted by the same authors that more and more focus is being put on existing buildings/infrastructures, and their optimisation, and less to the provision of new facilities (CIB Task Group 35, 2001).

3.2 São Paulo's real estate market

São Paulo is known to be one of the main cities in terms of attracting businesses in South America. 93 of the world's top 500 multinational companies are present in the city, providing space for a very active market with high purchasing power (Tavares, 2011).

According to UK Trade & Investment (2010), 1.44 million m² of high-class corporate buildings are being constructed in São Paulo - from 2009 to present day –, thus reaching the world's fifth position in terms of such projects. Nevertheless, the sector is coming from a

nearly 20 years period of stagnation, which has a significant impact on the relation between supply and demand.

Due to the lack of specialised manpower and equipment, developers were struggling to keep up with new clients as such demand has been much higher than supply (Secovi-SP, 2010; Landim, 2011; Scheller, 2010). Since the late 2008, the real estate market in the city of São Paulo has however been growing. According to Secovi-SP (2010) during the year of 2010 the growth has been consolidated, as such buyers kept on buying and developers developing.

The real estate market evolved from a situation where Brazilian families owned most buildings, and in some cases that is still the reality (Pacheco, 2011). Nevertheless, nowadays in São Paulo there is quite some foreign presence, as such some of the office buildings were bought up and are owned now by foreign investors. The arrival of such investors is said to have altered the sector, as many ideas were brought from Europe and North America. One of these ideas was to invest in the environment and to focus more on the social aspect of the companies and the buildings they were buying (Pacheco, 2011).

Such approach is in line with what is described by Michael E. Porter (2008) on his work on strategy and the five forces by him presented: 1) rivalry, 2) threat of substitutes, 3) buyer power, 4) supplier power and 5) threat of new entrants and entry barriers. To counter the effects of these five forces, that influence an industry's strategic planning, the idea of investing on a specific focus – environment, social issues – and from there deriving a clear differentiation from the remaining companies within the building sector was then a reality.

In terms of commercial buildings the market is dynamic; it is also reflected in the low percentage of vacant office spaces in the city. Seven percent of the office spaces are not rented out and the most sought buildings are the high standard ones (Landim, 2011). It is also important to mention that the demand for office space is not uniform throughout the city, as some locations are more attractive than others. For instance, the region of Faria Lima and Itaim are popular places where the rent values – per m² – are much higher than in the rest of the city (Scheller, 2010; O Estado de São Paulo, 2011).

In order to address the current relation between the supply and demand, retrofitting is currently being seen as a way to introduce high-performance buildings to the market, which would not be built otherwise. By acting in such a manner it was then possible to introduce to the buildings' customers new features – high-performance – towards which they would then become attached to thus reducing the potential threat of substitutes – regular buildings (Porter, 2008). It is important to take into consideration that the most sought after locations lack free land to build on, which then leaves demand unsatisfactory solutions. The Avenida Paulista, for example, a major avenue in the heart of São Paulo was the main business area from the 1960s onwards. The location is very popular, the buildings however are old and the only solution is to invest in renovation projects instead of new buildings (Scheller, 2010).

In 2009, there were around 30 000 m² of retrofitted commercial buildings in the city; this figure doubled in just one year. Also, Simone Santos² refers that in order to evaluate if a retrofit is economically viable, the owner/developer needs to assess its costs, the duration of the retrofit project and also the desired return rate on the investment (Matos, 2010). Currently in São Paulo, mainly due to the state of the real estate market, evaluations are not performed.

² Simone Santos is the Corporate Services Director of Herzog, a real estate company.

Retrofits are carried out without giving attention to the investment or to the return rate (Kochen, 2011).

In a near future the market will calm down, as there are already projects with up to 850 000 m² of commercial space planned in the city of São Paulo. The rise of availability of office spaces, increasing the supply, will make the demand follow and as such rent prices will stabilise (Valor Econômico, 2011).

When it comes to the market for high-performance office buildings, Anderson Benite³ refers that the current trend reflects the demand of companies for such spaces. The reason behind the demand is the need for the building to present low operational and maintenance costs while having the highest levels of energy efficiency and comfort. Such offices allow companies to reflect their values and principles in the bought/rented spaces towards workers and the market in general (Benite, 2010).

3.3 Two approaches to achieve a high-performance building

The first project presented depicts to a recently LEED certified building, the second one, to an unregistered building. These projects will allow an analysis process in terms of their perception of the different – above referred – tiers, and in terms of how to better apply the tools from available voluntary certification schemes.

By the end of this sub-chapter it is important to notice how the two projects are comparable both in terms of their location, which in both is outside the most sought after addresses – referred above. At the same time, they are both alike in the nature of their complexity as they both offer office space and opportunities for convenience stores to be located within. Also, in proportion, both projects are very much comparable in terms of the size entire building complex.

3.3.1 LEED EB Certified Project

As referred, having voluntary certification schemes and LEED existing building certification as a focus of this study, there were several interviews conducted in relation to projects that are already LEED certified or under certification. The Centro Administrativo Rio Negro – Administrative Centre Rio Negro – (CARN) was the selected building due to the fact that there was the opportunity to interview more than one actor – building owner and manager. One other reason was the fact that at the time of the interviews the project was close to achieve certification, which was also achieved at a later stage.

³ Anderson Benite is the Sustainability Director of CTE (Centro de Tecnologia de Edificações), a company specialised in the construction sector.



Figure 3-1 Administrative Centre Rio Negro

Source: Reproduced with permission of São Carlos Empreendimentos

The CARN is located in Alphaville, around 25 km east of the city centre, in an area that recently has been attracting some companies. It is mainly due to the fact that there is a lack of space to build new infrastructures and also a lack of office spaces to rent within the heart of São Paulo. The prestige of the Alphaville area is that it is generally considered to be safe and also well connected.

The Centre began being developed around the year of 2004, back then only two buildings were under the drawing board, but other two were already in the pipeline. As mentioned by Revista Infra (n.d.) currently the Centre stands on roughly 23 000 m², being that the built area is approximately 110 000 m². Occupancy in the CARN is composed of office buildings and convenience stores. Out of the four buildings, three are corporate buildings and one of them commercial.

The owner of the Centro Administrativo Rio Negro is São Carlos Empreendimentos⁴, and the manager of the Centre Jones Lang LaSalle⁵. This managing company was responsible for driving the certification process of LEED for existing buildings. According to the Manager of the Engineering and Technical Department of São Carlos Empreendimentos, the certification of the buildings they buy is part of their strategic model. Still, even in cases when certification is not the chosen path, it is always to retrofit and reposition the asset in the market (Kochen, 2011).

São Carlos Empreendimentos, the complex owners, first began the certification with the Brazilian Green Building Council – in early August 2010. It was able to achieve certification – Silver under to LEED categories, taking roughly one year to accomplish the goal of certification. Not all the buildings are certified, as the choice was to certify three of the four buildings – the corporate ones – for practical reasons that had to do with the multi-tenant

⁴ São Carlos Empreendimentos is one of the major companies in terms of investment and management of buildings in Brazil (SCSA, 2006)

⁵ Jones Lang LaSalle is an international company, specialised in investment consultancy and real estate services (Jones Lang LaSalle, 2011)

reality of the building that was left to certify. At the time of the decision to certify the buildings had and still have nearly 100% occupancy rates.

Being built, the first two towers, in the year 2004 the building already presents itself as quite modern and already with some measures dedicated at tackling water and energy usage in its design, such as: elevator traffic controlled via dedicated software, installation of photovoltaic panels, rain water harvest and usage, monitoring the main water consuming equipment (CARN, 2011). Nevertheless, as the owners were aiming for more than just certification, Silver being the desired goal, some retrofitting actions – changes in the lighting of the building façade and its interior; measurement of carbon monoxide levels to allow for automatic extraction fumes in the underground parking lot, amongst others – were still in line in order to achieve the proposed goal

3.3.2 Unregistered Project

The case that relates to unregistered projects is the one of the São Paulo's Business Centre (SPBC).



Figure 3-2 São Paulo's Business Centre

Source: Reproduced with permission of the São Paulo Business Centre

The SPBC began being built in 1973 and was inaugurated in 1977 (still with a few buildings left to be built). It stands on a 200 000 m² piece of land in the South of the city of São Paulo. During the year of 1988 the entire Centre was then finished and as then, currently it is composed of seven buildings with 285 000 m² of office spaces to be rented/bought, and also allowing spaces up to 2 900 m² on a single floor (SPBC, 2011).

From the year 2000 until 2011, nearly 120 interventions were performed – by the Maintenance, Utilities and Construction Department (MUCD) – in the building, adding up to figures around 15.5 million € being that the most significant ones were related to the changes in the systems of the lifts, air-conditioning and illumination (SPBC, 2011; Maran, 2011).

The retrofit projects in the SPBC have been constant since the late 1990s, involving significant costs. Still the way the projects were set up in the first place makes it possible for the owner not to have any significant implementation costs (Maran, 2011) as described below.

Such projects started being developed, as referred by SPBC's Maintenance, Utilities and Construction Manager, from the need directed towards the MUCD to cut on its expenses. As such, the decision was made that the MUCD would start developing pilot projects that would have the ultimate goal of allowing the building to continue to run smoothly, or even better, with a lower budget. The referred decision did not come from the owners, it came from the Department, which suggested that for the first projects, the attached budget would come from the condominium rates, to which the owners agreed (Maran, 2011). Once a pilot project has produced enough data – which is still considered by MUCD's Manager as being very scarce – it is then presented to the owners for final approval in relation to full-scale implementation.

Nowadays, pilot projects still exist, with the same intended purpose as before, but the budget for those comes from the savings of already implemented projects. As such the owner is happy with the overall outcome of the retrofitting actions, as little investment must be made in order to identify savings opportunity (Maran, 2011).

Currently the SPBC has full occupancy on its office spaces, and furthermore it is referred by MUCD's Manager that there is a waiting list of companies wanting to get into the Business Centre (Maran, 2011).

4 Policy and the building sector

The policy body addressing the building sector in Brazil is quite extensive and broad in its scope; it encompasses several aspects amongst others water, air condition system, waste. As such, and in order to put building certification schemes in to context, in respect to various policy instruments, a quick review will be performed.

The already existing policy measures in Brazil have in consideration the way the country is organised. Policy measures can be distinguished both by having a nationwide or state scope. Nevertheless, it is still widely accepted that policy measures and incentives directed solely to the building sector are still lacking (Campos, 2010; ICLEI - Brasil, 2011), mainly economic ones.

Vedung (2007) divides policy instruments into three categories: 1) Regulatory, 2) Economic and 3) Informative. Regulatory policies are those applied by governmental bodies with the intent to influence people, with its set of rules and directives, which instruct receivers to act accordingly (Vedung, 2007). Economic policy measures, also according to Vedung (2007), are those that involve either supporting or taking away material resources, both in terms of cash or kind. As such, such policy measures aim at making certain actions either more expensive or cheaper, in terms of money, time and other valuables. Finally, information policy, encompasses measures which aim at influencing people through disseminating knowledge, communicating arguments in a reasoned manner and through persuasion (Vedung, 2007). Important to refer, is the link between economic and information policies, in which neither of them involve government obligations. As such, the addressees do not have the obligation to act in the recommended manner (Vedung, 2007).

In Brazil, economic policies directed at high-performance buildings is close to inexistent, and as such are not mentioned in the following sub-chapters. Examples of such policy measures can be found in place in the United States, being one of them the Energy Efficiency and Renewable Energy Financial Opportunities, under the Department of Energy. Such policy tool – offering financial assistance – aims at the development and demonstration of renewable energy and energy efficient technologies in the building sector, in such a way that their use increases (U.S. Department of Energy, 2011). One further example, now on a state level also in the United States – New Mexico – is the Sustainable Building Tax Credit. Such tool, aims at driving the private sector design and construction of energy efficient and sustainable buildings (ECMD - EMNRD, n.d.).

In line with the outcome of the Intergovernmental Panel on Climate Change (IPCC, 2007), in 2009 the National Policy on Climate was published in Brazil - Law 12.187/2009 and Decree 7.390/2010 – and together with it reduction targets were set. The GHG emission reduction target was set between 36.1% and 38.9% until 2020 – having the National Inventory of 1990-2005 as a reference – to which the building sector was not excused (Presidência da República Casa Civil Subchefia para Assuntos Jurídicos, 2009). The sector is forced to introduce different mechanisms to its production process that will allow for emission mitigation. If a company is not able to meet the required reduction target, the door is still open to carbon trading.

This chapter will then attempt to summarise the existing policy relevant to the building sector. It focus on the policy tools that are considered vital to the existing building certification schemes in place in São Paulo, and also on the policy instruments that are considered by the author as holding potential to be integrated in the application process and overall LEED scheme, as it is the aim of this thesis.

4.1 Regulatory norms

The Brazilian Association of Technical Norms (BATN), a non-profit private organisation is vital in the topic debated in this thesis and plays an important role in the Brazilian policy scenario. The BATN has been recognised by the government as the country's normalisation entity already since 1992 (ABNT, 2006; ABNT, n.d.). The Association was established in 1940 and from then on supported Brazilian companies by developing and providing a strong base of voluntary norms for their developments of different technologies (ABNT, 2006; ABNT, n.d.).

The BATN develops its work and technical norms through nearly 60 established committees dealing with different issues. For the exercise of this thesis, it is important to point out that the committee dealing with the building sector directly is the Brazilian Committee of the Building Sector (CB-02). It is also important to acknowledge that there are other committees, which are also influencing the building sector, such as the CB-18 – Cement, Concrete and Aggregates (CB-18), Waterproofing (CB-22); Wood (CB-31) and Flat Windows (CB-37).

The CB-02 is responsible for developing and spreading the technical norms that apply to the building sector and while doing so it intends to boost the quality of the sector's products and services (Comitê Brasileiro de Construção Civil, 2004). Currently it has developed around 90 norms which among others address the structure of projects – regardless the used materials, the internal environment of new and existing buildings – regarding thermic, acoustic, visual and air quality issues, the safety of workers and building maintenance (Canal Verde Gaia, 2010). These norms function as instruments to influence the building sector on four fronts: 1) quality – setting standards according to users needs, 2) productivity – standardising products, processes and procedures, 3) technology – maturing, and establishing consensual parameters amongst all actors and finally 4) marketing – regulating buying and selling relations (Comitê Brasileiro de Construção Civil, 2004).

As an example, one could look at the Brazilian Norm 15114:2004, dealing with solid waste from the building sector. More specifically, such norm provides with the guidelines for the project, development and operation timeframes concerning the recycling areas (Associação Brasileira de Normas Técnicas, 2009). One further example of a norm produced by the BATN is the Brazilian Norm 15848:2010, addressing indoor air quality, dealing both directly with air conditioning and ventilation systems as it sets the procedures and requirements towards construction, repairs, operation and maintenance of such devices which affect indoor air quality.

These norms are of relative importance to the voluntary building certification schemes, as these voluntary schemes fully or partly rely on them (Fundação Vanzolini, 2010; GBCB, 2011; Caixa Econômica Federal, 2010). The integration of such norms in the voluntary certification schemes is made by integration them in the provided criteria guidelines and also in developing the criteria itself.

In order to establish the credibility of these technical norms, the work of INMETRO⁶, a third party organisation is important to mention. It is in charge of verifying the compliance of these norms in terms of measuring units, monitoring methods and instruments as well as pre-measured products. Of course the above is not reflecting all the competencies of the institute,

⁶ Instituto Nacional de Metrologia, Qualidade e Tecnologia (National Institute of Meteorology, Quality and Technology) is a federal agency bound to the Ministry of Development, Industry and External Commerce. It aims at *strengthening national companies boosting their productivity through the adoption of mechanism directed at improving product and services' quality* (INMETRO, 2011)

as it is also responsible for encouraging companies to implement and make use of quality management system, amongst several other competences. (INMETRO, 2011).

4.2 Further regulatory measures

Nationwide measures

Throughout Brazil one can find a whole set of regulatory norms, voluntary programs and laws that are either specifically designed to address the building sector or more generic in nature, but still applicable for the sector.

In order to deal with the construction waste, several nationwide public policies are in place. One of these is the Resolução CONAMA n° 307 – CONAMA Resolution dealing with Construction Waste Management from fifth of July 2002. The referred Resolution defines responsibilities of local governments and also of the waste producers in terms of the correct final destination of waste. At the same time, it defines, classifies and establishes where those final destinations are located (SindusCon-SP, 2005).

Statewide measures

According to ICLEI – Brasil (2011), local governments are of determinant importance in terms of the needed promotion of change in the building sector. It is due to them holding the main administrative, economic and regulatory tools to best address the sector. Local governments can also develop 1) minimum requirements directed at the sector – in terms of high performance construction and 2) trainings and information/educational programs as well as 3) fiscal and economical incentives (ICLEI - Brasil, 2011).

São Paulo's local state government already initiated a few actions, which are in line with the above list. The Madeira Legal, Legal Wood Program aims at eliminating the presence of illegally sourced wood from the Amazon forest at the same time promoting the sustainable consumption of such resource (Governo do Estado de São Paulo - Secretaria do Meio Ambiente, n.d.). In order to address the program's aim, three actions were developed 1) Cadmadeira, 2) Reposição Florestal and 3) Sistema DOF. The first is a state registry of legal entities that deal with products and sub products of native origin in respect to the Brazilian flora. The second obliges those who consume products or sub products of forest origins to plant a number of trees – in volume – equivalent to those consumed. Finally, the third action, sets an electronic platform which integrated the transport documents, in relation to forest products, in order to monitor and control the exploration, transformation, commercialisation, transport and storage of such products (Secretaria de Estado do Meio Ambiente, n.d.)

One other regulatory policy tool is the state driven QUALIHAB program. This program was developed by the State of São Paulo and is being adopted in other States. QUALIHAB, aims at ensuring good quality residential buildings, which were built by the state, with the premise that low income families are entitled to good quality, durable housing which at the same time allows expansion in order to follow the growth of the families (SindusCon-SP, n.d.). This measure is of great importance due to the high number of families in need of financial aid within the country.

4.3 Informative measures

Nationwide measures

In late 1985 the National Electricity Conservation Program was introduced. The Ministry of Mines and Energy and the Ministry of Industry and Commerce were involved in the development. An executive department subordinated to Eletrobrás⁷ runs the program. In 1991 it became a government program and both its scope and responsibility were widened. Its objective was, and still is, to “...*promote the production and consumption rationalization of energy, in such way that waste is eliminated and that both costs and sectorial investments are reduced*” (Eletrobrás, 2011). Such program has an impact on building projects, as its demands need to be taken into consideration at a design stage, thus allowing a building to achieve higher efficiency by eliminating waste as is mandated in the purpose of the program.

In 2003 the National Electricity Conservation Program welcomed a new subprogram, the PROCEL EDIFICA, which aims at developing activities towards the disclosure and stimulus of the application of the concepts of energy efficiency in buildings. It is also directed towards supporting national legislation in what concerns efficient buildings and also to contribute towards the energy efficient expansion of the Brazilian residential sector, thus reducing operational costs associated with the construction and use phases (Eletrobrás, 2010). This program has a certification attached to it, the PROCEL Stamp.

Very much active within Brazil is the Brazilian Council for Sustainable Construction (BCSC), which alongside with government departments, is responsible for several information programs that are driven by the need and desire for the country to attain environmental, social and economical sustainability. Some of the main focus areas of the BCSC are sustainability assessment programs, energy related matters and water usage amongst others (BCSC, n.d.) Also on the information side, one can find HABITARE⁸, a nationwide program dedicated to research in the built environment sector and its dissemination to the public (FINEP - Financiadora de Estudos e Projetos, n.d.).

Statewide measures

Water related issues are also addressed by a big set of laws and resolutions on a state level. Also several information campaigns are in place, some which have a pure informational aim while others go for providing information of what it takes to actually establish a water management program, this can be identified the Water Manual from ANA, FIESP and SindusCon-SP (2005) applicable to the state of São Paulo.

As can be understood already from the above mentioned policy measures, both the nationwide government and the state government play an important role in giving guidance and demanding to companies to follow a route that is in line with current environmental and economic demands.

4.4 Voluntary building certification schemes

In recent years several programs, voluntary schemes, such as rating systems directed specifically towards the building sector have been developed worldwide and Brazil has not

⁷ Open capital company that is controlled by the Brazilian government. It is the biggest company operating in the sector of electric energy in Latin America.

⁸ Program developed and financed by both FINEP – studies and projects financing company attached to the Ministry of Science, Innovation and Technology – and Caixa Econômica – Brazilian Federal Bank.

been an exception. These are mostly supported by existing national norms addressing incremental changes and also by project and construction methods to create high performance buildings (Gomes, 2008).

In general, such schemes were designed as easy to understand methods. These, through their simple structures, implicit weights and also through the fact that their development – most of the times – was made in order for it to function as a checklist, allows them to be easily incorporated into the overall construction/renovation processes (Gomes, 2008). Also, according to Gomes (2008), such schemes differ from the previously mentioned policies since they address sustainability differently, as they intend to cover a wider range of issues that are recognised to be important from energy efficiency to water and waste management, while regulatory and economic policy measures often do it subject by subject.

In the city of São Paulo, the main schemes available for voluntary certification are the Green Building Council's⁹ LEED, Fundação Vanzolini's¹⁰ (FV) AQUA and Selo Casa Azul by the Caixa Econômica Federal¹¹. The first two referred schemes came in to the country by means of adaptation of a tool that was developed in other countries; on the other hand the latter was fully developed within the country and is the most recent of all of them.

Naturally, there are differences between the schemes both in terms of their criteria and also in relation to the application process required to undertake if certification is pursued. As such, the following sub-chapters provide a clear and concise description of the three referred voluntary schemes as to better support the objective of this thesis.

4.4.1 Leadership in Energy and Environmental Design

In March 2000, the United States Green Building Council established LEED as a high-performance building certification scheme that is nowadays recognised throughout the world (USGBC, 2011), LEED aims at improving the sustainability of the building sector.

According to Valente (2009) and the USGBC (2011) the use of LEED allows building owners and operators to identify and implement solutions directed at different periods of the life of a building – design, construction, operation and maintenance – which are both practical and measureable. The scheme is built on rating systems that are developed by different LEED committees and also by representatives of the concerned industries. These committees have as main tasks to develop, implement and revise the scheme

The certification scheme can be applied to a wide variety of projects, from new to already existing, and from residential to commercial buildings. The scheme covers the entire lifecycle as referred above (USGBC, 2011). As such, LEED presents several possibilities with the appropriate rating systems, currently the choices are: New Construction, Existing Buildings:

⁹ An United States based non-profit organisation dedicated to acting in the building sector in such areas as energy savings and cost-efficiency (USGBC, 2011). The organisation is now mirrored in several nations around the globe in their own Green Building Council, as is the BGBC.

¹⁰ It is a not-for-profit private institution established on March 1967 with very close relations – in terms of its creation and management – with the Production Engineering Department of the Polytechnic School of the University of São Paulo (USP). The objective of FV, as stated in their website, is to develop and to share scientific and technological knowledge which are inherent to the above referred Department, while maintaining a clear innovative character (Fundação Vanzolini, 2010)

¹¹ The Caixa Econômica Federal, established in 1861, is the largest state owned bank in South America, reaching up to 50 million clients (Caixa Econômica Federal, 2011). During the year of 2009 it was accountable to roughly 70% of all mortgage loans in Brazil (Revista Amazônia, 2010)

Operations & Maintenance, Commercial Interiors, Core & Shell, Schools, Retail, Healthcare, Homes, Neighbourhood Development.

In LEED, a point based rating system, each one of the categories holds a point range, from mere compliance with minimum requirements to the completion of all the requested points, this makes it possible for the buildings to aim at a certain final certification results. If Platinum is what the building owner is shooting for then the point range to be obtained must be very high, if on the other hand simple certification is the aim then meeting prerequisites is at times enough (USGBC, 2011; Valente, 2009).

The aspects under scrutiny through LEED are those that deal with: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, locations and linkages, awareness and education, innovation in operations and also regional priority (USGBC, 2011). Table 3-1 points out the different points attributed to the several aspects to be addressed. Appendix II further develops this information and present the complete checklist table for LEED EB (Existing Buildings).

Under the Innovation in Operations category there is one point, which can be reached by the project proponents if they take on-board and involve a LEED Accredited Professional (AP). These are professionals who had to undertake an examination with the Green Building Certification Institute (GBCI). Such exams are specific to the different rating systems, and as such, a project under LEED EB should have a LEED AP if the project managers decide to pursue the associated point. The application to the exam is made through the GBCI, and involves payment of around 400€. The application and the exam itself need to be renewed every two years (GBCI, 2011). Knowing this, companies either have in their ranks accredited professionals or need to turn to external consultants. But again, this is not mandatory; it is one possible credit to be earned.

Table 4-1 LEED EB Point Based System

LEED for Existing Buildings

Total Possible Points**	110*
Sustainable Cities	26
Water Efficiency	14
Energy & Atmosphere	35
Materials & Resources	10
Indoor Environmental Quality	15
* From a possible 100 points + 10 bonus points	
** Certified 40+ points, Silver 50+ points, Gold 60+ points, Platinum 80+ points	
Innovation in Operations	6
Regional Priority	4

Source: Adapted from the USGBC (2011)

Although LEED is present in 41 countries – Brazil included – the certification process occurs with the GBCI, which performs such function all over the world. Currently, LEED certification is available to offices, service and retail establishments, residential – of four or more habitable stories – and institutional buildings as well as to hotels

The rating system that falls within the scope of this study is Existing Buildings: Operations and Maintenance. LEED Existing Buildings (EB) aims at measuring and monitoring O&M with the objective to reach operational efficiency and at the same time reducing environmental impacts (USGBC, 2011).

Naturally, there are minimum requirements that must be attended in order to be able to engage in LEED EB certification. These requirements are compliance with local environmental laws, which apply to all that falls within the boundary of the certification, being valid for the entire duration of the certification (USGBC, 2011). Further requirements relate to the fact the project must be encompass at least one building in its entirety. It is also needed that the boundary of the project shall be clearly defined and it shall be reasonable – meaning that a LEED project should keep its distance and have identifiable borders with non-LEED projects (USGBC, 2011). Furthermore, LEED EB candidates must comply with other requirements such as minimum floor area (at least 93 m²), pre-defined occupancy rates, commitment to share – with the USGBC and GBCI – energy and water usage data and finally the minimum building area to site ratio (gross project floor area not less than 2% of total land area) with respect to the LEED project boundary (USGBC, 2011).

There are two concepts within LEED in general, that are of relative importance in relation to the context of this thesis, dealing with the rating system outside the United States of America. Those are the Alternative Compliance Paths (ACP) and also the points attributed to the Regional Priority credit. The ACP are the manner the USGBC tackled the need to adapt, the tool to foreign countries, as such they act as a substitute credit providing an alternative to the original requirements, that can or not be used as it is up to the project owner/manager to decide (USGBC, 2011). The ACP aimed at facilitating access worldwide to the tool, by acting on its credits, but not all of the existing credits have ACP attached. Appendix II pinpoints which have and which don't. The other concept is the one related to the last credit on LEED EB checklist, Regional Priority. Again here, there is an attempt by the LEED tool to come close to different global areas by providing a maximum of 4 points to address geographically specific environmental priorities, nevertheless these priorities need to be validated by the USGBC in order for points to be attributed (USGBC, 2011).

4.4.1.1 LEED in Brazil

In 2007, the GBC Brazil was established. It is a non-governmental organisation that, as it states, intends to drive the construction industry in a sustainable path by means of government and civil society discussions, education of future professionals and also promoting voluntary certification schemes (GBCB, 2011). The Brazilian GBC is part of the World Green Building Council – organisation that regulates and motivates the creation of national GBC's – alongside nearly 87 countries also represented there, even if some of them are still not fully established (WGBC, 2011).

Prior to the establishment of the Brazilian Green Building Council, several projects had already been registered with the USGBC. The fact that LEED projects already existed in Brazil prior to the arrival of the GBCB, is due to the fact that there is not the need for its presence for projects to be developed, still it is possible that such projects never reached certification or on the other hand got an extra boost to achieve the intended goal, certification. Nevertheless it is noticeable the growing trend of both registered and certified LEED projects once the GBC Brazil is established, as can be seen from Figure 4.1.

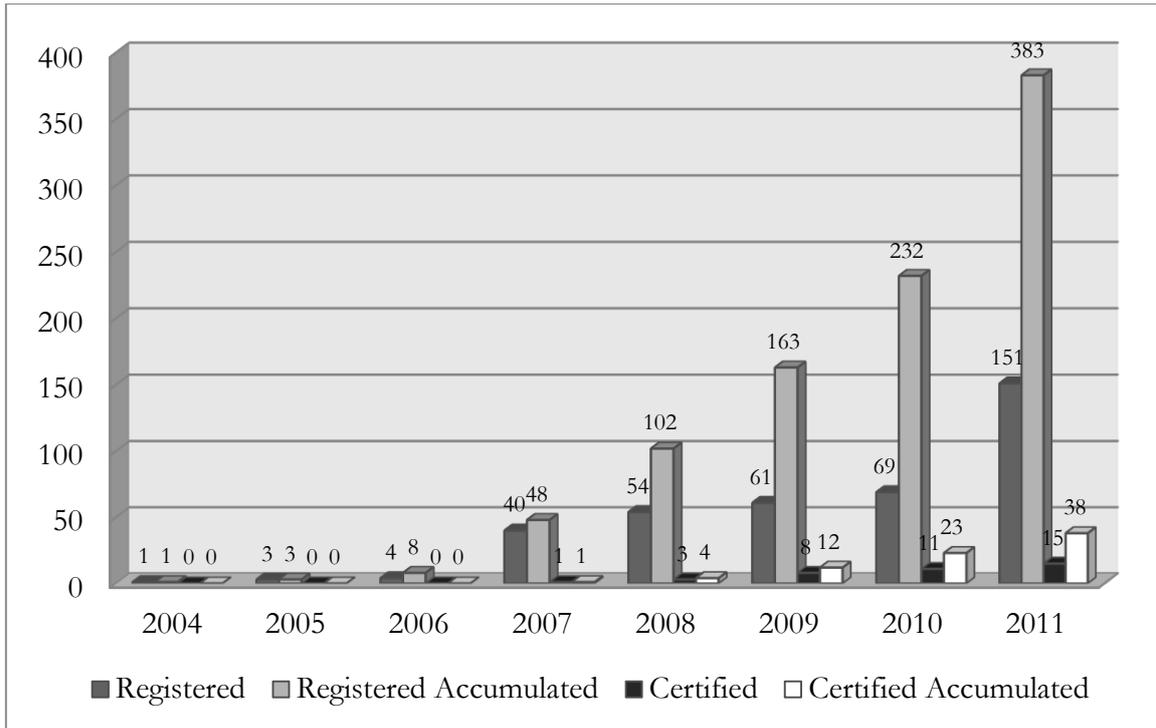


Figure 4-1 LEED Projects in Brazil

Source: (GBCB, 2011)

Out of all the LEED certification projects referred to above, nearly half of them relate to commercial buildings and spaces, and also out of the total, two thirds of the projects occur in the state of São Paulo (GBCB, 2011).

Out of the different rating systems, the one with the most number of projects associated is the one that relates to commercial interiors and also to core and shell, representing a total of nearly 80%, the third most represented system is the one directed at existing buildings (GBCB, 2011).

There are currently in the entire country 134 LEED professionals, being that from those 91 are LEED AP and the remaining 43 are LEED Green Associates¹², again here a growing trend is noticeable from the year of the establishment of the GBC Brazil as seen in Figure 4.2.

¹² LEED Green Associate is a title that be attributed by the USGBC to those who wish to demonstrate their expertise in the field of high-performance buildings in non-technical areas of practice.

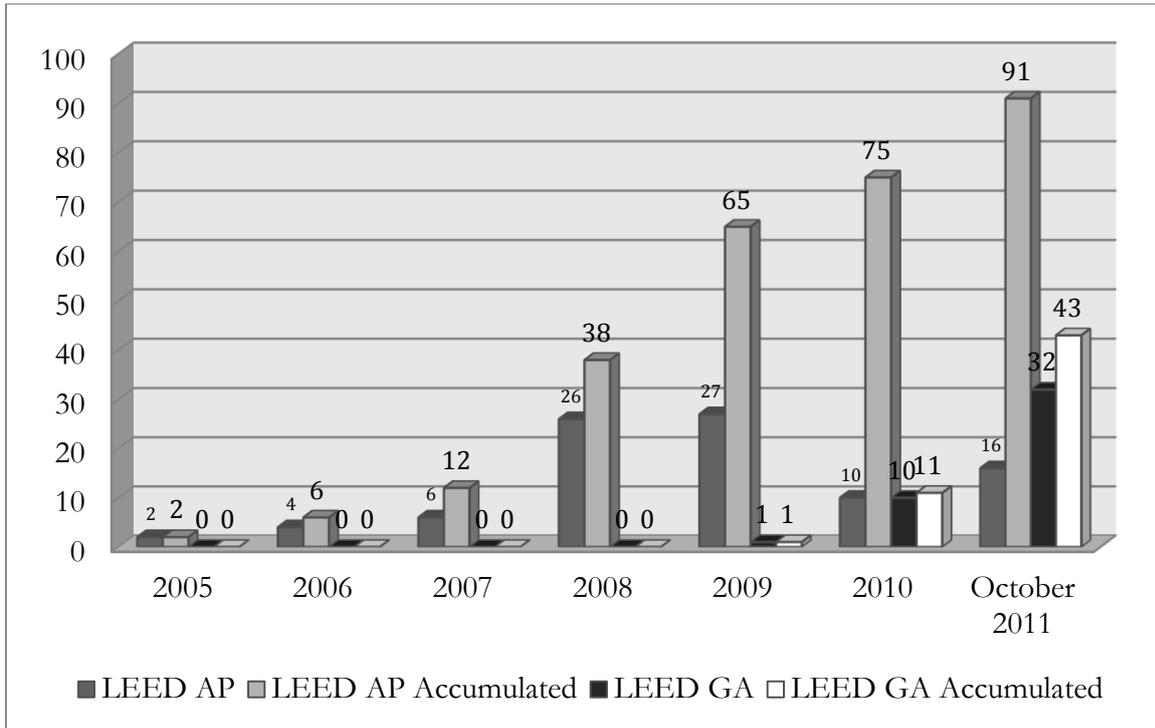


Figure 4-2 LEED Professionals in Brazil

Source: (GBCB, 2011)

4.4.1.2 Application Process

In order to drive a certification the promoter must register the project with the GBCI, and once that step is taken there are multiple tools available that are designed to aid the process (GBCI, 2011). Once a project has been registered, and fees have been paid, the project is made available at the LEED Online resource and it is part of the statistics marked as “ongoing project”. The amount to be paid, as an up-front flat fee can be variable dependent on the nature of the project; still it is fair to say that the value is in average around 750 € to be paid to the USGBC (GBCI, 2011). Also, once the above-described step is completed, the application process further develops with the project team going through the documentation requirements that are specific to each credit and prerequisite. At this stage the project team makes the decision on which credits to go for and assigns its members with responsibilities in relation to different credits (GBCI, 2011).

At this point in the process, it is important that the project team gathers all the relevant and needed information in order to allow for calculations in respect to the existing prerequisites and the chosen credits. At the end of preparing the application process is the collection of all the necessary documentation, which is then uploaded by means of the LEED Online portal. It makes the submitted project available for the review process (GBCI, 2011).

The review of the application documentation is the next step in the process, but in order for this to take place it is necessary that the project owners pay the certification review related fees. These fees are variable in accordance with the size of the project, affiliation with the Green Building Council and also if it refers to a first or appeal review (GBCI, 2011). As important as paying the certification fees, is submitting the documentation relevant to all prerequisites and minimum credits towards certification.

There are in total nine prerequisites in the LEED EB rating system, which are valid to all countries where LEED certification is present. The prerequisites are grouped in four topical areas:

Table 4-2 LEED EB Prerequisites

LEED for Existing Buildings: Prerequisites	
Topics	Prerequisite
I. Water Efficiency	1. Minimum indoor plumbing fixture and fitting Efficiency
	2. Energy Efficiency Best Management practices - Planning, Documentation, and Opportunity Assessment
II. Energy & Atmosphere	3. Minimum Energy Efficiency performance
	4. Fundamental Refrigerant Management
	5. Minimum Indoor Air Quality Performance
III. Indoor Environmental Quality	6. Environmental Tobacco Smoke (ETS) Control
	7. Green Cleaning Policy
	8. Sustainable Purchasing Policy
IV. Material & Resources	9. Solid Waste Management Policy

Source: Adapted from the USGBC (2011)

The final part of LEED EB certification is related to the review of the application, which then produces a first outcome that can be accepted by the project owners as final, if they wish so, or can follow to an appeal process, which will implicate payment of fees and subsequent further review of the credits under appeal (GBCI, 2011). Moreover, if the project owner/manager is satisfied with the outcome of the review, LEED certification is reached and with it the certificate and access to further marketing tools – plaque, certificates, photos – and the chance to figure in the LEED Online Project Directory and US Department of Energy High Performance Buildings Database is offered (GBCI, 2011).

4.4.2 Alta Qualidade Ambiental

The **AQUA Process** certification aims at enabling a given building to achieve high environmental quality through independent auditing procedures.

This voluntary building certification scheme was adapted, in 2007, to the Brazilian reality from the French certification scheme HQE (Haute Qualité Environnementale – High Environmental Quality). It is built on the nations norms, but allows for use of international norms when e.g. Brazilian ones fall short of what is demanded (Valente, 2009; Fundação Vanzolini, 2007). The adaptation performed was made on the criteria level so as to better suit the country’s needs and specificities.

The adaptation exercise, as referred, deals with the criteria of the certification scheme, as the topics – Table 3.3 – are the same when compared to the tool that it is adapted from – HQE. In order to perform the adaptation of the tool, Fundação Vanzolini reached out to the Polytechnic School of the University of São Paulo, more specifically the responsible for the Civil Construction Engineering Department.

Table 4-3 AQUA's Topics and Categories

		Alta Qualidade Ambiental	
		Topics	Category
Management of Impacts on the Outdoor Environment	Location and Construction		Building's relation with its surroundings
			Integrated choice of products, systems and construction processes
			Low environmental impact construction site
	Management		Energy Management
			Water Management
			Operation and Maintenance Waste Management
			Maintenance – Upkeep of Environmental Performance
Creation of a Healthy and Comfortable Indoor Environment	Comfort		Hygrothermal Comfort
			Acoustic Comfort
			Visual Comfort
			Olfactory Comfort
	Health		Sanitary Quality of the Environment
			Sanitary Quality of the Air
			Sanitary Quality of the Water

Source: Adapted from the Fundação Vanzolini (2007)

According to Fundação Vanzolini the benefits that can be attributed to the certification, under the AQUA Process, of a given building touch different areas and actors, such as to the developer/owner – differentiates its portfolio in the market, maintains the assets value through time, boosts sales and/or renting (Fundação Vanzolini, n.d.).

There are also benefits directed to the buyer such as water and energy savings, lower condominium expenditures, and increased value of the asset through time. Finally, certification brings benefits to the social and environmental reality such as pollution reduction, lower impact on the neighbourhood, improved working conditions, green house gases emission reduction, waste production reduction (Fundação Vanzolini, n.d.).

4.4.2.1 Application Process

In order to engage in AQUA certification a building owner/manager shall contact the Fundação Vanzolini, as for all aspect of certification pass through them. The certification is possible to be carried out in relation to different stages of the project independently, meaning that Fundação Vanzolini can issue different certificates for the different project stages – program, design and development (Fundação Vanzolini, 2010).

During the program stage, the project owner/manager should develop and assess the project's needs and define the desired performance profile in relation to the 14 categories – Table 3.3 – available in AQUA. Appendix III mentions the full list of categories and sub-categories of this system. According to Fundação Vanzolini (2010), also during this stage of the application, a

Building Management System (BMS) shall also be developed to ensure that there are enough resources available to achieve the desired profile and live up to the commitment.

During the program stage, an evaluation of the Building's Environmental Quality (BEQ) shall be performed in relation to the 14 performance categories of the AQUA process. Once these steps are fulfilled a certification audit is scheduled with FV. To be able to take this last step, both the BMS and BEQ need to reach FV (Fundação Vanzolini, 2010).

During the design stage of the certification process, the project owner/manager puts its desired performance profile and other project elements as a direct input to the project. At this stage the BMS is maintained and the BEQ evaluated in order to correct potential deviation from original plans. The next natural step is to contact FV in order to call for the second presential audit, which will certify the design stage of the entire project (Fundação Vanzolini, 2010).

The last stage of a complete AQUA is the one dealing with the development of the project. At this point the BMS is maintained; the work is performed, and as before the BEQ is evaluated to correct the possible deviations. The final audit is then carried out by FV, after receiving the last version of the BEQ, and if everything is according to the original plan, the building receives the last certificate (Fundação Vanzolini, 2010).

Important to highlight that in AQUA, unlike in LEED, there is no point based ranking. In this system, the performance profile stands on achieving either Good, Superior or Excellent in the various categories. There is a minimum performance combination demanded in order to reach certification, which currently stands on achieving 7 Good, 4 Superior and 3 Excellent in the 14 different categories.

The FV supplies in the beginning of the process support material, as is the Technical Referential, which guides project owners/managers in developing their application to certification. This guidance lives up to its name as it does not give any ready-made solutions but only proposes paths in order to better perform in a given category (Fundação Vanzolini, 2007).

Currently, AQUA certification is available to hotels, office spaces and schools, and also to residential buildings, as such the technical referential are made available accordingly. In the pipeline is the possibility to open AQUA to hotels, collective housing, and buildings associated with commerce, logistics, health, sports and leisure, industry. According to Fundação Vanzolini (2007) there are variations between the technical referential in order to better suit the type of project under certification, especially in the categories linked with the sanitary quality of the air and environment.

Moreover, in order for a building to become certified it is required to the developer/owner to be in control of the process during all phases – program, project conception, project development, normal operation. FV refers that in order for the above to be achieved it is necessary to develop and maintain a Building Management System that will allow achieving the performance criteria set on the Environmental Quality of the Building, which are the two main documents in terms of achieving certification with AQUA (Fundação Vanzolini, n.d.; Valente, 2009).

4.4.2.2 Main distinguishing aspect

The main aspects, which distinguish AQUA from similar systems (LEED and AQUA) is the mandatory requirement to develop a Building Management System and Building Environmental Quality.

The BMS can be summarised as being constituted by the elements that define the BEQ categories, also, it organises the project around such categories in such a way that allows for them to be successfully addressed. The BEQ reflects the building's capacity – in terms of equipment, site and building itself – to attend to demands related to both control of external environmental impacts and also to the creation of a Comfortable and healthy internal environment. This capacity is expressed by a performance profile of the referred 14 categories and sub-categories, translated by the mentioned Good, Superior and Excellent levels (Fundação Vanzolini, 2007).

Fundação Vanzolini (2007), in the definition of the BMS, refers that such a document should be organised through a distinct set of chapters, starting by the owner/manager's commitment. In such a chapter the project developer should describe the analysis elements in order to define the building's environmental profile and also describe the demands to reach this commitment. The following chapter should be implementation and functioning, in which the demands in terms of organisation are described. Further along the document, the next chapter shall be related to the management of the building. The demands in terms of monitoring, critical analysis of processes, BEQ evaluation and of corrections and corrective actions are described here. The final chapter should refer to learning, where demands related to experience learning and the balance of the project is described (Fundação Vanzolini, 2007).

Furthermore, Fundação Vanzolini (2007) refers that the matters related to organisation, competences, method, means and needed documentation in order to achieve the proposed goals, the needs and expectations of stakeholders and the demands the AQUA system, are in no way dictated by FV; it is up to the project owner/manager to do so (Fundação Vanzolini, 2007). Also, it is referred that such a document – the BMS – and its content, should be passed through everyone and every company operating under the project's owner/manager, in order for everyone to be made aware of its content and objectives.

The BMS can be summarised by referring that it allows project's owner/manager to correctly organise the work of the different actors in order to reflect a good joint cooperation. The BMS also assists in good decision making at the right moments. It is an evolving document, while continuously improving the effectiveness of the system (Fundação Vanzolini, 2007).

Making the bridge from the BMS with the BEQ, it can be said that the BMS integrates within BEQ by means of providing support on its three main stages of evaluation (Fundação Vanzolini, 2007). The BEQ is expressed by the desired performance profile in regard to the 14 categories and consequent sub-categories (marked by 1, 2, 3, 4 in Figure 4-3. Figure 4-3 exemplifies both the sanitary and environmental performance; such profile identifies either the desired or the achieved level for each of the categories in AQUA and its sub-categories. As mentioned before, it is possible to have such a profile for the different stages of the process – program, design and development.

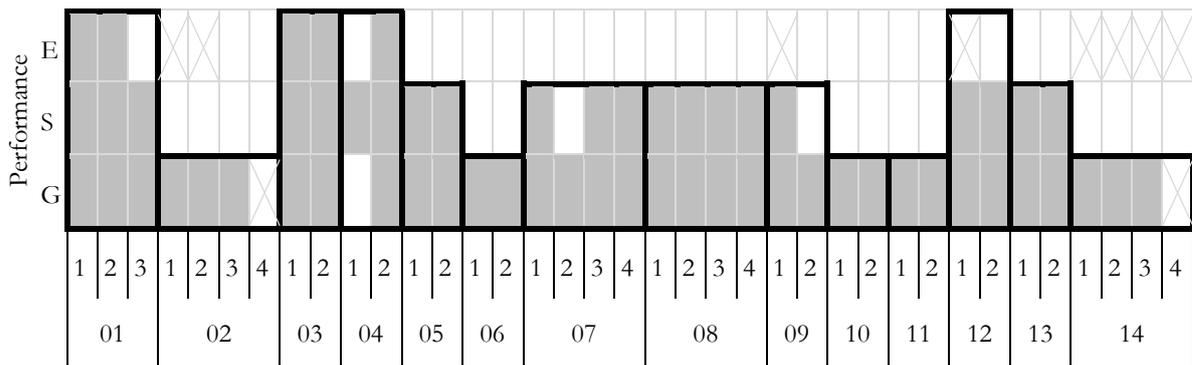


Figure 4-3 Fictitious example of a BEQ profile

Source: Adapted from Fundação Vanzolini (2007)

It shall be noted that such a profile is considered to be unique. Many different actions can be undertaken in order to achieve it, therefore the uniqueness. The justification behind wanting to reach such a profile is supported by the same concerns, dealing with costs, functional challenges, legal and regulatory demands amongst others (Fundação Vanzolini, 2007)

In sum, FV assumes that in order to achieve the building’s performance certification, there is a the need to attend to management matters as well as to architectural and design ones. As such, there is a need to have a strong and effective organisation within the project, which is the reason behind the existence the two instruments (BMS and BEQ). These allow the evaluation of the attained performance in relation to the matters of concern: the BMS referential, which evaluates the environmental management system set by the project owner/manager; the BEQ referential that evaluates the architectural and technical performance of the project (Fundação Vanzolini, 2007).

One additional feature of AQUA’s systems related to its evaluation stages, is the need for a system to be flexible. FV recognised this need and introduced the equivalence principle, which is only to be put in practice for the superior and excellent levels. The principle derives from the recognition of the fact that both architectural and technical solutions can be extremely varied, and thus cannot be foreseen, and also from the desire to drive innovation (Fundação Vanzolini, 2007). In order to make use of the principle, the project’s owner/manager should present, and justify, an alternative method, based on other criteria than those proposed by FV, to evaluate the building’s performance, of a given category/sub-category. By allowing the system to run in this manner it becomes more complicated and complex than the evaluation process run by FV. The Foundation leaves it open to call in specialised support in order to correctly perform the auditing task, without losing the inherent quality of the overall system (Fundação Vanzolini, 2007).

4.4.3 Selo Casa Azul

The Selo Casa Azul (SCA) – the Blue House Stamp in English – is the third voluntary building certification scheme also present within the city of São Paulo.

The SCA scheme was developed by Caixa Econômica Federal (CEF) and unveiled on June 2nd 2009. It is the first voluntary building certification scheme completely developed in Brazil to be used in Brazil. According to Benevides (2009) and Caixa Econômica Federal (2010) the main driver behind the development of such certification scheme is to promote sustainable construction methods amongst the companies within the sector. It was also pointed out that, by developing the scheme it would be possible to adopters to reduce maintenance costs, as well as to cut on the monthly expenditures.

In order to develop the methodology behind the SCA, a technical team was assembled from within the CEF, which as referred by Caixa Econômica Federal (2010) had vast experience dealing with housing and sustainability management projects. Nevertheless, CEF also made use of the consulting services of a group of experienced multidisciplinary professors from different universities in the country – Polytechnic school of the University of São Paulo, Federal University of Santa Catarina and also from the State University of Campinas.

This certification scheme is not as broad as the above referred AQUA or LEED, instead it is directed at all housing projects that approach CEF for financing or to those that opt for financing from the state government but still through CEF. The range of entities that can apply to the certification is wide and encompasses building companies, government, public housing companies, cooperatives, associations and entities that represent social interests (Caixa Econômica Federal, 2010; Benevides, 2009).

Upon successfully finishing a certification process under CSA, CEF attributes one of three possible levels – Bronze, Silver or Gold – being that those differ by the number of criteria project owners/managers intend to achieve (Caixa Econômica Federal, 2010; Benevides, 2009). There are in total 53 evaluation criteria (see Appendix IV) spread over six categories: 1) Urban Quality, 2) Project and Comfort, 3) Energy Efficiency, 4) Conservation of Material Resources, 5) Water Management and 6) Social Practices.

Additionally, still regarding the available levels, it should be pointed out that there have been established limits, as such the Bronze level will be attributed to projects that do not overshoot, in terms of the value of housing unit – relating to its selling value – the values shown on Table 4-4. At the same time, all the projects that go over 55 000 € in the same unit, must aim at a minimum level of Silver, an intermediate level, in between the lowest – Bronze – and the highest – Gold. (Caixa Econômica Federal, 2010). In Appendix IV the requirements to reach certification within each of the levels are described.

Table 4-4 Evaluation Limits and Locations for the SCA Bronze Level

Location	Value of Housing Unit Evaluation
Federal District	
Cities of São Paulo and Rio de Janeiro	Up to 55 000 €
Municipalities with 1 million, or more, inhabitants within the metropolitan regions of the state of São Paulo and Rio de Janeiro	
Municipalities with 250 thousand, or more, inhabitants	
Integrated Region of the Federal District and Surroundings on the remaining metropolitan regions and in the municipalities in conurbation situation with the state capitals (except São Paulo and Rio de Janeiro)	Up to 42 000 €
Remaining municipalities	Up to 33 000 €

Source: Adapted from Caixa Econômica Federal (2010)

Still, before a project dives into certification it shall firstly be in line and attend to the scheme's prerequisites. As referred by Caixa Econômica Federal (2010) it is vital to present the

documents that verify that the project to be certified is fulfilling all legal demands applicable to all building projects – as is the approval by the local government, the proof of feasibility by the water and energy providers, the construction permit and an environmental license to name a few – and of course, acceptance of the terms of financing with the CEF (Caixa Econômica Federal, 2010).

Furthermore, the project must comply with the requirements of another program of CEF, related to wood sourcing control – Ação Madeira Legal¹³, in English Legal Wood Action. Also, in relation to building accessibility, it is required that the project should attend to the requirements of the Brazilian Norm 9050¹⁴. It shall comply with municipal or state percentage of adapted housing within the entire project, although if no legislation exists, a 3% minimum should be adopted (Caixa Econômica Federal, 2010). In the state of São Paulo, no figure was found relating to the above requirement, so it is assumed that the proposed minimum applies in this case.

Finally, it is crucial that the project owner/manager when designing the project and specifying the services and materials to be used, it does so while attending to the BATN's technical norms whenever applicable (Caixa Econômica Federal, 2010).

4.4.3.1 Application Process

In order to start the certification under SCA, the proponent must express such interest with CEF, from which the proponent will then receive guidance documents and full support regarding the application registration. The project shall be presented alongside with all the necessary documentation and technical information – some of which already referred above – related to the project at hand, and it shall be dated and signed by the legal representative and by the project's technical responsible (Caixa Econômica Federal, 2010).

Like the other voluntary schemes, There is a fee to be paid in relation to the analysis of the process, that varies according to the number of housing units of the project, and has a set maximum of around 140€. This fee is based upon the following equation:

$Fee = 40 + 7*(n+1)$ “*n*” is the number of housing units (Caixa Econômica Federal, 2010).

It is referred that if the project is to suffer any change in relation to the defined and chosen criteria, this must be communicated to CEF. During the construction period, the project owner/manager shall attend to all the referred pre-requisites, put into practice the entire social practices foreseen in the design stage among other actions supported by the certification scheme's criteria (Caixa Econômica Federal, 2010).

As in the AQUA process, the achievement of the proposed criteria is verified by means of presential audits that can occur either on a monthly basis or on specific dates. If non-conformity is found, it is then registered in the monitoring report of the building and CEF will then officially demand the issue to be addressed and justified. If the non-conformity is not addressed and resolved, CEF holds the right to suspend the use of the SCA Caixa logo and prohibited to reapply to SCA for a period of two years (Caixa Econômica Federal, 2010).

¹³ By attending to the requirements of this program, the construction company must by the end of the work have delivered the Forest of Origin Document, in which it will be stated the volume, the species and final use of the wood in the construction site (Caixa Econômica Federal, 2010)

¹⁴ Brazilian Norm 9050 – Building, site, furniture and urban equipment accessibility towards handicapped people (Associação Brasileira de Normas Técnicas, 2009)

Also, if non-conformities are persistent and no appeals are left the proponent incurs in a fine up to 10% of the total investment of the project to be paid to the CEF

One last requirement is related to a criterion under category 6 – Social Practices – which deals with the Residents Guidance, in respect of which an owner’s manual must be prepared by the project proponent (Caixa Econômica Federal, 2010). The manual must contain information on the SCA criteria, must be simple and educational, and also must contain guidance to the most efficient use of the equipment installed.

Once the project is approved by the CEF, the project proponent will be notified on the level attained. As referred above, regarding certification expenses, there are no further expenses than those related to analyse the application (Caixa Econômica Federal, 2010). Also, at the end of the process, the proponent will receive all the due marketing material.

4.4.3.2 Main Distinguishing Aspect

Several aspects distinguish SCA from both LEED and AQUA. The SCA methodology does point the way to go in order to achieve a good level of performance in each criterion by providing a non-exhaustive list of actions that can be followed. Nevertheless, these are by no means mandatory to follow as they serve more as guidance, still, it is pointed out that choices must be made according to the type of project to be certified (Cardoso, Prado, & Vanderley, 2010).

In line with such a position from the CEF, it is then mandatory to develop the Project’s Agenda. This document has as the main goal to identify the project’s relevant social and environmental aspects, thus it plays a guidance role in order to select the proper and correct actions to be taken, keeping in mind the available resources and users’ characteristics (Cardoso, Prado, & Vanderley, 2010). According to the same authors, this document – having good quality or not – will dictate the socio-environmental sustainability level of the entire project.

Proposed by CEF, there are a number of criteria that should be attended when developing the Agenda: proponents socio-environmental priorities; project’s regional social and environmental conditions; functional characteristics of the project; characteristics of the project’s surroundings; legal and regulatory demands; users and their characteristics; costs (Cardoso, Prado, & Vanderley, 2010).

Naturally, the document is not carved in stone, as the project might go through changes due to a multitude of factors, thus influencing the criteria being addressed. As such, CEF allows for changes – as long as the overall final level remains the same – in the Agenda, which needs to be communicated and consequently approved by the technical departments within CEF, before the project proceeds (Cardoso, Prado, & Vanderley, 2010; Caixa Econômica Federal, 2010).

The CEF goes one step further and prioritises a list of areas that project proponents should definitely not neglect, such as the establishment of a suitable socio-environmental management system (Cardoso, Prado, & Vanderley, 2010). The same source indicates a set of processes that should be implemented in the beginning of the project and throughout its different phases: project’s social and environmental performance agenda planning; project planning; responsibilities and authorities; competences; contracts; communication; document and report control; monitoring and critical analysis; project’s social and environmental performance evaluation; corrections and corrective actions; continuous improvement.

5 Connecting I-beams

As referred in Section 2.1.3.2, data analysis was performed by making use of a five-step approach, which culminated in the data interpretation, the backbone of the current chapter. The objective of the analysis process of this thesis is to allow data to be analysed in terms of the different projects and different voluntary building certification schemes in such a manner that it would be possible to identify specific areas/tools in which LEED's application can be strengthened.

The approach taken makes it then possible to utilise the collected data from interviews with stakeholders of both certified and unregistered buildings, and also from the literature review, and to relate them to the four tiers of the adapted theoretical framework, in order to identify connections and patterns within the gathered information. As such this chapter is divided into three sections, being that the first one deals with the findings and analyses directly related with the presented projects and the four tiers in order to allow answering the research questions:

RQ1: How can LEED EB in Brazil be strengthened, by means of integrating features from other voluntary certification schemes?

RQ2: How can non-registered projects – in Brazil – benefit from using available building certification schemes to achieve higher performance levels?

The second section is built around the voluntary certification schemes, the information gathered through the literature reviews, in such a way that it analyses the different options in respect to strengthening the process behind LEED. The final section will make use of the outcome of the previous two sections in order to better launch and prepare the final chapter of the thesis – Discussion and Conclusions.

5.1 Two projects and four tiers

One of the most intense connections that was clearly identified through the gathered information was the agreement between all the interviewees, and also confirming the state of the real estate market in the city, regarding the importance of retrofitting projects, as these are seen as capable of revitalising or bringing the building back stronger to the market.

As summarised in Table 5-1 the interviewees from both projects do share some of the perceptions, as some similarities came to light, but nevertheless, there are a few differences that allow for distinction.

In terms of the **first tier – O&M (Operation & Maintenance)** – all respondents answered extensively to the perception of both costs and benefits associated with operation and maintenance actions. Still, the interviewees from the LEED certified project seem to be more aware of the implications – the direct cause/effect relation between O&M actions and its inherent cost/benefit – such tier holds, due to the fact that the proponents of these voluntary schemes are engaged in supplying and spreading such information directly.

Still on tier 1, it is referred by those involved in LEED certification projects that the guidelines of these systems aid the recognition of the relation between the costs and benefits involved. It was also referred that such reliance might also lead in the opposite direction, as a blind trust in such guidelines can be developed and therefore not helping the project owner/manager in correctly identifying the associated costs and benefits.

One difference between the projects in relation to this tier – even though not exclusively as it becomes transversal to all others – is the fact that in the unregistered retrofitting project, all the existing actions are developed from internal need and by a department operating within the complex and not from a set of externally demanded guidelines. As referred by the MUCD Manager, at a certain point the department had to cut cost and began developing pilot projects to present viable solutions to satisfy the top management’s demands. In this case, the MUCD needs to extensively report to the owners of the complex on both costs and potential benefits drawn from pilot projects before full-scale implementation. Furthermore, O&M projects have been developed at SPBC, and still are, in such a fashion for nearly 20 years now, conferring the MUCD with good working knowledge of costs/benefits in such kind of projects.

In relation to the aspect that links O&M practices to the market, a clear connection between good and effective practices and the “appetite” for the building in the market is common to both projects. This is backed by the notion that good O&M practices help in keeping the running costs low – even if quantitative data is not abundant – thus rents are able to be competitive which then attracts interest.

Another common feature of both projects, in which interviewees agree, is the notion that a certification scheme does help reducing the costs associated with O&M. This notion is supported much more on marketing campaigns and information processes conducted by the proponents of such schemes, than through the actual quantifiable realisation of such savings. Important to refer that the interviewee related to the uncertified project also shares the above opinion, although the decision to engage in a certification process does not rest on him. As such, SPBC owners are aware of the potential added benefits and reduced costs that a certification might bring, derived from the MUCD manager’s perception, but still not interested in certifying, as they are content with the financial returns and overall current building management.

Within LEED’s EB criteria there is one criterion, which is necessary to be mentioned as it is both relevant to the thesis and to the overall strength of the tool. The criterion, *Documenting sustainable building cost impacts* under the *Innovations in Operations* category has the potential to deal with the lack of quantitative data. It came to light during the interviews related to the LEED EB project. Project owners/managers who are willing to attain the available point this criterion holds shall engage in providing documentation supporting the data referring to the building’s operating costs for the previous five years, or the construction date if the building is more recent. This data documentation must be developed while also maintaining records of changes in operating costs during the building’s performance period (USGBC, 2011).

Furthermore, it is also required to document the costs and financial impacts of all LEED EB aspects on the building’s operations, and all the referred necessary actions to fully achieve the criterion point must follow detailed instructions supplied by the USGBC.

As such, a tool that could aid the correct identification and track keeping of costs related to retrofitting projects is contemplated within LEED EB, but nevertheless as a voluntary measure. Although the criterion exists, from the answers collected during the interviews with the responsible for the LEED project and remaining respondents involved in other LEED projects, it is then realised that such criterion is not that popular, otherwise the answers could have been different and the perception of each tier could have been backed with solid data.

As the criterion is not mandatory, as the definition of the word states, project owners/managers are not obliged to tackle it. The reasons behind not addressing the criterion might be in line with the difficulty to fully access all project related costs and financial impacts

from a period long before engaging in building certification. One other possible reason might be related to the fact that such criterion only carries one possible point for the overall score, thus it is possible that its attractiveness to be tackled is not that high.

In brief, both cases appear to share roughly the same perceptions of costs and benefits associated with Operations & Maintenance actions – and the consequent impacts – when applied to achieve the status of high-performance buildings. Still, and in line with what has been referred above, this perception seems to be a little more developed in the certified case, even if in the uncertified project this perception is more easily backed up with hard evidence – quantitative data on retrofitting projects' costs and potential benefits – due to the project's development nature.

Furthermore, the notion that there is room for improvement in terms of aiding the quantification of cost and benefits related to this first tier are emphasised by all interviewees, related to both projects. Therefore the need to alter and/or improve the current practices is a presence in both projects.

Also, it is important to be referred that building owners/developers should not overlook from the beginning setting up a clear and focused O&M plan, from which can later be derived specific data – through monitoring – from the chosen practices that can in turn be related accurately to the overall expenditures of the building (English, Sanvido, & Harrisberger, 2011; McEtroy, 2007). By acting in such a manner, it is mentioned that once a good O&M scheme and consequent interventions are in place, the desire from the owners in further developing such measures will increase making this a continuous loop of improvement (McEtroy, 2007).

The perception related to costs and benefits associated with **productivity – tier 2** – differs between projects. A vague association is present in all interviews, it is however difficult to establish a clear link between productivity and the costs and benefits. It is because when actions are developed they are mainly developed with O&M in mind and that the increase of productivity – or decrease for that matter – happens most of the times without intention.

On productivity, the Technical Director and LEED AP at Cushman & Wakefield South America Operations refers that one of the most important factor related to this tier is the perception of the user once the retrofitting projects has been carried out. There is then the clear need to involve the space users in order to correctly and accurately assess if a given project – switching the lighting systems as an example – impacts on the overall productivity of its workers, thus creating benefits – or not – towards the project owner/manager, which is not demanded under LEED EB scheme.

In the case of the SPBC, MUCD's Manager has the opinion that productivity driven actions are of great importance, as these have the potential to produce higher rent values, if the tenants realise the added worker satisfaction/productivity from the retrofitting projects.

The costs and benefits perception related to productivity within both projects is present as referred, but still hard to pinpoint. Nevertheless, there was one fact that all interviewees agree upon and that is related to the mentioned fact that the workers/tenants need to acknowledge the retrofitting actions and provide feedback, still only on the uncertified project was this said to be performed. If this is not happening, it is difficult to address increased – or decreased – productivity issues by the project owners/managers. All interviewees referred that the logic behind this notion is that if the worker/tenant realises the retrofitting actions allowed the company to achieve higher productivity figures, only then can the owner charge higher rent values, and reap the benefits of such cost. The Development Director and LEED AP at

OTEC – *Optimização Energética para a Construção*, a sustainability and energy efficiency consulting company – supports the above idea by referring that building certification only goes hand-in-hand with added value if it is perceived by competitors, public, future tenants to name just a few.

All interviewees refer **corporate image**, the **third tier**, as being crucial. The link between costs and benefits is seen as very much present by all interviewees, still it is referred, as being very difficult to quantify if on the table are actions that fall out of those directly applied in marketing, such as retrofitting projects that do not have a direct, identifiable, link to corporate image improvement.

Nevertheless, all interviewees state the importance of a clear link between cost/benefits and marketing. They also claim how important it is to include marketing in retrofitting projects in order to let the general public and possible future tenants know of the actions developed. The Engineering and Technical Department Manager of São Carlos Empreendimentos, is of the opinion that both the certification in itself and the process behind it include a clear marketing approach in order to potentiate results.

The fact that certification usually comes with a flag or a medal to host in the building lobby, makes the situation of public recognition of the certification as highly visible and thus important to boost its image. Of course, in LEED, the marketing aspect is inherent to the process, but still with room for improvement. As referred by the SPBC project, an effective marketing plan allied with retrofitting projects serves the purpose just fine; the important factor is to closely link both.

The perception of the benefits behind corporate image boost is, amongst the interviewees, very much related to the current state of São Paulo's real estate market, which is crossing a time of scarcity of available office spaces, thus all that can be done to come out with an improved image is done without looking at means. Such perception is shared by a professional working with Cushman & Wakefield South America Operations whom goes further to state that return periods are nowadays not in the equation of financial expenditures with retrofitting operations.

In brief, tier 3 related issues, even if difficult to quantify, are present in the mind of all interviewees, as it is widely accepted that the way a company is seen in the eyes of the general public reflects their actions. Important to refer that interviewees of the first project, CARN, refer that LEED certification does just that, by allowing the public to realise that project owners/managers are engaged in more than just the normal day-to-day business of running a building; here is where project owners/managers benefits lays.

The project owners/managers understanding related to **tier 4 – environment and economy** – is the one all interviewees expressed more concerns about, although when asked to elaborate in terms of costs and benefits of such externalities neither case can identify which costs are associated to which benefit, as these are part of exercises that they are not used to perform. Furthermore, during the interview process it was noticeable that there were also difficulties to pinpoint what are the actual externalities related to retrofitting action in high-performance buildings, let alone the costs and benefits associated with projects to tackle them. As such, one can say that there is no perception of the costs and benefits within this tier, only the realisation that they are important; still, no action is taken in order to correct such disparity.

Nevertheless, it is important to refer that in the CARN project, the externalities are seen as being addressed by the LEED EB certification procedure and as such dealt with, even if the

difficulties mentioned above are present. One of the functions of the promoters of such tools is to disseminate information, and information related to this tier is one of the most common, as it is pushed as one of the positive impacts of the certification process – internalisation of the costs of externalities. Nevertheless, the information provided is not accompanied with quantitative data to back up such positions, which in turn is not enough to stop making the expectation to reduce the building’s negative environmental and social impacts as main drivers of certification as is referred by the GBCB’s Technical Manager.

In the SPBC case, externalities costs/benefits are not part of the decision-making process, but nevertheless MUCD’s head highlights their importance. This awareness is in part due to the availability to information from within the building sector, which is widely available from the government, the union and also from non-governmental organisations. Again here, data in the quantitative form is scarce and identification of externalities is difficult.

All interviewees agreed that actions destined to reach a certain tier, will either voluntarily or involuntarily affect all other tiers, as the relationship between them is, as referred by all, one of the strongest aspects of retrofitting projects.

Table 5-1 Summary of both cases’ perception of costs and benefits associated with the different tiers

	O&M	Productivity	Corporate Image	Environment & Economy
Certified	High awareness, reliance on certification guidelines	Average awareness, derived from the actions of O&M	High awareness; perceived as easily accessible	High awareness; promoters and certification tool push the idea
Common Aspects	Always good investments if projects tackle the correct/needed aspects	Tenants acknowledgement and involvement is crucial	Retrofitting and marketing must go hand-in-hand	Of great value if clearly identified and properly quantified
Unregistered	Average awareness, self developed guidance through a dedicated department	High awareness; Increasing productivity is part of the main reason to develop retrofitting projects	High awareness; clear link between marketing and retrofitting	High awareness; no role in decision-making

As seen in the above figure, there are similarities amongst both projects – as identified by the row with the white background – and ranging through all defined tiers. Of course there are differences in terms of the perception of the different tiers, as expected, but nevertheless the connections between both present themselves stronger than the diverging aspects.

Retrofitting actions are seen in both projects, in respect to O&M operations, as investments that should be clearly adopted, regardless of the presence of LEED certification, as is referred both by the Manager of the MUCD and SPBC and also by the Manager of the Engineering

and Technical Department of São Carlos Empreendimentos – CARN’s owners – as well as other interviewees. Also constant to both projects – and agreed by the above referred interviewees – is the acknowledgement that only if tenants realise that there has been an increase in productivity – from developed actions – can there be an effective perception of costs and benefits of such tier, by the project owners/managers.

Regarding corporate image, there is a clear acknowledgement of its importance, and the pattern identified relates to the connection made between retrofitting actions and marketing. Amongst interviewees the notion of the importance of how the company/building is perceived by the general public in order to be attractive exists, even, if such awareness is not comprehensively backed up by quantitative data – what costs generate what benefits. Regarding the last tier, the connection made between cases is the clear link there is in terms of accepting its importance, if properly quantified and clearly identified, still it is referred that with the current project’s practices it is very much difficult to do so.

5.2 “Rotten beams” in high-performance retrofitting projects

In a retrofitting project is common to come across a few “*rotten beams*”, in the case of high-performance retrofitting projects there was one that was clearly identify.

One of the clearest patterns that was brought to light during the data analysis was the fact that all interviewees, with almost no exceptions, referred that there is one distinct factor that seems to hinder retrofitting projects, let alone certification processes; the identified factor is **multi-tenancy**. The Senior Infra-Structure Manager with Jones Lang LaSalle on multi-tenancy issues, is of the opinion that it is very difficult to align every tenant in the same line of thought thus certification, in his project LEED EB, becomes hard to accomplish.

As referred, the above opinion is reflected upon all interviewees, with the exceptions of the promoters of such voluntary schemes, the Brazilian Green Building Council and also Fundação Vanzolini.

In brief, there seems to exist some difficulties in making all the involved parties to agree on the retrofitting actions that need to take place, as such, many times – as referred by all – projects simply stop, or work their way around such barriers. The interviewees refer that there is already quite a good deal of information sources – as mentioned in Chapter 4 – that can be used in order to attempt to persuade tenants to be involved and allow for retrofitting action within the space they are renting or have bought, but still the information is far from the clear and convincing quantitative data. Furthermore, it is acknowledged that there is room for existing procedures – both in terms of a certification tool or an uncertified project – can and should be altered in order to allow minimisation of such barrier. As with every retrofitting project, a rotten beam is always possible to be corrected and the building will come out stronger than before.

5.3 Within certification schemes

This sub-chapter will serve one of the main purposes of this thesis, namely in what way LEED can make use of the different voluntary building certification schemes to strengthen its process.

Firstly, it is acknowledged that choosing which voluntary building certification system to be used is often a political decision made by project owners/managers – who can sometimes also be influenced by the main offices overseas or by strong lobbying from the system’s proponents. This was mentioned several times throughout the interviews. It was also

mentioned that most of the times there is no research to understand what the options are in the market and which one would better fit the project and its goals.

As such, bringing the systems together in order for one to come out of the process stronger might appear to be overkill, but it is the author's perception that by doing so, not only does it strengthen its process but provides the entire building sector with valuable information on different options and possible tool's integration amongst the schemes.

In respect to the voluntary building certifications schemes in the city of São Paulo – LEED, AQUA and SCA – there are clear differences between such tools but also similarities between them.

One aspect that clearly tells them apart is in their applicability, meaning that they cannot be applied to the same kind of projects. As already mentioned in the beginning of this thesis, the LEED's rating system under observation is the one related to Existing Buildings. Of course LEED in the scope of this thesis is applied to office space buildings to which SCA cannot be an option, as it is not directed at that particular market segment. One other differentiating factor, now between LEED and AQUA, is the fact that the latter is only applicable from the early stages of a project until it has been fully built as referred in sub-chapter 4.3.2 as opposed to LEED EB operation and maintenance focus.

As such, in the following sub-chapters an analysis is performed in respect to both the scheme's application process, to the criteria and finally lending special attention to the documents required.

5.3.1 Application process

With regards to the application procedure, each project owner/manager shall undergo this process in order to kick-off the certification. There are a few differences between the different schemes. The application procedure inherent to the LEED certification is quite unique in comparison to the other two voluntary schemes. In LEED, there is at no point in-person interaction with the certification body. Of course, the GBCB bridges the process at an initial stage, introducing the project owner/manager to the ins and outs of the certification. On the other hand, both SCA and AQUA and their proponents, FV and CEF, seem to have a much more participatory role in the entire process. By this it is meant that they are both the proponents of the scheme and market it, as well as deal with the entire certification process.

There are benefits to the application process of LEED certification, and as mentioned during the interviews, is the fact that the GBCI once a project is registered opens up a whole array of documentation that is available at any given time, on an internet website dedicated to the project owners/manager. Under LEED, as previously mentioned, all documentation review is performed by the GBCI, which requires that the required documents shall reach the GBCI through email or other means. The decision is taken solely based on the documentation sent as no audits are performed.

It is becoming clearer as the years go by that LEED is establishing itself as *the* voluntary building certification tool throughout the world, still it could be argued that such easiness to address certification, in terms of the application process solely, might be working as a booster for the worldwide number of projects. Still, one could question if the approach is the most credible one – one certifying body for the entire world – since, as it was previously addressed, LEED does in fact need correct and precise adjusting to the country's reality.

Still, as mentioned, there are no personal external audits for the developed projects, and if a company can do just as well without it, it is very unlikely that any company interested in the certification will invest additional resources – time and money – for an external audit.. it shows again that, choosing which voluntary scheme to embrace is not a straightforward process.

5.3.2 Schemes' Criteria

The objective of this sub-chapter is to identify areas within LEED's criteria that could be strengthened, by taking in the requirements from other schemes. Still, it is acknowledged that the exercise of adapting LEED to the Brazilian reality, by the GBCB, addresses mainly such criteria, but not in the manner that it is performed in this thesis.

As such, it presents itself as a good opportunity to scrape the surface of the three presented certification systems and point out possible areas where LEED can be strengthened as a tool and others where it clearly stands out as a model to be followed. The author believes that by doing so, added value is conferred to the thesis and to the reader.

From the interviews conducted to those engaged in LEED certification, there was an overall agreement, which relates to the fact that the scheme is built around a broad set of criteria, which enable them to know which areas to address in a much easier way. The working practices within SPBC that does not have set criteria to follow, or the guidelines to achieve those, represent a completely different situation. There all retrofitting actions are dealt one-by-one hence taking a considerably more time to identify all necessary action to be taken when compared to a certification project. As such, an unregistered project requires more time and money, in order to establish which areas will be tackled in order to be able to attain the same high-performance level which is made possible by a given certification's scheme criteria.

Within both AQUA and SCA one can clearly apprehend that the certification systems address a project from the beginning, while in case of LEED EB it is taken from the point once it has been built and then it tackles O&M solely. One example of such criteria is the one in AQUA under the category *Integrated choice of products, systems and construction processes*. Those issues are better dealt at the design stage of the entire project as they are tackling the entire *Building's end-of-life*.

As was previously referred, there is only one certification scheme, which was developed in Brazil; the other two have been adopted from other international systems. As such, SCA criteria were developed having uniquely the Brazilian reality in mind, therefore distinguishing itself from the other two schemes. This fact is very much evident in its last category of the certification tool, the one addressing *Social Practices*. In the author's understanding and according to a trend that has accompanied the Brazilian building sector's work force, its lack of qualifications and preparedness (Amorim, 1996; IBDA, n.d; Ventura & Araújo, 2007; Brito, 2010), makes this category a valid and important one, which shall not be overlooked by any present or future schemes.

Of course one might argue that within LEED a project owner can make use of the final credit in the scheme – Regional priority – and present actions directed at for example Employees environmental education as SCA does. Still such a proposal, under LEED, must be accepted by the USGBC as valid to undertake and worthy of receiving the correspondent credits. This process seems to be cumbersome, in comparison with SCA. Especially because in LEED, it would still remain as a voluntary action, while SCA sets mandatory standards, where three out of the eleven criterion shall fall under the Social practices category: *Education for construction and demolition waste management*, *Employees environmental education* and also *Residents guidance*. Criteria

such as the latter criterion are of great aid in order to overcome resistance to change, which is the case in the described projects with the issue of multi-tenancy in retrofitting projects, as it allows the involvement of all in a project.

Finally there is a characteristic, or a possibility, within AQUA to engage in what is called the equivalence principle as previously mentioned. This was set with innovation in mind, not flowing from the scheme's proponent to the project owner/manager but the other way around. If we consider that the GBCI does everything at a distance, there is a good chance, even with the presence of a Green Building Council in the country, that all related to building industry innovation within the country not to reach them. As such, such principle would play an important part in further adapting the criteria to the recipient country. Of course, the introduction of ACP is in some way related to this principle, but it only has the power to affect the criterion's guidelines – how to reach the criterion goal – it does not envision a full criterion change, adaptation to innovative solutions.

5.3.3 Valuable Documents

While projects following LEED certification have a lighter need for documentation, those engaged in the other two voluntary schemes must address a more extended set of mandatory documentation. Under LEED a project owner/manager must meet the demands of the GBCI and deliver the documents related to the fulfilment of the chosen criteria, and not much more. This fact gains further relevance, since it is these documents that will allow the project to achieve, or not, the certified status.

In a LEED engaged project, there is no need to present to the scheme's proponent, the *why* it engages the set of criterion it is engaging. By this, it is meant that there is no mandatory feature that would allow the certifying body to have a full grasp of what is behind the decision to tackle the criteria the project sets itself out to achieve.

The proponents of the voluntary schemes AQUA and SCA set a much different scenario, as demands reach beyond the mere proof that the chosen criteria are being addressed. As such, both the FV and CEF propose and demand a couple of documents to enrich the certification process and mainly the project itself.

AQUA introduces the BMS and the BEQ, which main purpose is for the project owner/manager to help to strengthen the overall project. This is achieved by demanding that the chosen criteria shall fully support, the evidence with regards to the actual needs and possibilities of the project. Such demands differ greatly from the LEED process, as here there is the need to address the *what, why, how* with regards to the tackled criteria, thus making their choice not arbitrary and actually in line with the needs of the project.

SCA's Project Agenda works similarly to the couple BMS/BEQ, as it is required that prior to choosing the criteria to be tackled a socio-environmental assessment must be conducted in order to concentrate efforts in the criteria that will actually be translated to added value to the project and its users.

From the above, a fundamental change can be depicted between these two schemes and LEED, and that is the focus made by the schemes' proponents. LEED focuses on documentation stating the criteria are being met and does this at a distance, while the other proponents focus on the stages before the actual tackling of criteria, thus allowing a project owner/manager to engage the projects' aspects much sooner. Of course there is no evidence that such documentation will lead to achieving higher performance but it is inherent to them

the fact that they will aid a project owner/manager to know all the aspects related to its project and correctly identify the criteria in need to be addressed.

One further aspect related to such documentation is the fact that they are not supposed to be static and stop being developed once certification is attained. There is the need for them to be continually updated with information coming from all projects directed at tackling the criteria thus allowing for lessons to be learned and corrections to be made in due time.

Overall, the approach taken by both FV and CEF, is one that resembles those described under general environmental or quality management systems – such as the ones in the ISO 14000 and 9000 series – with the characteristic loop of Plan Do Check Act (PDCA) in place. Instead, under LEED there is a need to maintain, if interested, the achieved standard once certified and for this the project must be able to keep up to its selected criteria, and proceed in the same way as before by sending the relevant documentation to the GBCI. As such, with LEED there seems to be left out parts of the classic loop, in this case both Plan and Check seems to be overlooked. This is mirrored in the fact that the system itself does not require an assessment to be made to choose criteria, and also due to fact that most respondents in the interview process, even if alert to the qualitative costs and benefits involved with several aspects of retrofitting projects, quantification seems to be left out of the overall equation.

It is also important to refer to the ins and outs of developing such documentation, that will guide a project to a certain set of criteria, are of easy access, as is the criteria themselves, meaning that a project which is not willing or not interested in the entire certification process can still make use of them and reap its benefits.

Again, it is naturally noticeable that the decision behind which voluntary building certification scheme to adopt is not a straight forward one, as a project owner/manager might choose the one that gets the job done – certification – with the least amount of workload possible. The power of such a certification as a marketing tool standing by itself is significant and can possibly play an important part in the decision making process behind the choice.

In brief, LEED differs both from AQUA and SCA in terms of the documentation required, at the same time from the interview process and the gathered perception of actors involved in LEED EB certification project, one could say that such documentation could come in handy in the case it is mandatory.

6 Discussion and Conclusions

The main purpose of this thesis was to address issues related to building certification schemes within the city of São Paulo, more specifically those that relate to the entire application process and requirements, and at the same time identify which practices could strengthen LEED and that could also be of use to uncertified projects.

From the gathered data it was possible to observe that those involved in both kind of projects – LEED certified and uncertified – share almost the same perception when referring to the different aspects analysed under the theoretical framework: 1) Operations and Maintenance, 2) Productivity, 3) Corporate Image and 4) Externalities.

The analysis of all four tiers acknowledges **the perception of the different tiers to be relatively the same for both kinds of addressed projects**. In all tiers, similarities all start with the same baseline, which is the lack of quantitative data that could support stronger cost/benefit perceptions. As such, in both the certified and unregistered projects, the tiers perception is derived from qualitative project experience, from certification promoters, from a dedicated department, from information campaigns ran both by the government and non-governmental institutions. Therefore, it is understandable that the cost/benefit perception in both case studies is relatively equal. Making a difference are situations when a certification promoter is present in the process or long-term project development experience is present.

Before addressing the research questions it is important to note that the proponents of such certification tool, do recognise the need to adapt their scheme to the Brazilian reality, and as such the GBCB tackles issues such as criteria adjustment. Although, the desire to adjust stops there and does not continue in to other parts of the certification process that could be beneficial for all involved.

The author acknowledges the leading role LEED has within the voluntary building certification schemes in the city of São Paulo, nevertheless, he also draws the attention to the newer and Brazilian exclusive schemes, which are appearing on the market. Such schemes appear to have a better grasp of the reality of the country/city and overlooking them would not be good practice. Under LEED EB application process there is no specific mandatory requirement to conduct an assessment of which are the aspects that the project should focus on in order to better tackle the referred main reason behind the will to certify. By this it is meant that those projects going for LEED EB certification can choose to pursue the low hanging criteria and not those that would actually make a difference, and be better suited, in the overall project.

In respect to the first research question, the LEED EB process has room to improve and to be strengthened in the Brazilian context, and in order for it to be achieved it would be possible to do so by including in its process features from other voluntary building certification schemes also present in the city of São Paulo.

It is considered that a LEED project has a lot to gain if it introduces a **mandatory social and environmental assessment** of the entire project before engaging in the certification. This way, it would be possible to identify the real issues inherent to the project and from an early stage in the process develop the correct actions to better suit the criterion to be addressed. By doing so, it would allow tenants to be engaged from an earlier stage, involving them in the entire process, thus possibly reducing barriers to their willingness to change. Both AQUA and SCA have features that could be of good use to LEED EB in such respect, being that the first

that comes out due to its overall importance is the one that relates to the demand, which the first two schemes put on the project owner/manager in terms of the criteria to be tackled.

In order to introduce such a change, and allowing project owners/managers to **innovate and drive the sector forward**, it is possible to benchmark from both SCA's and AQUA's processes and its reliance on the Project Agenda and the combination of BMS and BEQ, respectively. Making use of such documents, and what is involved in them, can possibly also address LEED projects relying solely on the presented guidelines. At the same time it strengthens the certification process they are engaged in. In order to best achieve such result in regard to project innovation it is concluded that FV's take on the subject – *Equivalence Principle* – can prove to be the correct path to follow. By introducing it, the GBCI would still have the final say on the proposed action, but would spark interest and ingenuity within the project's responsible to further options than those presented.

Unlike LEED the approach taken by the also other certification schemes, is one that resembles the **PDCA loop**, and from the data collected – or not, in terms of the lack of quantitative data – seems to be the correct manner to develop such voluntary tools. By introducing such tools and processes, in LEED, it would then be possible to involve more stakeholders earlier on a retrofitting project – tenants, neighbours, amongst others – allow for project owners/managers to have a full grasp of action taken while improving both qualitatively and quantitatively their perception of the costs and benefits involved. Finally, by allowing such loop, LEED proponents would then be able to reap the fruits of well design projects. In terms of data it would allow to further polish the certification tool and at the end of the day the entire sector.

In respect to the second research question, which refers to the tools and processes of voluntary building certification schemes in the city, it is concluded that as those projects engaged in LEED, **unregistered projects can also benefit from introducing them to their operation methods**.

Non-registered projects, by means of dedicated research and application of best practices, can reach significantly high-performances. This can be done by **taking in the guidelines of the several certification schemes and putting them in to practice**. The environmental champion is the one that should be occupied with this task. Still, in the absence of such fundamental character, it is still possible to keep good standards in terms of reaching high-performances but at a greater cost, as it would be similar to driving blind – knowing how to steer, accelerate, brake and shift gears, but not being able to see here to go.

Of course what has been referred for strengthening the process behind LEED EB application can also be applied in an unregistered situation, such as carrying out environmental assessments, identifying social needs, in brief, **pinpointing the real needs of the entire project** and of those involved. Even if the MUCD is already working at cruise speed for quite some years now, it is important to remember and embrace that there is always room for improvement, and taking in such practices can do just so.

The above is concluded having in mind that all the criteria, and application processes, from the tackled voluntary schemes are of free consultation, at least to a certain extent.

It is important to refer the role that a department, such as the MUCD, has on the overall building project. From the analysed data it is recognised that the work developed by the **department**, which has as sole role to maintain and develop the complex, can be compared to a certification process. This is possible due to the presence of an environmental champion

within the MUCD, the Head of department, who continuously pushes for the development of new projects, stays in touch with trends, and above all knows the relation between the successfully developed measures and the need to clearly market them in order to reach the public perception of the complex.

The alternative, that is, an **environmental champion** to the certification process, is not identified as an easy one. Still, information can be gathered from both public and governmental sources on the latest building technologies. Both, the building sector union and several other institutions spread the news regarding the more recent economic and regulatory policy measures. As such, all these features and situations allow an environmental champion to keep in touch with the market and not engaging in a certification process. Furthermore, having a department within an office space building that is specifically dedicated to continuously develop projects that are dedicated to retrofitting it. This can be more effective in achieving a long lasting high-performance building as opposed to a one of certification process without follow up.

Of course, as mentioned above, the SPBC project is an example of a success case, where work habits have been set for several years and able to produce concrete results and reaching up to the LEED certified projects in terms of the perception of costs and benefits associated with retrofitting actions. A building, project, which does not perform as well, is prone to reap greater benefits from integrating the tools and processes of certification schemes.

As such, it is identified that to projects such as the SPBC, bringing in to its operating methodology a set of **criteria** in the likings of those under LEED EB, AQUA or SCA, can most definitely provide guidance to the MUCD. Such guidance would allow MUCD to have in hand a rather complete set of issues that could be addressed. By introducing such criteria and subsequent guidelines, it would then be possible to better compare to certified buildings, or even surpass them if criteria is taken from more than one scheme in order to come up with a tailored solution for the project. Still, this should not deter anyone from taking up a given certification scheme, but on the other hand serve as information to future project managers, and building owners, willing to take their projects to higher-performances.

Nevertheless, there is always the point that at the end of a certification process, if successful, a big marketing campaign is launched in order to raise **public awareness** to the project's certification. Although as proved by the SPBC, and more specifically MUCD, an effective communication project accompanied with a solid project development mechanism can allow for the same results in the public's eye. As such, even projects that do not register for a given certification scheme, can use the same social tools in order to reach out to the same target, just as a certification scheme would at the end of the certification process. Of course, the main difference would be that an unregistered project would not have the access to the contact network already established by the certification scheme proponents – in the case of LEED EB, the network would be a global one.

In brief, with this thesis, it is concluded that LEED EB in Brazil, can most definitely be improved and strengthened to the reality of the country. To do so, it should incorporated features from local certification schemes, such as SCA's Project Agenda, AQUA's combination of BMS and BEQ or FV's *Equivalence Principle*. By doing so, a win-win scenario has the possibility to come to light as a project owner/manager enhances its perception of the different aspect related to retrofitting project, through a better control of the entire project, and the rating system's proponent can then make use of the information derived from such improvement to further polish the building rating system.

Furthermore, **it is concluded** that non-registered projects in Brazil have the possibility to achieve higher performance levels, by means of using the available content – guidelines – of existing certification schemes, with the added value of being able to skim through all of them, and choosing the correct actions in order to achieve the set goals.

A final consideration is also due – even if outside of the proposed research questions – to the fact that common to both certified and unregistered existing office space buildings was the statement that multi-tenancy is considered to hinder retrofitting projects in general. The discussion behind this fact leads to the conclusion that an unregistered building has some sort of advantage here. This is because, in a certification process, minimum requirements must be met, thus there is the absolute need for agreement between all parties, which in an unregistered case does not happen. As such, in an unregistered approach the owner might just leave a certain office space – a room, a floor – out of the process, while in a certified case the need to have everyone on board is imperative.

Even if not backed with actual data on the subject, the author considers that if there is involvement of tenants in the retrofitting projects there might be the chance for addressing situations, as the ones described above, possibly to be avoided or at least minimised. As such, involvement from an early stage of all stakeholders is considered to be crucial in order to achieve the highest potential of the retrofitting operation.

The author comes to realise that **choosing which voluntary building certification system to engage** is not as straightforward as one might think it to be. It would be considered that project owners/managers would study all available options before engaging in certification in order to allow the project as a whole to be enhanced. Still, what interviews show to happen is that often times LEED is the chosen option irrespectively of being or not the right choice to address what is referred as main reason to certify. These reasons vary, from trying to reach out to certain companies – that have LEED certification as a demand to lease/buy an office space – to the acceptance that LEED is the unquestionable leader in building certification.

6.1 Recommendations

One of the pressing issues within the sector is the need to obtain strong, reliable and unbiased **quantitative data** derived from retrofitting projects, as such it is identified as an area where research is most definitely needed as its results can have a great deal of influence in future decision-making processes. It is advisable that the scope of such research, as this thesis, be focused on more than just LEED certification, as lessons can be learned from other available options.

Multi-tenancy is one aspect that has the potential to block retrofitting and certification projects as such it would be of great value to address such issue through further research. This would be advantageous if performed against building certification successes, this way it could allow for smoother processes in the future, by the adaptation of the voluntary schemes such as certification, as an example.

In respect to the LEED application process it would be of great value to develop further research on **the role of the GBCB**. The need for research comes from the fact that the centralised certification body operating LEED is located far from the project and might not be entirely aware of specific environmental and social needs. As such it is recommended that such research is conducted having in mind expanding the responsibilities and overall decision power of local Green Building Councils.

Considering the conclusions drawn from this thesis and the scope that is defined for the applicability of results, it is then recommended that further research be performed **opening the scope to other geographical locations**. By doing so, it would be possible to come to broader conclusions, building on further locally developed voluntary certification tools, on the issues related to high-performance building certification, and the process behind LEED in particular.

It would also be of interest to conduct a study in order to assess the benefits of introducing the already mentioned **LEED EB's criterion** - *Documenting sustainable building cost impacts* – as a mandatory requirement as opposed to the current voluntary status. Due to the quantitative nature of such criterion, it is believed that it could aid both project owner/managers to know fully understand their retrofitting projects and also for LEED's proponents to better promote their tool.

Bibliography

- ABNT. (2006). *ABNT*. Retrieved 11 17, 2011, from ABNT: http://www.abnt.org.br/m3.asp?cod_pagina=929
- ABNT. (n.d.). *Da proteção da marca e das normas da ABNT*. ABNT. Retrieved from ABNT.
- Albrecht, C. F., Griffith, J. J., & Carvalho, A. W. (2009). Simpósio Brasileiro de Qualidade do Projeto no Ambiente Construído. *Adequabilidade do LEED-ND no caso do Plano de Reabilitação do Hipercentro de Belo Horizonte* (pp. 444-454). São Paulo: Universidade de São Paulo.
- Amorim, S. L. (1996). Inovações tecnológicas nas edificações: papéis diferenciados para construtores e fornecedores. *Gestão & Produção [online]*, 3(3), 262-274.
- ANA; FIESP; SindusCon-SP. (2005). *Conservação e Reuso de Água em Edificações*. São Paulo: ANA; FIESP; SindusCon-SP.
- Anderson, S. W. (2007). Managing Costs and Cost Structure throughout the Value Chain: Research on Strategic Cost Management. *Handbook of Management Accounting Research*, 481-506.
- Arditi, D., & Gunaydin, H. (1998). Factors that affect process quality in the life cycle of building projects. *Journal of Construction Engineering and Management*, 194-203.
- Associação Brasileira de Normas Técnicas. (2009). *ABNT Catalogo*. Retrieved 08 15, 2011, from ABNT Catalogo: <http://www.abntcatalogo.com.br/norma.aspx?ID=349>
- Association HQE. (n.d.). *Présentation - Association HQE*. Retrieved 08 14, 2011, from Association HQE: <http://assohqe.org/hqe/spip.php?rubrique9>
- Bardaglio, P. W. (2011). *To LEED or not to LEED*. Retrieved 11 15, 2011, from Today's Campus - The Business Magazine for Higher Education: <http://todayscampus.com/articles/load.aspx?art=1823>
- BCSC. (n.d.). *CBCS - Página Principal*. Retrieved 08 16, 2011, from CBCS - Página Principal: <http://www.cbcs.org.br/index.php?>
- Benevides, J. R. (2009). Selo Casa Azul da CAIXA certifica empreendimentos sustentáveis. (AECweb, Interviewer)
- Benite, A. (2010, 11 26). *Segunda onda Green Building: retrofit e operação predial verdes*. Retrieved 08 20, 2011, from CTE - Inteligência 360º: http://www.cte.com.br/site/artigos_ler.php?id_artigo=3225
- BGBC. (2011, 05 02). Building a Sustainable Future. Lund, Sweden.
- Biernacki, P., & Waldorf, D. (1981). Snowball sampling: problem and techniques of chain referral sampling. *Sociological Methods and Research*, 141-163.
- Black, T. (1999). *Doing quantitative research in the social sciences: An integrated approach to research design, measurement, and statistics*. Thousand Oaks, CA: SAGE Publications, Inc.

- Boyce, C., & Neale, P. (2006). *Conducting in-depth interviews: A Guide for Designing and Conducting In-Depth Interviews for Evaluation Input*. Watertown: Pathfinder International.
- Brito, A. (2010, 06 21). País perde US\$ 15 bi com má formação de engenheiro . *Folha de São Paulo*.
- Building Science Corporation. (2008). *Towards Sustainability: Green Building, Sustainability Objectives, and Building America Whole House Systems Research*. Somerville, MA: Building Science Press.
- Caccavellia, D., & Gugerlib, H. (2011). TOBUS - a European diagnosis and decision-making tool for office building upgrading. *Energy and Buildings*, 113-119.
- Caixa Econômica. (2009, 06 02). *CAIXA: Imprensa*. Retrieved 08 15, 2011, from CAIXA - O banco que acredita nas pessoas: http://www1.caixa.gov.br/imprensa/imprensa_release.asp?codigo=6609833&tipo_noticia=3
- Caixa Econômica Federal. (2010). *Selo Casa Azul - Boas Práticas para a Habitação Mais Sustentável*. Brasília: Caixa Econômica Federal.
- Caixa Econômica Federal. (2011). *Caixa Econômica Federal - Institucional*. Retrieved 11 22, 2011, from Caixa - O banco que acredita nas pessoas: <http://www.caixa.gov.br/acaixa/index.asp>
- Campos, A. A. (2010). *Construção Sustentável*. Comitê do Meio Ambiente da SindusCon-SP. São Paulo: COMASP.
- Canal Verde Gaia. (2010, 06 08). *ABNT-CB-02 tem novo escopo*. Retrieved 12 03, 2011, from Legislação ambiental | Notícias de meio ambiente | Lei ambiental | Artigos: <http://www.canalvg.com.br/index.php/canalvg/descricao/geral/45/ABNT-CB-02+tem+novo+escopo.html>
- Cardoso, F. F., Prado, R. T., & Vanderley, M. J. (2010). *Agenda do Empreendimento*. Brasília: Caixa Econômica Federal.
- CARN. (2011). *Centro Administrativo Rio Negro*. Retrieved 08 28, 2011, from Centro Administrativo Rio Negro: <http://www.carn.com.br/>
- Casado, M. (2011, 07 04). High-performance buildings certification schemes. (H. Simões, Interviewer) São Paulo.
- Choi, C. (2009). Removing Market Barriers to Green Development: Principles and Action Projects to Promote Widespread Adoption of Green Development Practices. *Journal of Sustainable Real Estate*, 107-138.
- CIB Task Group 35. (2001). *Innovation on Construction - An International Review of Public Policies*. (A. Manseau, & G. Seaden, Eds.) London: Spon Press.
- Clements-Croome, D., & Baizhan, L. (2000). Productivity and Indoor Environment. *Proceedings of Healthy Buildings*, 629-634.

- Coelho, F. (2011, 07 14). High-performance buildings certification schemes. (H. Simões, Interviewer) São Paulo.
- Comitê Brasileiro de Construção Civil. (2004). *Comitê Brasileiro de Construção Civil*. Retrieved 12 01, 2011, from Comitê Brasileiro de Construção Civil: <http://www.cobracon.org.br/>
- Costanza, R. (1991). *Ecological economics*. New York, NY: Columbia University Press.
- Costanza, R. (1997). *An introduction to ecological economics*. Fla.: St. Lucie Press.
- Crosbie, M. J. (2000, 08 30). Commercial High-Performance Buildings. *ArchitectureWeek*.
- Crosbie, M. J. (2011). *Michael J. Crosbie | LinkedIn*. Retrieved 08 16, 2011, from World's largest Professional Network | LinkedIn: <http://www.linkedin.com/in/michaeljcrosbie>
- Daly, H. A., & Townsend, K. N. (1993). *Valuing the earth*. Boston, Mass.: MIT Press.
- Danks, R. (2010, 09). O&M in green buildings: Are operators prepared? *ASHRAE Journal*, 92.
- Dimitrokali, E., Hartungi, R., & Howe, J. (2010). The Applicability of LCA to assess environmental impacts of building technologies in buildings. *The 16th Annual International Sustainable Development Research Conference, Paper Number: 62*. Hong Kong.
- Douek, D. (2011, 07 05). High-performance buildings certification schemes. (H. Simões, Interviewer) São Paulo.
- ECMD - EMNRD. (n.d.). *SustainableBuildingTaxCredit*. Retrieved 12 30, 2011, from Index: <http://www.emnrd.state.nm.us/ecmd/cleanenergytaxincentives/sustainablebuildingtaxcredit.htm>
- Eletrobrás. (2010). *Sumário Executivo | Resultados do PROCEL 2009*. Rio de Janeiro: Eletrobrás.
- Eletrobrás. (2011). *Introdução*. Retrieved 02 06, 2011, from PORCEL - Programa Nacional de Conservação de Energia Elétrica: <http://www.eletrabras.com/elb/main.asp?ViewID={974CF275-82FE-4483-8551-855F9A98A370}>
- English, L., Sanvido, V., & Harrisberger, D. (2011, 03). Energy Retrofits: When Is the Time to Act? *HPAC Engineering*, 36-39.
- Femenías, P. (2004). *Demonstration Projects for Sustainable Building: Towards a Strategy for Sustainable Development in the Building Sector based on Swedish and Dutch Experience*. Göteborg: Chalmers Tekniska Högskola, Sektionen för Arkitektur.
- FEMP. (2010). *Operations & Maintenance Best Practices A Guide to Achieving Operational Efficiency*. U.S. Department of Energy, Federal Energy Management Program. Federal Energy Management Program.
- Figueiredo, P. (2011, 07 17). High-performance buildings certification schemes. (H. Simões, Interviewer) São Paulo.
- FINEP - Financiadora de Estudos e Projetos. (n.d.). *HABITARE*. Retrieved 08 16, 2011, from HABITARE: <http://www.habitare.org.br/capa.aspx>

- Fonseca, J. C. (2009). *Por um "LEED" Brasileiro*. Belo Horizonte: Lugar Certo.
- Fundação Vanzolini. (2007). *Referencial Técnico de Certificação - Edifícios do setor de serviços – Processo AQUA Escritórios - Edifícios escolares*. Fundação Vanzolini. São Paulo: FCAV.
- Fundação Vanzolini. (2010). *Portal da Fundação Vanzolini: Aqua*. Retrieved 11 11, 2011, from Portal da Fundação Vanzolini: http://www.vanzolini.org.br/conteudo-77.asp?cod_site=77&id_menu=758
- Fundação Vanzolini. (2010). *Portal da Fundação Vanzolini: Principal*. Retrieved 07 26, 2011, from Portal da Fundação Vanzolini: Principal: http://www.vanzolini.org.br/conteudo.asp?id_menu=6&cod_site=0#
- Fundação Vanzolini. (n.d.). *Processo AQUA*. Retrieved 07 03, 2011, from Processo AQUA: <http://www.processoaqua.com.br/beneficios.html>
- GBCB. (2011). Retrieved 11 20, 2011, from <http://gbcbrasil.org.br/iframeEmpreendimentosLeed.php>
- GBCB. (2011, 11 9). *GBC Brasil | Construindo um Futuro Sustentável*. Retrieved 11 15, 2011, from GBC Brasil | Construindo um Futuro Sustentável: <http://gbcbrasil.org.br/?p=certificacao>
- GBCB. (2011). *GBC Brasil | Construindo um Futuro Sustentável*. Retrieved 11 13, 2011, from GBC Brasil | Construindo um Futuro Sustentável: <http://gbcbrasil.org.br/?p=certificacao>
- GBCB. (2011). *GBC Brasil | Construindo um Futuro Sustentável*. Retrieved 11 20, 2011, from GBC Brasil | Construindo um Futuro Sustentável: <http://gbcbrasil.org.br/?p=world&M=3&O=1>
- GBCI. (2011). *GBCI: LEED Professional Credentials*. Retrieved 11 22, 2011, from GBCI: Green Building Certification Institute: <http://www.gbci.org/main-nav/professional-credentials/credentials.aspx#>
- GBCI. (2011). *LEED for Existing Building: Registering a Project*. Retrieved 11 14, 2011, from GBCI: Green Building Certification Institute: <http://www.gbci.org/main-nav/building-certification/certification-guide/leed-for-existing-buildings-operations-and-maint/project-registration/registration.aspx>
- GBCI. (2011). *LEED for Existing Buildings: Certification*. Retrieved 11 14, 2011, from Green Building Certification Institute: <http://www.gbci.org/main-nav/building-certification/certification-guide/leed-for-existing-buildings-operations-and-maint/certification.aspx>
- GBCI. (2011). *LEED for Existing Buildings: Certification Fees*. Retrieved 11 15, 2011, from GBCI: Green Building Certification Institute: <http://www.gbci.org/main-nav/building-certification/certification-guide/leed-for-existing-buildings-operations-and-maint/submit-application/cert-fees.aspx>
- GBCI. (2011). *LEED for Existing Buildings: Certification Review*. Retrieved 11 14, 2011, from Green Building Certification Institute: <http://www.gbci.org/main-nav/building->

- certification/certification-guide/leed-for-existing-buildings-operations-and-maint/application-review/certification-review.aspx
- GBCI. (2011). *LEED for Existing Buildings: Preparing Application LEED EBOM 2009 Projects*. Retrieved 11 14, 2011, from Green Building Council Institute: <http://www.gbci.org/main-nav/building-certification/certification-guide/leed-for-existing-buildings-operations-and-maint/prepare-application/v3.aspx>
- GBCI. (2011). *LEED for Existing Buildings: Registration Fees*. Retrieved 11 14, 2011, from GBCI: Green Building Council Institute: <http://www.gbci.org/main-nav/building-certification/certification-guide/leed-for-existing-buildings-operations-and-maint/project-registration/registration-fees.aspx>
- Gomes, V. (2008, 09 05). *SBCS 08 - | Simpósio Brasileiro de Construção Sustentável*. Retrieved 08 16, 2011, from SBCS 08 - | Simpósio Brasileiro de Construção Sustentável: <http://www.cbcs.org.br/simpósio/sbcs08/evento.htm>
- Governo do Estado de São Paulo - Secretaria do Meio Ambiente. (n.d.). *Madeira Legal*. Retrieved 08 16, 2011, from Secretaria do Meio Ambiente: <http://www.ambiente.sp.gov.br/madeiralegal/>
- Grupo SustentaX. (n.d.). | *Grupo SustentaX* |. Retrieved 08 21, 2011, from Grupo SustentaX - Sustentabilidade Empresarial, Certificação de Edifícios e de Produtos: <http://www.gruposustentax.com.br/historia.html>
- Haynes, B. P. (2007). The impact of the behavioural environment on office productivity. *Journal of Facilities Management*, 158-171.
- Haynes, B. P. (2008). The impact of office layout on productivity. *Journal of Facilities Management*, 189-201.
- IBDA. (n.d.). *A importância da profissionalização de mão de obra na impermeabilização* | Fórum da Construção. Retrieved 12 11, 2011, from Fórum da Construção: A importância da profissionalização de mão de obra na impermeabilização
- ICLEI - Brasil. (2011). *Construindo Cidades Verdes - Manual de Políticas Públicas para Construções Sustentáveis*. São Paulo: ICLEI - Brasil.
- IEA. (2011). *Technology Roadmap Energy-efficient Buildings: Heating and Cooling Equipment*. Paris: OECD/IEA.
- INMETRO. (2011). *Inmetro - O que é o Inmetro*. Retrieved 11 19, 2011, from INMETRO - Instituto Nacional de Metrologia, Qualidade e Tecnologia: <http://www.inmetro.gov.br/inmetro/oque.asp>
- IPCC. (2007). *Climate Change 2007 - Synthesis Report*. Cambridge University Press.
- IPT. (2011). *IPT - Instituto de Pesquisa Tecnológica*. Retrieved 08 16, 2011, from IPT - Instituto de Pesquisa Tecnológica: <http://www.ipt.br/institucional>
- Iwu-Egwuonwu, R. C. (2010). Corporate Reputation & Firm Performance: Empirical Literature Evidence. *International Journal of Business and Management*, 197-206.

- Jansson, A. M., Hammer, M., Folke, C., & Costanza, R. (1994). *Investing in natural capital*. Washington, D.C.: island Press.
- Johnson, S. D. (2000). The Economic Case for "High Performance Buildings". *Corporate Environmental Strategy*, 350-361.
- Jones Lang LaSalle. (2011). *Jones lang La Salle. Global Commercial Real Estate Services. Investment Management*. Retrieved 08 30, 2011, from Jones lang La Salle. Global Commercial Real Estate Services. Investment Management: <http://www.joneslanglasalle.com/Pages/Home.aspx>
- Kats, G., Braman, J., & James, M. (2010). *Greening our built world: costs, benefits and strategies*. Washington: Island Press.
- Keller, K. L. (2003). *Strategic brand management* (2nd edition ed.). Upper Saddle River, NJ: Prentice Hall.
- Khasreen, M. M., Banfill, P. F., & Menzies, G. F. (2009). Life-Cycle Assessment and the Environmental Impact of Buildings: A Review Mohamad Monkiz Khasreen 1, Phillip F.G. Banfill 2,* and Gillian F. Menzies 3. *Sustainability Journal*(1), 674-701.
- Kochen, S. (2011, 07 15). High-preformance buildings certification schemes. (H. Simões, Interviewer) São Paulo.
- Kozlowski, D. (2003). Green gains: where sustainable design stands now. *Building Operating Management*, 26-32.
- Kwong, B. (2004). *Quantifying the Benefits of Sustainable Buildings*. AACE International Transactions.
- Lana, L., Wargockib, P., & Lian, Z. (2011). Quantitative measurement of productivity loss due to thermal discomfort. *Energy and Buildings*, 1057-1062.
- Landim, R. (2011, 05 24). Imóvel comercial tem procura superaquecida. *O Estado de São Paulo*.
- Librelotto, G. R. (2010). *Comparação entre os critérios de avaliação envolvidos nos sistemas de certificações de edificações AQUA e LEED for Schools*. Porto Alegre: Universidade Federal do Rio Grande do Sul.
- Lielgaidina, L., & Geipele, I. (2011). Theoretical aspects of competitiveness in construction enterprises. *Business, Management and Education*, 67-80.
- Lucuik, M. (2005). *A business case for green buildings in Canada*. Canadian Green Building Council.
- Malhotra, N. K., Rocha, I., Laudisio, M. C., Altheman, É., & Borges, F. M. (2005). *Introdução à pesquisa de marketing*. (R. B. Taylor, Trans.) São Paulo: Pearson Prentice Hall.
- Malina, M. A., Norreklit, H. S., & Selto, F. H. (2011). Lessons learned: advantages and disadvantages of mixed method research. *Qualitative Research in Accounting & Management*, 59-71.
- Maran, M. (2011, 07 13). High-preformance buildings certification schemes. (H. Simões, Interviewer) São Paulo.

- Matos, C. (2010, 11 08). Dobra recuperação de prédios para escritórios em São Paulo. *Folha de São Paulo*.
- McEtroy, M. (2007). Quality Strategies for Facility Operations and Maintenance. *Buildings*, 92-96.
- Mello, L. B. (2007). *Modernização das pequenas e médias empresas de Construção Civil: impactos dos programas de melhoria da gestão da qualidade*. Universidade Federal Fluminense. Niterói-RJ: Universidade Federal Fluminense.
- Mello, L. C., & Amorim, S. R. (2009). O subsetor de edificações da construção civil no Brasil: uma análise comparativa em relação à União Europeia e aos Estados Unidos. *Produção*, 388-399.
- Miller, E., & Buys, L. (2008). Retrofitting commercial office buildings for sustainability: tenants' perspectives. *Journal of Property Investment & Finance*, 552-561.
- Montoro, V. (2011, 07 08). High-performance buildings certification schemes. (H. Simões, Interviewer) São Paulo.
- Morgan, D. L. (1998). Practical Strategies for Combining Qualitative and Quantitative Methods: Application to health Research. *Qualitative Health Research*, 362-376.
- National Institute of Building Sciences. (2010, July 07). *Facilities Operation and Maintenance | Whole Building Design Guide*. Retrieved July 22, 2011, from WBDG - The Whole Building Design Guide: <http://www.wbdg.org/om/om.php>
- Newsham, G. R., Mancini, S., & Birt, B. J. (2009). Do LEED-certified buildings save energy? Yes, but... *Energy and Buildings*, 897-905.
- O Estado de São Paulo. (2011, 05 30). *Faria Lima atinge marca de R\$ 200/m² para locação - economia - brasil - Estadão*. Retrieved 09 09, 2011, from O Estado de São Paulo: <http://economia.estadao.com.br/noticias/economia%20brasil,faria-lima-atinge-marca-de-r-200m%C2%B2-para-locacao,69199,0.htm>
- Pacheco, J. A. (2011, 07 12). High-performance buildings certification schemes. (H. Simões, Interviewer) São Paulo.
- Pike Research LLC. (2010). *Green Building Certification Programs Global Certification Programs for New and Existing Buildings in the Commercial and Residential Sectors: Market Analysis and Forecasts*. Boulder: Pike Research LLC.
- Porter, M. E. (2008, January). The five competitive forces that shape strategy. *Harvard Business Review*, 78-93.
- Presidência da República Casa Civil Subchefia para Assuntos Jurídicos. (2009, 12 29). *L12187*. Retrieved 08 29, 2011, from Presidência da República: https://www.planalto.gov.br/ccivil_03/_ato2007-2010/2009/lei/112187.htm
- Preston, M., & Bailey, A. (2003). The potential for high-performance design adoption in retail property portfolios. *Corporate Social Responsibility and Environmental Management*, 165-174.

- Reinhart, C., & Selkowitz, S. (2006). Daylighting — Light, form, and people. *Energy and buildings*, 715-717.
- Revista Amazônia. (2010, 06 30). *Blog Amazônia: Caixa lança guia de sustentabilidade ambiental do Selo Casa Azul*. Retrieved 11 22, 2010, from Blog Amazônia: <http://revistamazonia.blogspot.com/2010/06/caixa-lanca-guia-de-sustentabilidade.html>
- Revista Infra. (n.d.). [Revista Infra 2011]. Retrieved 08 25, 2011, from [Revista Infra 2011]: <http://www.revistainfra.com.br/textos.asp?codigo=8188>
- Romm, J. (1994). *Lean and Clean Management*. New York: Kodansha International.
- Scheller, F. (2010, 11 08). Mercado de escritórios de luxo vive 'febre'. *Estadão.com.br*.
- Schneider Electric. (2010). *Green Buildings Certifications - An Overview and Strategic Guidance for Schneider Electric Employees*. North Andover, MA: Schneider Electric.
- SCI. (2011). *Sustainable Cities Institute: Buildings: Environmental Challenges*. Retrieved 08 20, 2011, from Sustainable Cities Institute: What's New on SCI: http://www.sustainablecitiesinstitute.org/view/page.basic/class/feature.class/Lesson_Bldg_Envr_Challenges
- Scofield, J. H. (2009). Do LEED-certified buildings save energy? Not really... *Energy and Buildings*, 1386–1390.
- SCSA. (2006). *São Carlos Empreendimentos e Participações S.A.* Retrieved 08 23, 2011, from São Carlos Empreendimentos e Participações S.A.: <http://www.scsa.com.br/saocarlos/index.htm>
- Secovi-SP. (2010). *Balço do Mercado Imobiliário 2010*. Retrieved 08 20, 2011, from Portal Secovi - "O sindicato da Habitação na Internet": <http://balanco.secovi.com.br/2010/>
- Secretaria de Estado do Meio Ambiente. (n.d.). *Madeira Legal*. Retrieved 12 30, 2011, from Secretaria do Meio Ambiente: <http://www.ambiente.sp.gov.br/madeiralegal/index.php>
- Shu-Yang, F., Freedman, B., & Cote, R. (2004, 07 10). Principles and practice of ecological design. *Environmental Reviews*, 97-112.
- SINDUSCON. (2011, 04 11). *Sistema SINDUSCON*. Retrieved 11 13, 2011, from Sistema SINDUSCON: <http://www.sinduscon-fpolis.org.br/index.asp?dep=9&pg=1024>
- SindusCon-SP. (2005). *Gestão Ambiental de Resíduos da Construção Civil A experiência do SindusCon-SP*. São Paulo: SindusCon-SP.
- SindusCon-SP. (n.d.). *SindusCon-SP*. Retrieved 08 20, 2011, from SindusCon-SP: <http://www.sindusconsp.com.br/msg2.asp?id=3239>
- SindusCon-SP; WWF-Brasil. (2011). *Aquisição responsável de madeira na construção civil - Guia prático para as construtoras*. São Paulo: SindusCon-SP and WWF-Brasil.

- Sonnino, G. D. (2011, 07 04). High-performance buildings certification schemes. (H. Simões, Interviewer) São Paulo.
- SPBC. (2011). *Condomínio no Centro Empresarial de São Paulo - CENESP*. Retrieved 08 21, 2011, from Centro Empresarial de São Paulo - CENESP: <http://www.centroempresarial.com.br/pt-br/o-complexo/condominio.asp>
- Tavares, E. (2011, 05 04). As 10 melhores cidades da América Latina para se investir. *Exame.com*.
- Taylor-Powell, E., & Renner, M. (2003). *Analyzing Qualitative Data*. Madison: University of Wisconsin-Extension Cooperative Extension.
- Téchné. (2009). Avaliação ambiental. *Revista Téchné*.
- U.S. Department of Energy. (2011). *EERE: Financial Opportunities Home Page*. Retrieved 12 30, 2011, from Energy.gov | Department of Energy: <http://www1.eere.energy.gov/financing/>
- U.S. EPA. (2010, 09 30). *An Office Building Occupant's Guide to Indoor Air Quality | Indoor Air Quality | U.S. EPA*. Retrieved 08 19, 2011, from US Environmental Protection Agency: <http://www.epa.gov/iaq/pubs/occupgd.html>
- UK Trade & Investment. (2010). *Sector briefing Brazil Opportunities in Construction*. London: UK Trade & Investment.
- USGBC. (2011). *LEED 2009 for Existing Buildings Operations and Maintenance*. United States Green Building Council.
- USGBC. (2011). *LEED 2009 for Existing Buildings Operations and Maintenance With Alternative Compliance Paths for Projects Outside the U.S.* Washington: USGBC.
- USGBC. (2011). *LEED 2009 Minimum Program Requirements*. Washington: United States Green Building Council.
- USGBC. (2011). *LEED International Program: Alternative Compliance Paths for Projects Outside the United States*. Washington: USBGC. Retrieved 11 25, 2011, from <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=221#ACPEBOM>
- USGBC. (2011). *USGBC: About USGBC*. Retrieved 08 15, 2011, from USGBC: U.S. Green Building Council: <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=124>
- USGBC. (2011). *USGBC: How to achieve certification*. Retrieved 11 14, 2011, from USGBC: U.S. Green Building Council: <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1991>
- USGBC. (2011). *USGBC: LEED for Existing Buildings*. Retrieved 08 13, 2011, from U.S. Green Building Council: <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=221>
- USGBC. (2011, 11 4). *USGBC: Press Information*. Retrieved 11 15, 2011, from U.S. Green Building Council: <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=97&>
- USGBC. (2011). *USGBC: Rating Systems*. Retrieved 08 19, 2011, from USGBC: U.S. Green Building Council: <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=222>

- USGBC. (2011). *USGBC: What LEED Is*. Retrieved 08 14, 2011, from USGBC: U.S. Green Building Council: <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1988>
- USGBC. (2011). *USGBC: What LEED is?* Retrieved 11 13, 2011, from USGBC: U.S. Green Building Council: <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1988>
- USGBC. (2011). *USGBC: What LEED Measures?* Retrieved 11 14, 2011, from USGBC: U.S. Green Building Council: <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1989>
- Valente, J. P. (2009). *Certificações na Construção Civil: Comparativo entre LEED e HQE*. Rio de Janeiro: Escola Politécnica, Universidade Federal do Rio de Janeiro.
- Valor Econômico. (2011, 04 12). Falta de escritórios coloca São Paulo e Rio entre as mais caras do mundo. *Valor Econômico*.
- Vedung, E. (2007). Policy Instruments: Typologies and Theories. In M.-L. Bemelmans-Videc, R. C. Rist, & E. Vedung, *Carrots, sticks and sermons - Policy instruments & their evaluation* (pp. 21-58). New Brunswick, New Jersey: Transaction Publishers.
- Veljkovic, D., & Petrovic, D. (2011). The role of corporate image in the process of company takeovers. *MEGATREND REVIEW*, 77-94.
- Ventura, S. S., & Araújo, A. f. (2007, 05). Exploração da mão de obra na construção civil na região de Bauru. *Revista Científica Eletônica de Ciências Contábeis*.
- Vorwald, R. (2011). New Energy Technologies For High-performance Buildings. *Energy Engineering*, 17-24.
- WBCSD. (2010). *World Business Council for Sustainable Development (WBCSD)*. Retrieved 03 02, 2011, from World Business Council for Sustainable Development (WBCSD): <http://www.wbcsd.org/templates/TemplateWBCSD5/layout.asp?type=p&MenuId=MTA5NQ&doOpen=1&ClickMenu=LeftMenu#>
- WGBC. (2011). *World Green Building Council :: GB Councils -- Find a GB*. Retrieved 11 21, 2011, from World Green Building Council :: Home: <http://www.worldgbc.org/site2/index.php?CID=104>
- Wilson, A., Atlee, j., & Webber, D. (2008). *Paper 3b: Institutional Efforts for Green Building: Institutional Efforts for Green Building in Canada and the United States*. Green Building in North America.

Appendix

Appendix I – List of interviewees and informal talks conducted

Name	Position	Company
Interviews		
David Douek	Director	OTEC – Otimização Energética para a Construção
Felipe Queiroz Coelho	AQUA’s technical officer	Fundação Vanzolini
Guido David Sonnino	Senior Infrastructure Manager at CARN	Jones Lang LaSalle
João Pacheco	Technical Director	Cushman Wakefield
Marcos Casado	Technical Manager	Green Building Council Brazil
Marcos Maran	Department Manager	CENESP
Sérgio Kochen	Engineering Manager	São Carlos Empreendimentos e Participações S.A.
Informal talks		
Gil Anderi da Silva	Professor	University of São Paulo
Paola Figueiredo	Director	SustentaX
Racine Tadeu Araujo Prado	Professor	University of São Paulo
Sérgio Ennes	Owner and Director	Lumina Energia
Vanessa Montoro Taborianski	Former employee	CBCS

Appendix II – LEED EB Project Checklist

LEED 2009 for Existing Buildings: Operations & Maintenance Project Checklist

Sustainable Sites		26 Possible points
Credit 1	LEED Certified Design and Construction	4
Credit 2	Building Exterior and Hardscape Management Plan	1
Credit 3	Integrated Pest Management, Erosion, and Landscape Management Plan	1
Credit 4	Alternative Commuting Transportation	3 – 15
Credit 5	Site Development – Protect or Restore Open Habitat	1
Credit 6	Stormwater Quantity Control	1
Credit 7.1	Heat Island Reduction – Non-roof	1
Credit 7.2	Heat island Reduction – Roof	1
Credit 8	Light Pollution Reduction	1
Water Efficiency		14 Possible Points
Prerequisite 1	Minimum Indoor Plumbing Fixture and Fitting Efficiency	Required
Credit 1	Water performance Measurement	1 – 2
Credit 2	Additional Indoor Plumbing Fixture and Fitting Efficiency	1 – 5
Credit 3	Water Efficient Landscaping	1 – 5
Credit 4.1	Cooling Tower Water Management – Chemical Management	1
Credit 4.2	Cooling Tower Water Management – Non-potable Water Source Use	1
Energy and Atmosphere		35 Possible Points
Prerequisite 1	Energy Efficiency Best Management Practices – Planning, Documentations and Opportunity Assessment	Required
Prerequisite 2	Minimum Energy Efficiency Performance	Required

Prerequisite 3	Fundamental Refrigerant Management	Required
Credit 1	Optimize Energy Efficiency Performance	1 -18
Credit 2.1	Existing Building Commissioning – Investigation and Analysis	2
Credit 2.2	Existing Building Commissioning – Implementation	2
Credit 2.3	Existing Building Commissioning – On-going Commissioning	2
Credit 3.1	Performance Measurement – Building Automation System	1
Credit 3.2	Performance Measurement – System Level Metering	1 – 2
Credit 4	On-site and off-site Renewable Energy	1 – 6
Credit 5	Enhanced Refrigerant Management	1
Credit 6	Emissions Reduction Reporting	1
Materials and Resources		10 Possible Points
Prerequisite 1	Sustainable Purchasing Policy	Required
Prerequisite 2	Solid Waste Management Policy	Required
Credit 1	Sustainable purchasing – On-going Consumables	1
Credit 2.1	Sustainable Purchasing – Electric-Powered Equipment	1
Credit 2.2	Sustainable Purchasing – Furniture	1
Credit 3	Sustainable Purchasing – Facility Alterations and Additions	1
Credit 4	Sustainable Purchasing – Reduced Mercury in Lamps	1
Credit 5	Sustainable Purchasing – Food	1
Credit 6	Solid Waste Management – Waste Stream Audit	1
Credit 7	Solid Waste Management – On-going Consumables	1
Credit 8	Solid Waste Management – Durable Goods	1
Credit 9	Solid Waste Management – facility Alterations and Additions	1

Indoor Environmental Quality		15 Possible Points
Prerequisite 1	Minimum Indoor Air Quality Performance	Required
Prerequisite 2	Environmental Tobacco Smoke (ETS) Control	Required
Prerequisite 3	Green Cleaning Policy	Required
Credit 1.1	Indoor Air Quality Best Management Practices – Indoor Air Quality Management	1
Credit 1.2	Indoor Air Quality Best Management Practices – Outdoor Air Delivery Monitoring	1
Credit 1.3	Indoor Air Quality Best Management Practices – Increased Ventilation	1
Credit 1.4	Indoor Air Quality Best Management Practices – Reduce Particulates in Air Distribution	1
Credit 1.5	Indoor Air Quality Best Management Practices – Indoor Air Quality Management for Facility Alterations and Additions	1
Credit 2.1	Occupant Comfort – Occupant Survey	1
Credit 2.2	Controllability of Systems – Lighting	1
Credit 2.3	Occupant Comfort – Thermal Comfort Monitoring	1
Credit 2.4	Daylight and Views	1
Credit 3.1	Green Cleaning – High Performance Cleaning Program	1
Credit 3.2	Green Cleaning – Custodial Effectiveness Assessment	1
Credit 3.3	Green Cleaning – Purchase of Sustainable Cleaning Products and Materials	1
Credit 3.4	Green Cleaning – Sustainable Cleaning Equipment	1
Credit 3.5	Green Cleaning – Indoor Chemical and Pollutant Source Control	1
Credit 3.6	Green Cleaning – Indoor Integrated Pest Management	1
Innovation in Operations		6 Possible Points

Credit 1	Innovation in Operations	1 – 4
Credit 2	LEED Accredited Professional	1
Credit 3	Documenting Sustainable Building Cost Impacts	1
Regional Priority		4 Possible Points
Credit 1	Regional Priority	1 – 4

Source: (USGBC, 2011)

Appendix III – AQUA’s Categories and Sub-Categories List

Topics	
Category	Sub-Category
Location and Construction	
Building’s relation with its surroundings	Context Consideration
	Building’s Layout on the Terrain
Integrated choice of products, systems and construction processes	Building’s Adaptability and Durability
	Construction Processes Choice
	Construction Products Choice
	Building’s End of Life / Easiness to Demolish / Recyclability
Low environmental impact construction site	Production, Identification and Management of Waste
	Nuisances and Pollution
	Resources – Water and Energy Production
Management	
Energy Management	Non-renewable Primary Energy
	Nuisances and Pollution
Water Management	Potable Water Savings
	Rain Water Management on Site
	Sewage System
Operation and Maintenance Waste Management	Waste Production Control
	Matching Internal and External Waste Collection
	Waste Sorting Control
	Internal Waste Collection Optimisation
Maintenance – Upkeep of Environmental Performance	Maintenance Needs Optimisation
	Maintenance’s Environmental and Sanitary Effects Control
	Easy Access to Maintenance
	Equipment Destined to Maintain the Use and Operation

	Performance
	Comfort
Hygrothermal Comfort	Winter and Mid-Season
	Summer
Acoustic Comfort	Spatial Architectural Dispositions
	Acoustic Isolation
	Acoustic Corrections of Environment (If Necessary)
	Noise Effects on Neighbourhood
Visual Comfort	Daylighting Consideration
	Artificial Lighting
	Visual Relation with the Exterior
	Artificial Lighting of Exteriors
Olfactory Comfort	Unpleasant Odours Sources
	Unpleasant Olfactory Sensations
	Health
Sanitary Quality of the Environment	Indoor Environment and Surfaces Treatment
	Specific Hygiene Conditions (Collective or Professional Equipment)
Sanitary Quality of the Air	Pollution Sources
	Air Pollutant's Effect on Health
Sanitary Quality of the Water	Internal Consumption Water Quality Maintenance
	Controlled Access to Collective Distribution Networks
	Quality Control of Water from Non-potable Sources

Source: Adapted from (Fundação Vanzolini, 2007)

Appendix IV – Selo Casa Azul Criteria List

Categories, Criteria and Classification Board						
Categories/Criteria		Classification				
1 – Urban Quality		Bronze	Silver	Gold		
1.1	Surroundings Quality – Infrastructure	Mandatory	Mandatory Criteria + 6 Criterion of choice	Mandatory Criteria + 12 Criterion of Choice		
1.2	Surroundings Quality - Impacts	Mandatory				
1.3	Surroundings Improvement					
1.4	Rehabilitation of Degraded Areas					
1.5	Rehabilitation of Buildings					
2 – Site and Comfort						
2.1	Landscape management	Mandatory				
2.2	Project Flexibility					
2.3	Neighbourhood Interaction					
2.4	Alternative Transport Solutions					
2.5	Area dedicated to waste management	Mandatory				
2.6	Leisure, Social and Sporting Equipment	Mandatory				
2.7	Thermal Performance – Isolation	Mandatory				
2.8	Thermal Performance – Sun and Wind Orientation	Mandatory				
2.9	Daylighting in Common Areas					
2.10	Daylighting and Natural Ventilation of Washrooms					
2.11	Adaptation to the Physical Conditions of the Land					
3 – Energy Efficiency						
3.1	Low Consumption Lamps – Private Areas					
3.2	Low Consumption Lamps – Common Areas	Mandatory				
3.3	Solar Heating System					
3.4	Gas Heating System					
3.5	Individual Monitoring – Gas	Mandatory				

3.6	Efficient Elevators	
3.7	Efficient Electronic Appliances	
3.8	Alternative Energy Sources	
4 – Material Resources Conservation		
4.1	Modular Coordination	
4.2	Component and Material Quality	Mandatory
4.3	Industrial or Pre-fabricated Components	
4.4	Reusable anchors and shapers	Mandatory
4.5	Construction and Demolition Waste Management	Mandatory
4.6	Optimally Dosed Concrete	
4.7	Pozzolanic and Blast Furnace Cement	
4.8	Pavement with Construction and Demolition Waste	
4.9	Façade Maintenance Easiness	
4.10	Planted or Certified Wood	
5 – Water Management		
5.1	Individual Monitoring – Water	Mandatory
5.2	Economizing Units – Discharge System	Mandatory
5.3	Economizing Units – Aerators	
5.4	Economizing Units – Registration Flow Regulator	
5.5	Rain Water Use	
5.6	Rain Water Retention	
5.7	Rain Water Infiltration	
5.8	Permeable Areas	Mandatory
6 – Social Practices		
6.1	Education for Construction and Demolition Waste Management	Mandatory
6.2	Employees Environmental Education	Mandatory

Mandatory Criteria + 6 Criterion of choice

Mandatory Criteria + 12 Criterion of Choice

6.3	Employees Personal Development	
6.4	Employees Professional Training	
6.5	Local Workers Inclusion	
6.6	Community Participation in Project Development	
6.7	Residents Guidance	Mandatory
6.8	Residents Environmental Education	
6.9	Building Management Training	
6.10	Actions Directed Towards Minimizing Social Risks	
6.11	Actions Directed to Job Creation and Income	

Source: Adapted from (Caixa Econômica Federal, 2010)