A COMPARISON OF 3STAR (CHINA) & LEED (USA) GREEN BUILDING CERTIFICATES

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Declaration:

I hereby confirm that this dissertation is my own work.

_____ _____
Signature Date

DECLARATION

I, Marina Voynas (Student Registration No: 101646170), confirm that this work submitted for assessment is my own and is expressed in my own words. Any uses made within it of the works of other authors in any form (e.g. ideas, figures, text, tables) are properly acknowledged at their point of use. A full list of the references employed has been included.

Signed ……

Date ……

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Abstract

Lately China has started to take some steps towards a greener future and has seriously included sustainability in its development agenda. In the construction field, green building have started to be encouraged and so green building certifications started to play an important role in the real estate market. China is overall the country of the world with the busiest construction activity right now so it raises interest to question which green building certification is mostly preferred and sought after in this market. The main certifications being LEED (USA) and 3Star (China), this dissertation comes to investigate the not yet very well known but fast emerging 3Star in comparison to LEED, which is the leading and mostly prevailing certification in the construction market in China so far.

The study consists of a detailed literature review on LEED and 3Star and a qualitative research based on a questionnaire survey that serves to understand users' preferences and thoughts regarding these two systems. The combination of literature review, and analysis, interpretation and conclusions on the questionnaire research leads into proving the aims and objectives stated at the beginning: the two certifications play both key roles in different important points of green building and socio-economic interests and they actually work complementary to each other instead of competitively as one would expect, both having strengths and weaknesses in opposite or independent fields.

Keywords: Green building, LEED, 3Star, China, Chinese Market, sustainability

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List of Terms and Abbreviations

3Star: Chinese Three Star Green Building Certification & Rating System

BREEAM: Building Research Establishment Environmental Assessment Method

CASBEE: Comprehensive Assessment System for Building Environment Efficiency

CBR: China Business review

CIERP: Center for International Environment and Resource Policy

China: The People's Republic of China

DGNB: Deutsche Gesellschaft fuer Nachhaltiges Bauen (German Sustainable Building Council)

GBES: Green Building Evaluation Standard

GOBAS: Green Olympic Building Assessment System

HVAC: Heating, Ventilating, Air Conditioning

LBNL: US Department of Energy's Lawrence Berkeley National University

LEED: Leadership in Energy and Environmental Design

MOHURD: Ministry of Housing and Urban Rural Development

RMB: (Ren Min Bi) Chinese Yuan

USA: United States of America

USGBC: United States Green Building Council

Chapter 1: *Introduction*

1.1 Introduction

The first chapter of this dissertation is an introduction to this research paper, to its content and to its structure, so the reader can get an overall idea of what is going to be read and why. It starts with the rationale behind choosing this topic, continues with the explanation of the aim of this work and then states the objectives of it. The chapter ends up with a clarification of the research methodology that will be used to demonstrate the above stated and then unfolds the research structure followed.

1.2 Rationale

3Star is China's first attempt to launch a prevalent green building evaluation standard in the country. It is authored by MOHURD and has local focus. As the introduction of the rating system notes, its purpose is to create a voluntary rating system that will encourage green development. The evaluation system, introduced in 2006, is credit-based, and allows developers to choose which credits they want to pursue.
(Source:http://chinagreenbuildings.blogspot.com, accessed 14.1.2013).

Another evaluation system that has a strong presence in China is LEED (USA). LEED developed as a worldwide evaluation standard and is being used in several countries mainly because of its worldwide brand recognition.

The growth rate of these rating systems is remarkable. LEED is the best-known system and overall more popular in China, but 3Star rating system is fast catching up. In fact the growth rate in terms of registered project for 3Star is much faster than LEED. LEED registration grew at 39% in 2011, and 29% in 2010, while 3Star has grown at 191% in 2011. LEED has nearly 800 registered projects, while 3Star has 242. (Source: www.cargocollective.com, accessed 14.1.2013).

These two certification systems are the protagonists of China's green building scene. It is of great interest to understand how they work in this context and what purpose they serve. A comparison between the two of them in order to understand and discuss about this will form the main body of this research.

1.3 Aim

The aim of this dissertation is to reveal the best green building certification for the Chinese construction and development market now and in the future.

1.4 Objectives

The first objective of this dissertation is to present and compare LEED and 3Star considering their structure and usage and other factors affecting them. The second objective is to investigate the green building market in China and how these two rating systems fit in it. The final objective is to prove the hypothesis that these two certificates are actually both necessary in China and complementing each other instead of competing.

1.5 Research Methodology

Rationale, aims objectives and hypothesis stated, it remains to choose the most appropriate method to follow in order to conduct this research in the most effective, realistic and productive way. For this reason, this study is based on two important research pillars: a review of the available literature regarding the two evaluation systems and a qualitative research, being a questionnaire, formulated to prove the above stated. A combination of both methods' results will answer the stated objectives.

1.5.1 Literature Review

The literature review for this research was based mainly on sources about LEED certification. There is not much literature on 3Star, partly because it is a newcomer and partly because the available texts are mainly in Chinese language. So, whereas the LEED comments and research based on books, journals, reports and conferences, the 3Star ones based mainly on internet sources such as blogs and websites of organisations, users, academics and other professionals who are involved in it. On the contrary, exploring the Chinese path of green building was easier and more fruitful in terms of literature as a lot has been said and written both from Western and Asian authors about China.

1.5.2 Questionnaire Based Study

The most important aspect of this dissertation is trying to show how these two systems work specifically for the Chinese green building market. For that reason a questionnaire has been created and circulated among people who work for the construction and design business in China and can be considered directly or indirectly involved in the green building discussion. For homogeneity and practical reasons, as well as to keep up with the geographical area of the case study, the research area of the questionnaire has been limited to Shanghai, where most of the headquarters of leading design, development and construction firms and organisations are concentrated. The purpose of the questionnaire is to answer to questions set by the aim and objectives of this study from a market professionals' point of view. This will enable the results and conclusions to be more realistic and up-to-date. According to Naoum (1998) a questionnaire can be regarded as an attitudinal and exploratory research technique. It fits this research's purposes because an attitudinal method for research aims subjectively to assess the viewpoints and perceptions of an individual in regard to a particular question or factor. So being an exploratory research method, it is used to diagnose the situation and screen the available alternatives.

1.6 Research Structure

This dissertation is broken down into 6 Chapters. Each of them contains a number of subchapters in it for a better understanding of the structure and follow-up on the reader's side. There is a small introduction in the beginning of every chapter to present what is dealt following and usually there is a summary or conclusion in the end of it to put together hypothesis, analysis and results derived from the afore-written.

The 1st Chapter is an introductory chapter where the rationale, aims and objectives are stated and the research methodology along with the research structure has been introduced and presented.

The 2nd Chapter is about literature review around Green Certifications and the benefits of green building, LEED & 3Star's structure, criticism and comparison.

The 3rd Chapter puts the reader in the Chinese context of green building market based on historical and actual facts then analyses incentives and barriers involved in it.

The 4th Chapter is about the methodology review. It analyses quantitative and qualitative methods on which a research can be based, explains the forming and implementing of the questionnaire.

The 5th Chapter analyses the data obtained from the literature review and the questionnaire and discusses on the results of them.

The 6th and final Chapter presents total conclusions and analysis of the limitations faced in writing this research work plus recommendations for the future of the green building scene in China.

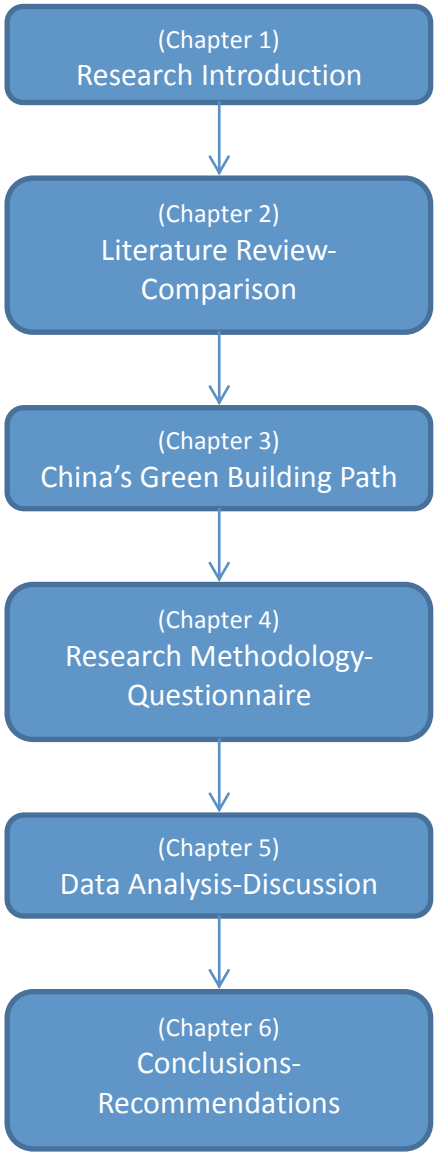

Fig.1: Research Design Diagram

Chapter 2: *Literature Review*

2.1 Introduction

This chapter is about literature review around LEED and 3Star. It starts with a brief history of the development of green rating systems in general. Second, the benefits of green building are introduced and then LEED and 3Star are presented. A comparison on many points and aspects based on literature review about LEED and 3Star follows. Conclusions are driven and summarized in the final part of the chapter.

2.2 Green Certification

After the Industrial Revolution, urbanisation and the building construction have seen an accelerating growth. During this, the grave impacts on the environment largely were not taken into consideration. All attempts on a total green framework were nonexistent, and emphasis only started in the late 1970 with increasing ecological lobbyists and campaigners (Keeler and Burke, 2009).

One such proposal suggested elevating global and social responsibilities and awareness by highlighting the inefficient use of natural resources and consumptions (Jones, 2008). Yet, studies were more about the inclusion of ecological concerns into the green framework and attaching design methodologies of the past. It is only in the 80's that the concept of sustainability comes to the fore and it is then when architecture and civil engineering become largely involved and consequently transformed by this impact and made progress. Emphasis was then placed on specific building projects and suggestions on energy technologies and innovations started to gain traction. During this period the design approach becomes more pragmatic and substantial. On similar grounds, establishments are started to be created which oversee and develop green assessment techniques and practices. The first green certification body for buildings, BREEAM, is established in the UK in 1990 and is followed by USGBC (LEED) in 2004, whereas in China the 3Star by MOHURD has been launched in 2006.

In the early years of the green development relevant initiatives were brought about mostly by government authorities, which is the case in China. Around the world lately,

with the rise of green consumers and the demand from the market, more and more organizations, private companies and consultancy firms emerged and started taking a competitive role in green initiatives.

2.3 Benefits of Green Building

The green market and demand for its products has been aggressively increasing since the late 70's until today. Businesses have started to consider more and more the introduction of a green initiative in their agenda to boost up their performance. The green building market included 2% of non-residential construction starts in 2005; 12% in 2008; and grew to 28%-35% in 2010 (USGBC, 2013).

Studies on green buildings have proved qualitatively and quantitatively that investing in green is more profitable than a green absent approach. First of all, green buildings consume less energy and fewer resources. For example, in case of a LEED commercial building, it consumes 25% less energy and 11% less water, has 19% lower maintenance costs; 27% higher occupant satisfaction and 34% lower greenhouse gas emissions compared to the average commercial building (USGBC, 2013). These studies have also proved that green programs add significantly up to the market value of a building. Either because of their better design or a premium that comes from green certifications' benchmarking, these buildings are one step ahead of their similar with no green considerations. As a consequence, from the real estate owners' perspectives, it minimizes the need for sale or lease considerations, and more long term tenants are acquired (Fineman, 2000). Other interests to green building owners, especially when considering office buildings, are the betterment of employees' performance and productivity due to betterment of their living conditions in their working environment. Such betterments are due to better indoor air and lighting conditions. For example, the use of day-lighting, which is gaining importance and popularity towards environmental impacts recently, has been shown by studies to have direct relationship with increased performance and health. Green investments also possess good cost-benefits. According to Kats (2003), the high initial investment cost of LEED accredited buildings has been offset by greater productivity and health benefits over the buildings' life cycle through their green design and use of methodologies. This has aroused the governments' interest and enacted legislations

and enforcement of mandatory green measures throughout developed and/or developing countries and thus an urge of promotion of the green designs on more properties and facilities.

	Operating Cost	Building Value	ROI	Occupancy	Rent
New Construction	drop 13.6%	rises 10.9%	improves 9.9%	rises 6.4%	rises 6.1%
Existing Building	drop 8.5%	rises 6.8%	improves 2.5%	rises 1%	rises 19.2%

Table 1: Cost benefits of Green Building, according to building owners (Source: Mc Graw Hill Construction (2010). Green Outlook 2011: Green Trends Driving Growth)

Currently, LEED is still the dominant leader for green and sustainable development programs around the world. In China by the end of 2011, more than 800 construction projects had been registered for certification while nearly 200 had been LEED Certified. Moreover, China is the No.1 locale after USA to have the biggest number of registered + certified buildings as of June, 2012 (USGBC, 2013). 3Star is newer and has fewer projects, but it has seen similar growth, increasing from 10 projects certified in 2008 to 83 in 2010 (CBR, 2012). A rise in eagerness to attain a green certification for a newly constructed building or a renovation project is generally very much in trend lately all over the world. This is as well one of the rationales behind this dissertation, to explore and carry out a study on the comparison of the two most lately discussed rating systems.

2.4 LEED & 3Star

This study focuses on both LEED and 3Star's program objectives and their overall intentions, though more emphasis is given to LEED's suitability as being the leading green rating system in China's sustainability scene so far. 3Star is comparatively new and lacks of a wide range of criticism or euphemisms.

LEED is a voluntary, consensus-based, market-driven program that provides third-party verification of green buildings. LEED is developed, implemented and maintained with the help of the LEED Committees. Building projects earn points for satisfying green building criteria. Within each of the environmental LEED credit categories, projects must satisfy particular prerequisites and earn additional points. The number of points the project earns

determines the level of LEED certification the project receives. Projects must earn at least 40 points to achieve basic certification. Various rating systems exist to address different types of building projects, including healthcare facilities, schools, homes and neighbourhoods (USGBC, 2013). *(See clarifications about versions and more information on LEED in Appendix 1)*

China's 3Star system rates residential and commercial buildings, including apartments, hotels, and office and commercial space, from one to three stars with three stars indicating the highest performance level. Like LEED, the rating uses a point system to evaluate a building's water and energy efficiency, materials and resources use, indoor environment, operation and maintenance, and site efficiency and outdoor environment. A building must obtain a certain number of points in every category to qualify for a star rating. A building is evaluated by a local, provincial, or national committee, depending on the location of the building and what star-level a developer hopes to obtain. (Nelson, CBR, 2012)

A lot has been said and done about green initiatives throughout the years. A vast academic and popular literature has been written relevantly. Especially in LEED's case references and criticisms are abundant but unfortunately it is not the same for 3Star. 3Star is a relatively new system and literature concerning it consists mostly of Chinese text and a very few English. This constrains this dissertation to base more on LEED's literature than 3Star's and in addition on studies on the comparison of a multitude of systems of other countries. 3Star has yet taken only baby steps as an integrated rating system, and mostly bases on existing systems of technologically more advanced countries such as LEED (USA), BREEAM (UK), CASBEE (Japan) and/or others. Hence, being a very present introduction requires this study to involve existing and well established frameworks underlying other systems, i.e. LEED, as their practices and the already existing research and published data about them gives a solid base to rely on.

2.4.1 LEED Criticism

LEED has been largely criticized as being a superficial rating system with emphasis only on point gathering than actually benefiting the sustainability of the building and its impact to the environment. The first versions of LEED have also come under fire

for certain non-empirical criteria and selection process, and that it is not congruent with life cycle concepts and analysis (Cole, 1998) but this has been remedied in a certain degree in the following versions. Still there are big gaps in the system. For example, there are still several environmental impacts and attributes of materials that are not included. Curiously, there is still no mention of embodied energy in products or product assemblies despite the fact that embodied energy is often equivalent to many years of energy consumption associated with a structure. Similarly, there is no mention of emissions linked to production and use of construction materials. Also not mentioned is any requirement for consideration of life cycle inventory data using common criteria as part of the materials rating system, nor is there any requirement for certification of any material or other products other than those made of wood (Bowyer et al. 2006) in the earlier or the later versions of LEED.

LEED has also been criticized of favoring managements and stakeholders' needs, plus lacking of adaptability and comprehensiveness to other contexts. LEED is also said to focus only on the results without considering the intent of how it was achieved (Newsham, Mancini and Birt, 2009).

The overall environmental performance of LEED has long been criticized because of its ratings and point allocations. Moreover, its measurability and assessment has come into question whether they are capable on their path to standardization.

A careful analysis of the literature around the importance of LEED and the rise of similar green certifications, end up with interesting insights and conclusions:

- Projects that have not been selected for a green certificate could actually attain one;
- Some green ratings that could be attained have less functional importance than others;
- Only easier and cheaper to attain ratings are popular (such as energy efficiency, water consumption) and the actual environmental performances of these are usually ignored;
- Ratings or certifications that do not add value or serve the organizational interests are largely ignored;

- Some ratings are more popular as they are perceived and have direct impact on individuals and consumers (such as indoor air quality).

2.4.2 3Star Criticism

3Star has not yet met much of criticism or reference in articles and other academic works majorly because of its' not yet fully developed market recognition. More reasons for that are probable. For example, 3Star is a government produced and promoted system so commenting or criticizing it would be equal as criticizing the governmental performance itself. That could be one of the reasons why Chinese authors are reluctant criticizing or commenting on it. The second possible reason for that could be the fact that this certificate concerns the Chinese territory only so it doesn't really intrigue overseas authors to consider it for commenting. In case of Chinese commentators, their work is usually in Chinese language and therefore unavailable broadly.

The main fault of 3Star appears to be its lack of transparency through its certification process. There are no Project Check Lists, Scorecards, explicit Minimum Program Requirements and other forms such as in LEED *(See Appendices 2, 3, 4),* nor clear point allocations or scores, so everything depends on the MOHURD's certifying committee's judgment and final decision.

2.5 Comparison of LEED & 3Star

2.5.1 Introduction

This chapter is about the comparison between LEED and 3Star and it bases on three pillars: the main areas of concern they focus, their credit allocation and their administration and usage. The first part is broken down in six main subcategories, being Site, Energy, Materials and Indoor Environment, which broadly create a common basis of concerns to include and discuss about almost all chapters of both systems. The second part is about point allocation correspondence between the two systems and the third part is about their administration and usage, which make the biggest difference in users' decision to choose one or the other.

2.5.2 Main Areas of Concern

The Literature Review shows that LEED and 3Star deal with the same areas of concern in their major part. Site to be chosen, water usage, materials' preference, energy usage and indoor environment's quality is their main areas of concern. What is different is the way each system's perception of these issues. One would notice even from the titles given to each category that the scope and confrontation of them is different. LEED focuses more on high-tech equipment and sophisticated material use, one would say on consumption or acquisition of added solutions and 3Star is keener on preserving the existing sources, limitation, managing and controlling of them. *(The following comparison is based on LEED's NC 2.2 version and the 3Star Code's English translation from Chinese).*

- Site: 3Star refers to it as "Land saving and Outdoor Environment" whereas LEED as "Sustainable Sites". Their point of views overlap in most areas except that LEED includes incentives for alternative transportation and 3Star includes credits for reducing environmental noise and paying attention to the wind environment (Hubbard, 2009).

3Star refers to this chapter as "land saving". By saving a land it is meant that the operation of an already being used, abandoned or waiting to be upgraded land is preferable to 3Star. LEED doesn't promote such an initiative just favors an alternative transportation method if introduced, so the car use is minimized. This is very close to USA mentality as use of car is the prevalent mean of transportation over public. 3Star also includes a chapter for reducing environmental noise. This is probably because in this context, it foresees that the site chosen will be part of the city, so surroundings should be considered. There is no such specific consideration in LEED.

- Water: It is addressed as "Water Efficiency" in LEED, and as "Water Saving and Water Resource Utilization" in 3Star. Basically, all LEED areas are covered by 3Star but it also includes credits for including water systems planning in early design, avoiding pipe leakage, monitoring safety of non-traditional water sources and efficient use of reclaimed water (Hubbard, 2009).

3Star pays extra attention in monitoring the water systems involved in the procedure. In 3Star's rationale, as it will be justified by the fact that 3Star awards its certificates after one year of usage, it is of utmost importance to check whether the building will actually function the way it was supposed to after being built and operated.

- Energy: It's "Energy and Atmosphere" in LEED, whereas "Energy Saving and Energy Utilization" in 3Star. Some credits, Commissioning and Refrigerant Management of LEED are not in 3Star and vice versa, 3Star has credits that are not in LEED, such as the "No use of electric boiler/water heater for heating or cooling" and "Standard for air tightness of windows" (Hubbard, 2009).

One can again notice, that LEED assumes a building will a priori use refrigerants to cool or heat itself, so gives credit for their choice, sophistication and usage. 3Star on the other hand accredits the effort of avoidance of such machinery and encourages a better HVAC system by relevant design. It also gives extra attention to preserving the existing good air condition in an indoor space by accrediting existing windows' leakage monitoring and other such "preserving" means, instead of adopting new ones.

- Materials: It is referenced as "Materials & Resources" in LEED versus "Material saving and Material Resource Utilization" in 3Star. There are credits that are only in LEED, such as the collection and storage of recyclables, the rapidly renewable material and the certified wood and there are credits that are only in 3Star, such as the methods for increasing efficiency in concrete, adopting an efficient structural system, specific thresholds for harmful substances in material and encouragement of flexible partitions use (Hubbard, 2009).

As mentioned in LEED criticism chapter above, LEED ignores life cycle assessment of the materials used and their energy emissions. Its logic about recycled materials used is not very clear and thorough and among all other materials that are more likely

to be used in a construction only wood is required to be certified. 3Star on its side bases on already long existing legislature of Chinese building codes and introduces methods for increasing efficiency in concrete and adopting an efficient structural system. It foresees specific thresholds for harmful substances in material (the latest is common in China) and encourages flexible partitions use so the building can be altered in size or re-used later, which would be another environmental benefit that is not perceived in LEED. Though LEED tends to push towards preference of specific materials, 3Star being away from marketing mentality ignores this aspect of material use and focuses on other aspects which were mentioned before.

So it is not really all that surprising that 3Star has a greater focus on *energy consumption*: by requiring more energy prerequisites, and specifying a lower energy consumption baseline. Furthermore, since the 3Star program does not have the same collaboration between green building suppliers and industry it tends to focus on simpler and cheaper solutions for energy efficiency, while LEED has a much stronger preference for high tech solutions and materials (www.cargocollective.com, accessed 12.11.2012).

- Indoor Environment: This chapter is mentioned as "Indoor Environmental Quality" in LEED, whereas as "Quality of Indoor Environment" in 3Star. Again, there are some credits that are only in LEED such as the Tobacco Smoke Control, Low-Emitting Material, Thermal Comfort and Verification, and credits that are only in 3Star, such as noise reduction measures, air contaminant concentration standard, maximum temperature of room allowed under natural ventilation and sound insulation requirements.

LEED gives credit to smoking restriction, whereas 3Star totally ignores it. It is a difference in cultural perception that is probably lying behind: in USA it is very common not to smoke whether non smoking is the exception in China. Banning smoking in a building would be unconceivable in Chinese context and a big determent for pursuing 3Star for developers. The rest of the considerations about materials used,

thermal control, verification etc. are similar in both systems but there are some additional noise reduction measures, maximum temperature of room allowed under natural ventilation and sound insulation requirements in 3Star. What is curious is that 3Star also includes an air contaminant concentration standard which makes total sense in the Chinese context. In China air pollution constitutes one of the major environmental and practical everyday problems faced, its levels hitting world highest every day.

To sum up, differed ratings for one system are not minimal but could be adjusted with higher values to fit the other system on the same classification (Reeder, 2010). It appears that all LEED chapters are included somehow in 3Star but 3Star has also some additional ones that LEED doesn't mention. These are goals such as establishment and implementing of energy savings, water savings, and other energy saving policies as well as green management policies in addition to relating improved performance to resource savings and financial benefits.

- Credit Allocation: 3Star has prerequisites similar to the "Control items", credits similar to "General items" of LEED, and its own "Preference Items" which are some strategic and harder to reach targets. It consists of six thematic categories and has three levels of rating (Hubbard, 2009).

This is one of the most criticized aspects of LEED. Especially in earlier versions of LEED it was possible just to gather points regardless which ones picked up and once a required score was achieved the certification was granted but the same problem still exist for the latest LEED version in a certain degree. This results in questionable environmental benefits. In 3Star a three star rated building must have a three star score for every category. This method is in some ways an improvement over LEED. Since LEED credits are all counted equally, it is possible to pick and choose the easiest credits, while ignoring the more important and more difficult credits like Energy Efficiency. In fact, it was possible to get a LEED certified project with no energy credits at all in early LEED versions, and many LEED Certified projects only

attempted a minimal number of energy credits. In this aspect, achieving a 3Star degree is a more overall evaluation procedure than a partial points' summa which appears to be in LEED.

As for 3Star, the point allocation method it uses is not very clear, nor transparent, and when comparing to LEED, only an approximate analogy can be made. A simulation made by Hubbard to compare points in LEED NC 2.2 version and 3 Star (2009) follows:

Category	3 Star	LEED NC 2.2
Sustainable Site	9	14+1
Water Efficiency	7	5
Energy & Atmosphere	14	17+3
Materials & Resources	10	13+1
Indoor Environmental Quality	9	15+2
Operations & Maintenance	8	
Innovation		5
Total	57	69

Table 2: 3Star & LEED Credit Distribution (Source: Hubbard, 2009)

Category	3 Star	LEED NC 2.2
Sustainable Site	8	11
Water Efficiency	5	1
Energy & Atmosphere	5	5
Materials & Resources	10	2
Indoor Environmental Quality	9	12
Operations & Maintenance	3	
Innovation		
Total	40	31

Table 3: 3Star & LEED: Reference Codes (Source: Hubbard, 2009)

All credits are totaled together for a final score in LEED regardless of the category. In contrast, 3Star requires every building to achieve all the control items as well as a minimum of one star in each category. To receive higher certifications you must achieve that higher score for every category (www.cargocollective.com, accessed 13.11.2012).

There are similarities and differences at all levels of 3 Star and LEED certifications, being 1 Star, 2 Star, 3 Star for 3-Star and Certified, Silver, Gold and Platinum for LEED. The correspondence of the award degree is shown below.

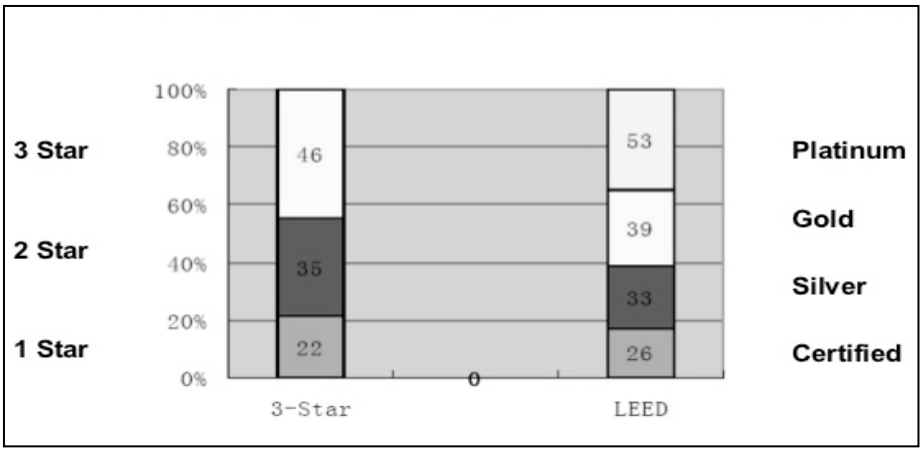

Table 4: 3Star & LEED Levels of Certification (Source: Hubbard, 2009)

- Administration and Rationale: One important feature that separates the two systems is how they are administered. In LEED's case, LEED accredited professionals help administer the design and construction submittal and then an unknown 3rd party evaluates the documentation. Whereas in 3Star, MOHURD in each province certifies for 1 Star and 2 Star degrees and the Beijing Office of MOHURD only gives a "3 Star" (Hubbard, 2009).

This difference between these systems reflects the different goals and philosophies of the organization designing and running them. LEED was designed by the USGBC, collaborating between developers, architects, engineers, and green building material suppliers, to generate a market for green buildings, green building products and

services, and promote sustainable design. In short and in green building jargon: transform the marketplace (www.cargocollective.com, accessed 12.11.2012).
By almost any measure LEED has been an incredible success in generating a market and creating a buzz around the idea of sustainable design around the world. The 3Star system on the other hand, is an Academic and Government-led project. While 3Star shares market transformation goals, it also has an overriding policy goal that fits into China's long term environmental and energy policy: namely reducing building energy consumption (www.cargocollective.com, accessed 12.11.2012). The marketability ambitions of these two systems are totally different: 3Star is not seeking to take a leading place amongst the world's green-certifications, whereas LEED is making a conscious effort to spread into new markets worldwide.

Another fact that makes LEED and 3 Star's purpose difference more evident is the fact that the registration fee for a LEED project is: US$900 - US$1200 application fee + US$2000 average certification fee (USGBC 2013), whereas the 3Star's registration is almost free (MOHURD, 2013). This gives the idea that LEED wants and/or needs some financial support by its applicants or even has a profit aspiration, whereas 3Star is promoted by the Chinese Government and is given incentives to apply for.

To sum up, the main difference LEED and 3Star have is that LEED is an independent organization, a certification system that aims to spread as much as possible around world markets based on its reputation and worldwide recognition. It is already the most recognizable benchmark among green building certifications and opts to grow in this direction in the future. This is also its strongest point why professionals choose it. Its background is market driven, or in other words it is "down to top", which means, it was a strong market demand that created it, but it also means that people will choose to pursue it because of that market response to it.

It is a totally different case for 3Star. 3Star is a "top to down" case, first made to fit the environmental policies of the Chinese Government and then introduced to the market. It aspires to become popular around China but it doesn't have any ambition to spread outside China. Being focused on the Chinese area and its reality, it handles better China's region specific environmental concerns such as extreme cold, extreme

hot or mixed areas and is more practical and innovative in many points. There is no search for profit in it, just an effort to make it more efficient for a specific scope. LEED on the other hand, has to keep its flexibility to adapt to diverse markets around the world and keep a homogeneous standard to meet most of the requirements. This makes it weaker to respond to some specific demands and realities of the Chinese market, such as ignoring air pollution levels or smoking habits and so on.

- Usage: LEED is usually sought after for commercial and benchmark buildings by individuals such as developing companies, a building's management or organizations whereas 3Star is majorly sought after for residential, demonstration, or government buildings and so by the Chinese government itself (Li & Currie, 2010).

It is important to note, that China is a vast country, including 5 different climatic zones with different energy requirements within its borders. Unlike LEED, which is designed to fit every building in different parts of the world, 3Star is exclusively made by China for China and has considered different approaches for different climates and geographical zones throughout the country. Where LEED's adaptability is not sufficient to endorse these kinds of details 3Star comes into help. Another point of view regarding this issue suggests that since review processes are carried out by respective local government, procedures and standards can vary and might even be less strict than necessary. In this regard, LEED -known for its stringent guidelines- trumps 3Star (www.bee-inc.com, accessed 4.3.2012).

3Star, being formulated to work in the Chinese context only, is closer to the Chinese property market reality than LEED. According to Reeder (2010), LEED is more complex and difficult to comprehend and so much larger in scope due to differences in climatic, social and cultural needs, though it has introduced the web-based assessments, the requirement for greater expertise to understand its extensive scope and methodologies make it too technical and harder to implement.

Last but not least, the most important feature of the 3Star is that rating happens after one year of occupancy of the building and this can be highlighted as the biggest

difference and most positive point pro 3Star. The feature where 3Star gets the most appraise from sustainability critics is the fact that it screens whether a building actually meets the hypothetical benefits achieved after one year of occupation of the building. In the construction business it is very well known that a building can be said to function properly after at least one year of operation. One year (or even later) is the proper time to measure whether all the green innovations applied in a building actually meet the preset goals. This makes 3Star more reliable, more realistic and more credible for its validity. This though, is a determent for the developer applying for it. After all the time, money and effort spent the developer risks the possibility that the building will not actually manage to meet all the requirements and eventually fail to be awarded the desired degree or even fail to be awarded any degree at all. There is no such danger in LEED, where the level of certification is awarded in planning stage and there is no screening after that.

Area of Concern	Certification	
	LEED	3STAR
	Reference Name	
Site	Sustainable Sites	Land Saving and Outdoor Environment
Water	Water Efficiency	Water Saving and Water Resource Utilization
Energy	Energy and Atmosphere	Energy Saving and Energy Utilization
Materials	Materials & Resources	Material saving and Material Resource Utilization
Indoor Environment	Indoor Environmental Quality	Quality of Indoor Environment
Credit Allocation	Platinum, Gold, Silver, Certified	3 Star, 2 Star, 1 Star
Administration/Rationale	USGBC	MOHURD
Usage (mostly)	Commercial, benchmark buildings	Government, demonstration buildings

Table 5: Comparison of the Main Areas of Concern in LEED & 3Star - Summary

To conclude, it is important to mention that architects and academics around China and USA tend to have relatively polarized positions about these two systems. Chinese university professors see LEED as mostly marketing and as a hype that will not actually reduce building energy consumption in China, and in some ways the data is proving them right. Western Architects, on the other hand, tend to discount 3Star as non-transparent and lacking the objective and trusted brand name of LEED. This viewpoint is also right to a certain point, 3Star is more subjective, but as far as

popularity goes it's actually growing faster than LEED, and growth rates are expected to increase (www.cargocollective.com, accessed 12.11.2012).

2.6 Conclusion

Green certification has become important since the 90's as green development started to be more taken into consideration by government authorities and the private sector. Many green building certifications such as LEED and 3Star have been established since then. Benefits of green building have been proved by academic studies and research throughout these years and this aroused even more interest towards this kind of certifications. Among them LEED has already been intensively criticized and 3Star has just started being under examination.

Regarding their structure, LEED and 3Star have many corresponding features such as their main areas of concern and credit allocation but also some basic differences in their structure, administration, rationale and usage. As far as their overall policies and tendencies are concerned, 3Star appears to focus more on preserving resources and saving financial means whereas LEED seems to promote mostly high-cost and high-tech solutions.

As far as which system is more compatible with China is concerned, 3Star appears to be more suitable to respond to China-specific issues and demands but fails in lack of transparency and organization, whereas LEED, though having many structural and content problems itself, offers a more time-tested, organized, worldwide recognized and reputable option.

Chapter 3: *China's Green Path*

3.1 Introduction

This chapter is an introductory chapter to China's green path since its first efforts in the '80s, till the introduction and further promotion of 3Star today. It underlines the significance of China in the global construction and green building scene in order to answer the question why China's green building effort particularly is so important and

thus under examination in this research work. Then it analyses the barriers and incentives of green building in this country. It ends up with a paragraph of relative conclusions that summarizes the Chinese green building reality as of today.

3.2 Historical and Actual Facts

Buildings play a very important role in the energy demand sector as they account for more than ¼ of China's total primary energy consumption. The speed of construction in China is amazing and it is stimulated even further by the fast rates of urbanization (Chmutina, 2010). Nearly 60% of its population is expected to live in urban areas by 2030 (compared to today's 45%) (SSB 2006).

China has the largest construction volume in the world with about 2 billion square meters of new buildings completed annually. Currently about 80% of these are categorized as high-energy buildings. The World Bank estimates that by 2015 about half of the world's new building construction will take place in China (LBNL, 2008). China's Ministry of Construction estimates that China will add 4 billion square meters in new construction by 2020. More than 90% of new buildings are considered high life-cycle energy buildings (NDRC 2005).

In 1980s, MOHURD began to promote energy efficiency in buildings. The works started with formulating energy code/standards for residential buildings in the north area. The building energy codes/standards system has been improved and enlarged step by step from north to south, from residential to public building, and from new building to existing building ever since. China has four types of energy code/standards concerning construction sectors: national, industry, local and appliances energy efficiency standards. Up to now, the MOHURD has issued three energy efficiency design standards for residential buildings and one for public buildings. All of these four standards have two main parts. One is the thermal performance requirements for building envelope. Another is the requirements for HVAC equipment and system.

Another green building evaluation effort that was introduced in 2004 was the Green Olympic Building Assessment System GOBAS which was created by Tsinghua

University and funded by the Beijing Science and Technology Committee. It is based on the Japanese CASBEE and has some features of LEED. This system is composed of four assessment tools corresponding to a building life-cycle: pre-design; new construction, assessments based on the design specification and the anticipated performance; existing building (an assessment based on the operation record for at least one year after completion); renovation (assessment of the degree of improvement) (GOBAS, 2004).

In 2006 MOHURD introduced the 3Star green building certification system which remains until now the most prevalent and well-known evaluation system in China. In addition, the Ministry of Construction has also issued one design standard for efficient lighting system. A legal government document named "Civil Building Energy Saving Regulations" was issued and put into effect on Oct. 1st 2008, which emphasized on government office building should be enforced to disclose their energy consumption to the public annually. "Technical Directors of Civil Building Energy Labeling Test and Assessment" was issued in June 2008, which was draft by China Academy of Building Research with other Design Institutes and Stockholders (Liu, 2010).

From 2008 to the first quarter of 2011, LEED and 3Star certified a total of 194 green buildings in China. Approximately 25% of these buildings were certified in the first quarter of 2011, mainly driven by the growth in China's 3Star certifications (Source: MOHURD and USGBC website).

3.3 Incentives and Barriers for Green Building in China

3.3.1 Incentives

According to Kwan (2012), companies that chose to build green in China early on were not necessarily focused on cost. The early adopters in China have tended to be large, multinational corporations with a "sustainability vision" and those that see green building as a good marketing tool. But now more companies are considering operation costs, return on investment, higher tenant occupancy rates, and a premium on rents. She adds that those things are real tangible financial reasons as to why people are building green buildings from an owner-developer point of view.

To respond to environmental strains brought about by a burgeoning building stock, China's government is extending favorable policies for green buildings in the 12th Five-Year-Plan (2011-2015). The mandates and incentives issued by the government have been indispensable drivers of green building design in China, and the market experienced 25% growth in green building certifications in the first quarter of 2011 (Source: CGTI White Paper 2011). According to LBNL (2012), current building codes require that new buildings achieve a 50 percent reduction in energy use compared to the 1980s. The energy efficiency label is still voluntary for most residential and non-residential buildings, but the government requires that certain buildings receive a star rating, including new government-owned and large public buildings, existing government-owned office buildings, and large public buildings that apply for government energy retrofit subsidies.

MOHURD released its first set of incentives for complying with the China GBES as part of the 12th Five-Year Plan in 2011. MOHURD will subsidize new 3Star-certified green buildings at the rate of RMB75 (US$12) per square meter (Source: www.house.focus.cn, 2011). With this incentive, MOHURD expects to see a dramatic increase in 3Star-certified buildings in the next five years. According to Lin (2012), RMB75 represents about 30% of the extra cost that it takes to design and build a 3Star-certified building over standard construction. This subsidy represents a concerted effort by the government to push the 3Star system. And in China, the market moves when the government makes its preferences clear (www.cargocollective.com, accessed 11.11.2012). To promote the 3Star rating system, MOHURD has been giving out subsidies on a per square meter basis for buildings that achieve 2 or 3 stars. But while incentives can be encouraging, a mandatory green building policy in China might just be the push that developers need to get them on track (www.bee-inc.com, accessed 4.3.2013).

3.3.2 Barriers

Green building still makes up a small proportion of building in the world's largest construction market, where maximizing profits and lowering building costs often trump sustainable design and energy efficiency considerations (CBR, 2012).

The main challenges that China's green building development faces are financial, technological, and regulatory. There is decreased market value due to low awareness. Potential occupants and building developers lack knowledge of the capital costs and the benefits of green building solutions. As the awareness is low, investors are not willing to pay higher initial costs, even though it would result in lower resource expenditures over the long-term. Moreover, in the Chinese building market foreign designers and builders can play only a very limited role due to Chinese regulations. This results in distortions of competition and complicates green building implementation, resulting in a low skills transfer (Crachilov et al 2009).
According to Liu (2010), the biggest barriers for green building in China are:

- Lack of awareness and wiliness of to promote Green building for owners
- Lack of incentive policy and measures to promote Green Building
- Lack of technical expertise for Green building systematically
- Lack of sufficient investment for Green Building (Liu, 2010)

Many studies discuss barriers to energy efficiency in policies towards buildings (IPCC, 2007; Deringer et al, 2004; Westling et al, 2003). The number of them is large, however the main barriers for energy efficiency improvement in commercial buildings are:

- Technical barriers: standards should be suitable for local climate conditions. Design and materials (such as energy efficient construction materials, envelope insulation, and ventilation options) should be promoted as an important contribution to energy-saving and climate change mitigation.
- Institutional barriers: cost-reflective methods should be promoted to attract the interest of consumers and supplement the implementation of energy efficiency in buildings. Consumers are not eager to save energy while compromising their comfort, therefore reasonable price signals should be sent to them.
- Trend of energy use in buildings in China: the statistics do not count renewable sources in the energy balance of buildings energy consumption. The awareness of renewable energy use should be promoted amongst commercial building users.
- CO2 abatement measures: technical solutions, such as renewable energy technologies, are not used properly: CO2 mitigation in buildings needs to

identify the 26 most effective and cost-effective measures to address the problem of climate change; cost effectiveness and relevance should be considered as primary criteria in assessing the mitigation policies (Li 2008).

Regardless of the certification system used, the green building concept does not always translate to the China market. According to a 2011 report by the China Greentech Initiative, a collaboration between more than 100 organizations that focuses on identifying and developing green tech solutions in China, lack of understanding of green building and misaligned incentives have slowed the adoption of green building in China. Experts say construction decisions are often made based on short-term costs, such as material and labor costs, instead of considering the long-term savings from energy efficiency or green building techniques (CBR, 2012).

A 2012 policy brief prepared by the CIERP outlines five reasons why green building is still not the norm in China (Source: www.bee-inc.com, accessed 4.3.2013):

- Lack of transparency in the 3Star rating system
- Absence of market demand for green buildings
- Lack of technical capacity
- Lack of a robust green building materials supply chain
- Developers' perceptions of cost-benefit analysis

Normally, it is more likely that businesses would be in tuned with competitive advantages in the long run than short term gains (Makower and Pike, 2009), which means that green consumers would adopt a specific rating system or methodology and accept its wide usage only after it is tested in response to the actual market and they are assured of its long term benefits but actually the opposite happens in China.

Because developers in China may not see immediate cost savings, they often overlook the green features—such as better insulation and sealed windows—that could help the government meet its energy targets. This is especially true in the multi-family residential buildings that most people in urban China live in, say researchers at the LBNL. Zhou (2012) thinks that it also gets complicated because the tenants that live in the building didn't build it. The builder doesn't operate the building, so they are not

motivated to invest in better insulation. As Bisagni (2012) summarizes, working on green building projects in the United States and China is like night and day because Chinese builders still prefer to cut costs in the short term. The extent of solutions that you can propose in a project in China is limited in a way because of that payback and cost mentality. In China, there's still a large knowledge gap. In order to cross that it takes a lot of effort".

3.4 Conclusions

Summing up the information above, it is clear that green initiatives in China are mainly taken by the government, either by MOHURD or by other governmental organizations. Plans work when the government pushes. After several steps taken throughout the last decades, the latest and most important step towards a green future has been the latest Fine-Year-Plan of 2011-2015, which favors green building and thus green building certification. 3Star certification and rating system has been introduced in this context and gained pace since then. Chinese government is in the "green path" for at least the next five years and makes this clear by stating it openly and by encouraging 3Star certified buildings financially. Yet some barriers for green development exist. Incentive issues seemingly solved, lack of awareness and expertise constitute the biggest determent factors for a significant green building evolution. Although the market is expanding, green buildings are still rare in China.

Chapter 4: *Research Methodology*

4.1 Introduction

This chapter presents the rationale behind the methodology chosen to prove the objectives and reach the aim of this dissertation. It starts with reminding this aim so as to justify the research method followed later. There is a discussion about appropriate methodologies for this kind of research and a presentation of the method preferred for this specific one. The reason for the selection of a qualitative method thus of a questionnaire as well as advantages and disadvantages of the basic methods mentioned will be highlighted and discussed. Finally, the chapter will close with a detailed explanation on how the analysis of the gathered data of the questionnaire has been done.

4.2 Research Aim Re-Statement

In a dissertation one starts from the aims set at the introductory chapter to identify the best methods that will serve to reach it. This method should at the same time respond to all the objectives that need to be answered. The aim of the dissertation is to identify the best green building certification for the Chinese market. With focus on LEED and 3Star, the method chosen should be able to present each system and cast light into their common aspects and differences, plus highlight the user preferences of them in the Chinese market. In the end it should prove the hypothesis that more than competing, these two systems are actually complementary to each other.

4.3 Research Approach

There are many approaches available for data collection. Nevertheless, selecting which ones relies basically on the nature of the specific research and the type of information that the researcher needs to prove his/her theories. According to Fellows and Liu (1997), in order to achieve a research's aim and objectives, it is very important for a research study to adopt a comprehensible and clear methodology.

There are two issues that one should take into consideration for the data analysis methods chosen for this dissertation. In order one to be able to make such a decision

should first compare the two systems and impartially identify the strengths and weaknesses of each system alone, then in comparison to each other, and then must bring into surface what people in the directly relevant field actually and subjectively think of the two systems and what is the reality around this matter. According to Naoum (2007), the strategy chosen for a research should not only be informed by the aim and the objectives stated for it but also on the availability of the information to the researcher. Creswell (2003) argues that the factors that necessitate the appropriateness and the final selection of a specific strategy are diverse and many, such as the personal experience of the researcher, the research problem itself and the readers to whom the result of the research is meant for. The two research typologies encountered in this kind of research are the quantitative and the qualitative.

4.3.1 Quantitative Research

This research method is used to gather objective data from sources of information and data (Naoum 2007). The nature of the information gathered this way is numerical and measurable in basis. It is supposed to entail the measurement of tangible and countable physical features of life. Here the data gathering is hard but more reliable (Bouma and Atkinson, 1995). Creswell (2002) addresses this method when investigating human or social issues that involve testing of a hypothesis with variables and its approval and because data are numerically and statistically analysed. Also According to Bouma & Atkinson (1995) quantitative approach measures countable, physical and tangible features of life. According to Naoum (2007), the premises where this strategy will be most fruitful are when information about a concept, a question or an attribute is needed, when a particular hypothesis or theory needs reliable evidence collected and investigation into the relationship between these evidences against that hypothesis should tested.

Amaratunga et al. (2002) argues that next to some advantages that follow this strategy in a research, such as allowance of comparison of the result with the theory, the objectivity of the data in nature which enhances the reliability of results, the encouragement of the formulation of a result for subsequent checks and the independency of the researchers from the object of investigation, there also are some serious weaknesses regarding its failure to uncover in-depth meanings and causes of an event or a result such as the limitation of the data to measurable and numerical

only, without the essential consideration of the psychological, emotional, etc factors that usually highly affect the result. That's why this method is put aside for this research work.

4.3.2 Qualitative Research

This research method is basically used for gathering descriptive information about the meaning and experience on a subject. The information mentioned here is usually a non-measurable, numerical but informed of the respondents experience and feelings one, thus subjective. The kind of information that one gathers from this approach are two: explanatory and attitudinal. Exploratory research is useful when little or no idea around the subject is known so as to fathom the clear and specific situation of an identified problem. It seeks to diagnose a situation viewing to discover new ideas. This method is when the researcher conducts interviews or uses open ended questions in questionnaires. Attitudinal research is used to elicit and subjectively evaluate the opinion, perception or view of a person about a specific area of concern (Naoum 2007).

Among the benefits of this method are richness and reliability of the information, being closer to the information than in quantitative research and the capability to measure attitude of the respondents based on their opinion and perception measurement (Naoum 2007). If little research has been done on the subject so far but a thorough investigation and understanding of a specific concept is needed, then qualitative research approach is the most appropriate method (Creswell, 2002) and this is exactly the case with 3Star certification.

Advantages of this method are flexibility and speedy data collection (Amaratunga et al., 2002). The qualitative research method is usually appraised as the most appropriate research strategy to gather data for a new research field or when developing a new hypothesis. All of these qualities mentioned here suggest a qualitative method for this research work.

As in the case of the quantitative research there are some negative aspects of this method as well. Richards & Richards (1994) argue that this method involves data of

high volumes which usually become too complex and burdensome to analyse but this can be overcome by limiting the questions and properly presenting them.

4.4 Research Methodology Selection

According to Naoum (2007), the purpose of the research must be the guide for the selection of the appropriate research method. The two methods' pros and cons considered the best approach to follow in this research results to be a qualitative method. The purpose in doing this is to cover as many objectives set as possible and drawing as many close to reality conclusions to prove them as possible. As Fellows et al. (2003) have already stated, the efficacy of the approach by instigation helps significantly in understanding in depth about a subject area and helps in making references and in drawing conclusions.

In this case, what should be investigated is, where the construction market stands in terms of green building certifications in China, whether users are actually informed, interested or adopting any of these certifications and specifically what happens in case of LEED and 3Star. If they are, what is their personal opinion and general perception of them? In order to answer to these questions two methods could be followed: either a questionnaire or a series of interviews.

The idea of interviews got almost immediately abandoned as the professionals in China would very difficultly speak openly about confidential issues about their work and especially in person. Anonymity helps a lot when it comes to questionnaires. Of course one cannot be sure of the honesty of the answers even in an anonymous questionnaire but still it is much more close to the reality then the interviews. A questionnaire is able to collect data on three important types of variable: attribute, behavior and opinion (Dillman, 2000) and this research needs all three of them to reveal the circumstances surrounding the perception and use of the two aforementioned certificates. So the method chosen for this research is decided to be a questionnaire because of its following qualities:

- *Speed:* The time constraint of this research, made it impossible to follow an interview method. There was not much time to interview as many people as to

get an overall opinion on the subject area. The questionnaire is simple and fast to send, both on the senders and on receivers' side when they respond.

- *Convenience:* In the case of an interview the interviewee feels usually apprehensive (Babbie 1995). Appointments, time and commitment is needed on both sides. A questionnaire can be filled in ones free time with no commitment to when or where.

- *Cost Effectiveness:* Going around Shanghai to interview people would require a serious mount of financial means and time. As Kumar (1999) also mentions, conducting a questionnaire is more cost effective than any interview that opts to collect samples scattered in big geographical areas.

- *Anonymity of the Respondent:* In an interview the respondent has to answer questions face to face. This intimidates the respondent and usually prevents him from answering sensitive questions. A questionnaire is an anonymous and that's why an efficient way to collect data especially if they are confidential.

Unfortunately there are some inherent disadvantages of the questionnaires as well. These mainly are:

- *Low response rate:* it is highly probable that the replier will totally ignore the questionnaire, though in an interview the interviewee is obliged to answer. Kumar (1999) states that in questionnaires' case a very low response is regarded as bias plus would not represent the circumstance of the generality of an industry.
- *Rigid questions:* questionnaires are usually strict on what they ask, if the respondent wants to explain his/her opinion or use examples this is mostly not possible.
- *Poor responses:* comparing to an interview, where one can control the quality of the answers, according to Descombe (1998), the answers got from a questionnaire depend solely on the state of mind, readiness and interest of the respondent at that given time.

4.5 Questionnaire

After all the most suitable methods of research for this paper have been discussed, it was concluded to run a questionnaire to get answers to the aforementioned questions and concerns.

Questionnaires provide a means of standardizing questions, enabling easier responses and interpretations. According to (Dillman, 2000), questionnaires collect data on three types of variables: attribute, behavior and opinion. In this case attributive data is required to understand what kind of professionals are involved in the green building certification process, what kind of company they work for and other specifications of this kind; the behavioral data is required to see how they actually perceive, how much they are involved and how aware of the nature of these two certifications they are; and finally the opinionative data is required to understand subjective and intangible aspects, reasons and thoughts of these professionals about this issue.

The questionnaire was designed and carried through in order to fill in the gaps the literature review would leave about the actual, Chinese market specific facts, realities and concerns side of this dissertation.

The questionnaire survey had the purpose of getting the building and construction professionals' view on LEED and 3Star in China. It was sent to more than 50 professionals, architects, civil engineers, developers, design company owners and design and construction consultants, with different degree and position in their companies, all operating in the Shanghai area and involved in the design, construction and marketing of buildings around China. The Shanghai area has been chosen because it is the biggest design and construction companies' hub in China. Indeed most of the Chinese and foreign architectural companies have their headquarters or at least a brunch of them in this busy city. As well as exporting designs, Shanghai itself is a city which is constantly under construction. The companies that took part in the survey were either of Chinese or foreign interest with the respondents being Chinese or foreign employees or employers. The questions have been inspired mostly by the aim of the dissertation and the need to answer as many objectives set as possible. It was designed carefully not to take too much time from the respondent and eliminate all the

determent factors involved. Concepts were expressed by a clear and simple everyday language and the cover letter has been kept to the minimum explaining who and for what reason is conducting this survey, reassuring the participant of his anonymity and the confidentiality of his/her answers.

Before distribution a pilot run has been set and three people participated in measuring the time needed to fill it in. It didn't exceed the 5' time limit aimed. The questions were separated into 4 sections to control the flow, and the answers were to choose from a number of them just by ticking. In some cases there was an open-ended choice so the participant willing to contribute more could fill in if felt something should be added to the proposed answers. In general, open-ended questions have been avoided. As Oppenheim (1992) states, the open-ended questions, when designing a questionnaire, require the replier to spend time, think and write, so they need to be kept in minimum otherwise being time consuming they might discourage the respondent. Moreover, analyzing and driving spherical conclusions from this kind of answers is more difficult for the author.

The rest of the questions were asked to be answered in a numeric way, so as the replier had to number the reason he thought of being more relevant to the answer from 1 to either 5 or 6. No more than 6 choices of answers have been set, to keep it clear, simple and quick. *(See Appendices 5 & 6)*

The questionnaire was distributed via email. This way of sending was chosen for its immediate response and practicality. The answers were sent back either to the authors personal email account, or to her Heriot-Watt Outlook account. Tang (2003) supports this method of delivery of the questionnaire as having many benefits starting from cost effectiveness to the reduction of the bulkiness of the questionnaire. A period of two weeks has been given to the respondents to complete the questionnaire and send it back. A reminder has been sent after 20 days of sending. According to Oppenheim (1992), the postal (in this case via email) questionnaires, offer less control over the replier answering the questions and the way they answer, but gains in being a reliable method of data collection in which all the repliers are presented with similar questions in similar order.

Chapter 5: *Data Analysis*

5.1 Introduction

This chapter's purpose is to analyse and discuss the results of the Literature Review and the Questionnaire in combination to China's green path findings. First there is an extensive analysis of the questionnaire and after an overall discussion on the results.

5.2 Results and Analysis

5.2.1 Analysis of the Questionnaire:

The target group of the questionnaire was building design and construction professionals which were easily reached in contrary to clients, organizations and academics. Still their opinion represents a fair portion of population involved in this context and gave insightful results about these certifications. The number of the total questionnaires sent was 50 and the companies chosen to participate were 21. Out of 50 questionnaires sent 18 were answered and returned and the total number of the companies that took part in the answering procedure consecutively was 16. Almost all questionnaires were returned in the first 3 days of receiving and only 4 of them were returned after a reminder of the deadline.

It results that 30% of the questionnaires were answered and this is considered to be an expected and satisfactory rate of return to enable the researcher to deduce results. According to Stutely (2003), a sample size of 30 per category is representative of a population because a mean distribution for this number statistically results to be very similar to that of a whole population.

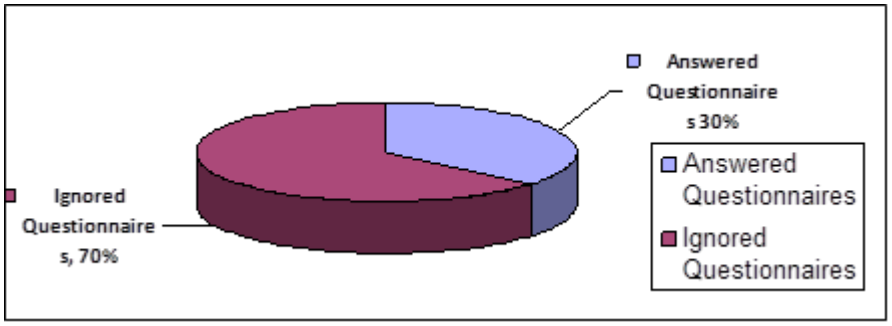

Fig.2: Returned to ignored questionnaires ratio

Out of these 18 companies 15 belonged to the private sector and 3 to the public one, whereas 13 of them where architectural design companies and 5 both architectural design and construction/development companies. No one from a purely construction/development company answered. Statuses of the professionals answered the questionnaire were: 5 architects, 5 project managers, 3 directors and/or company owners, 3 assistant architects and 2 design department managers. (Similar positions were gathered under a single title.)

The first set of questions were asked to detect whether these professionals were familiar with green building certifications at all, which one more and what they think of them in general. In result, only 3 of them were very familiar with LEED and 1 with 3Star. 9 of them were somehow familiar with LEED and only 6 not familiar at all, contrary to 3Star where 11 were not familiar with it at all and only 7 were just somehow familiar. This gives a clear image that almost only half of the professionals familiar with LEED know 3Star. Most of them haven't heard or are not familiar with 3Star at all. Among all these professionals' companies, only 3 have ever applied for a LEED certification for a project. None of them have ever applied for 3Star. When they were asked what in their opinion would the reason for applying for a green building certification be, the answers were more or less equally distributed between long term building operational cost saving, publicity, environmental concerns, better design and other reasons, but market obligation and competitiveness stood out with 37% being double or triple % regarding to each of the other options. It must be noted that in this question participants were actually asked to number the order of their preference but less than half of them actually did this. In order to reach out a fair result, only their first choice was taken into consideration. Some of them chose more than one answer without specifying which one they believe comes first. In this case all of the marked answers were counted as having equal weight and this method was followed for the rest of the answers as well. In option "Other" the suggestions they made were: "*For public relations reasons*" and "*For brand image reasons*".

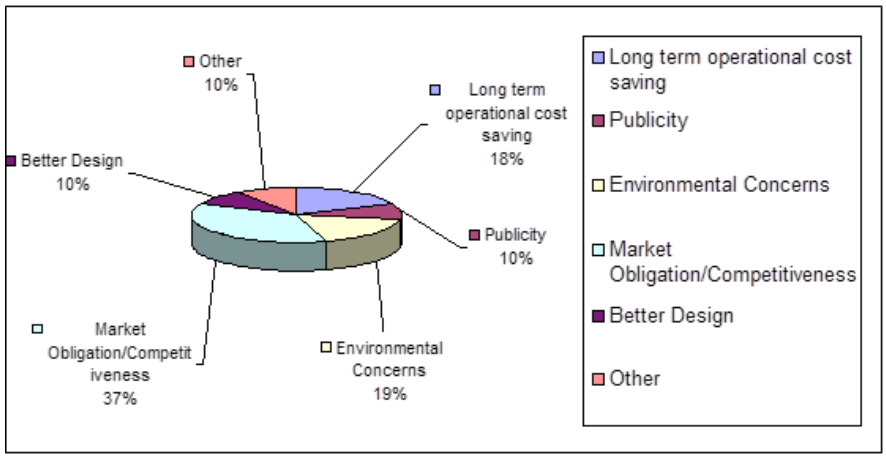

Fig.3: Major reasons to get a green building certificate

In the chapter regarding LEED, the question asking "which of its qualities makes it most worth applying for" collected almost equal marks for all reply options but leading with a small difference resulted to be "its market driven background" with "worldwide brand recognition" and "ease of application and obtaining it" coming respectively second and third.

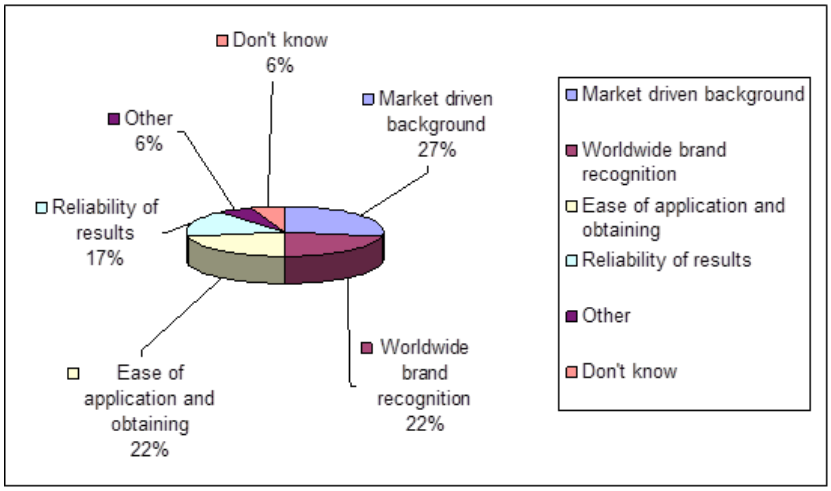

Fig.4: Major reasons to apply for LEED

On the other hand, participants were clear about what they think the major reason for a company to avoid applying for LEED is and they indicated the "difficulty meeting its requirements". Second was "increase in the initial building cost". "High cost of obtaining the certificate itself" came third and reasons such as "questionable contribution in environmental concerns" and "significant alteration of the building's

design" were almost not important. In "Other" option suggestions were: "*the customer seldom have request of it*" and "*not a necessity in many markets*", which means there is no market request for it so no need to apply for.

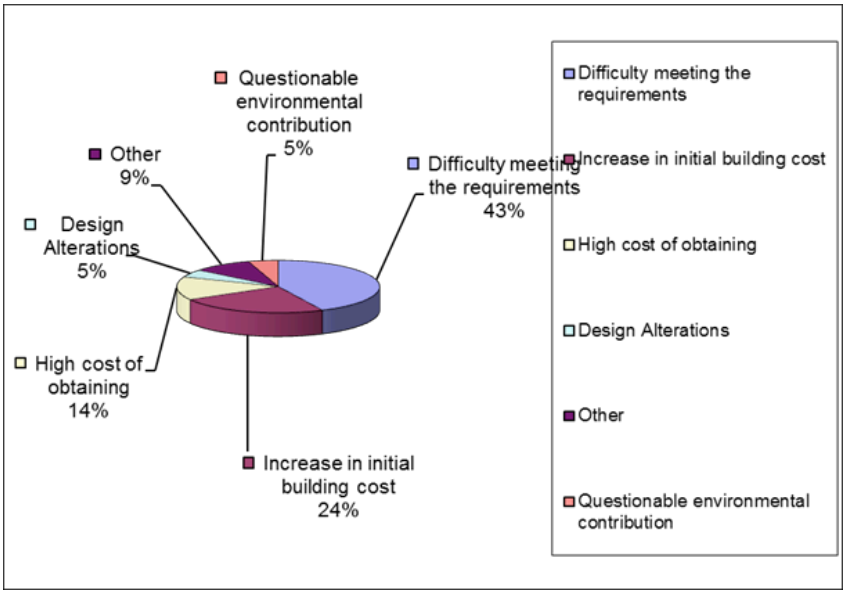

Fig.5: Major reasons to ignore LEED

The same questions were asked for 3Star too. Based on literature review the answer options were formulated slightly differently. The major quality that makes 3Star worth applying for resulted being "its brand recognition in China or Asia in general" and a small portion chose "the reliability of its results". Ease of application and procedure of obtaining it came third and other reasons had a minimal percentage, no one chose its academic background as a reason and a big portion of participants declared they don't know why one should apply for 3Star. What should be noted here is that considering the high percentage of people that answered not actually being familiar with 3Star, one is led to think that the answers they gave about it don't arise from actual knowledge but from shear guessing and thus they are not considered totally reliable, still they reflect the perception that prevails in the market.

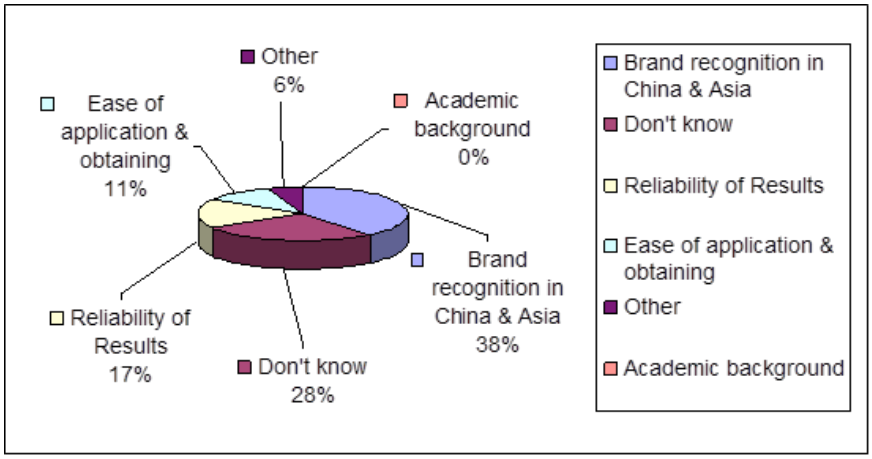

Fig.6: Major reasons to apply for 3Star

As for the major reason for a company to ignore 3Star, participants chose the answer "high cost of obtaining the certificate itself" and second came "Increase in initial building cost". "Difficulty meeting its requirements" and "Other" followed third with the equal percentage. Again, a big portion equal to the most popular answer's percentage, answered they "don't know". Just a few chose "questionable contribution in environmental concerns" as a reason. No or irrelevant additional comments to the option "Other" were made.

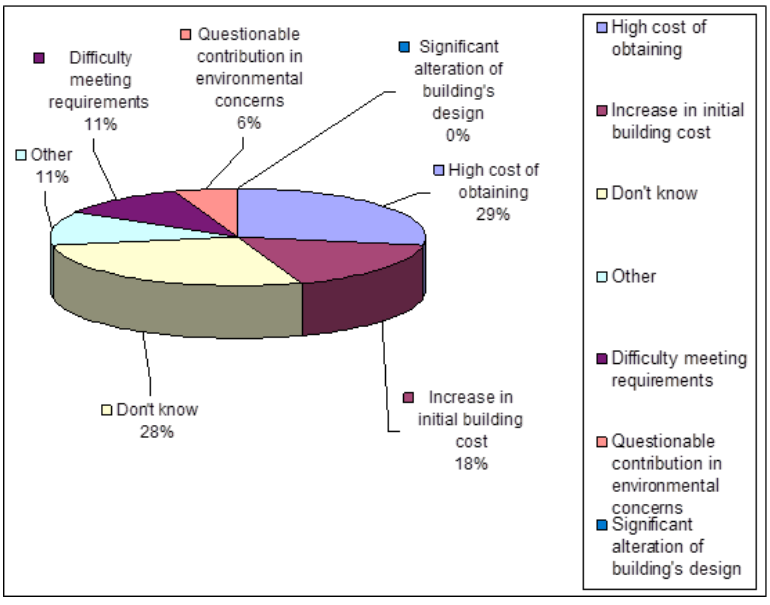

Fig.7: Major reasons to ignore 3Star

The last question of the questionnaire was a combinatory one and crucial to understand the opinion of the professionals on whether LEED and 3Star compete, complete each other or are irrelevant to each other. The majority here, 47% (8/18 people), believes they complement each other, 18% (3/18 people) believes they compete and 29% (5/18 people) believes they are irrelevant. Only one person didn't know what to answer.

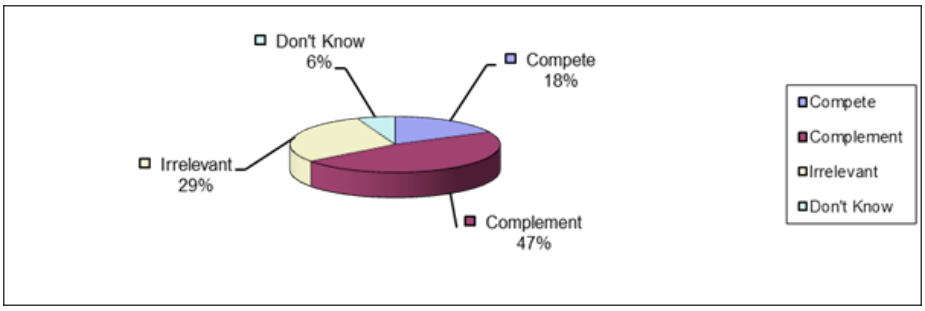

Fig.8: Correlation between LEED & 3Star

Due to the big portion of the participants who initially stated they don't know about 3Star but still answered this question, the result of it can only prove the common belief of the related professionals and it shouldn't be considered as being a thorough scientific result.

In the additional thoughts section only two people added an opinion suggesting that "*It is better for more companies and people to get to know LEED and 3Star, this way professionals can design more Green Buildings. It is good for the environment and for the next generations, it is a good thing in long term.*" And "*I would also like to mention that I consider both systems mentioned above as half ways: there are more ambitious certifications on the market such as DGNB. These second generation certifications, or sustainable building certifications (as opposed to green building) should lead the way now, if the general objective is really to continue improving best practices of the building industry*". *(For the Questionnaire results see Appendix 7)*

5.3 Discussion on the Research Results

Following there is a discussion on the above and on the overall research results. It combines results deduced from the literature review and the questionnaire and

summarizes the main points of interest and investigation in a consequence of questions and answers for an organized reading.

- *Why is green building and green building certifications' pursue still in primitive stage in China?*

The literature review shows that, though the Chinese Government encourages green building by positioning it between its primary goals in the latest "5-year-plan" and promotes 3Star by helping interested parties financially, barriers appear to be more than incentives and it seems that they will hold this procedure back for yet a long while. The most important barrier revealed to be lack of awareness and technical expertise in the field. Both according to the literature and the questionnaire results, the main reason to pursue a green building certification in China is short term profitability, though this is not and shouldn't be any green certificate's end. Both LEED and 3Star are probably equally not attractive to the Chinese market for this reason.

- *What is the reason to pursue a green building certification in China and why LEED or 3Star?*

The literature review shows that the major reason for professionals in China to pursue any green certification is for better competitiveness in the building market. Having a "green label", especially if it is certified by a valid organization is considered to add some market advantage when it comes to impress clients. Reasons such as environmental concerns, design improvements and so on come second or are largely ignored.

The questionnaire adds that the reason why one would apply for LEED is because of its market driven background and worldwide brand recognition and for 3Star it is its brand recognition in China and around Asia. So, both certificates are majorly sought after for their recognition in the market.

- *What we learn from the literature review about LEED and 3Star in a nutshell?*

The literature review shows that LEED has been much criticized and much discussed about so far. The contrary applies for 3Star. It results that they have much in common,

such as structure, areas of concern and final sustainability purposes, but they also have some basic differences. This is because LEED is a market-driven certification whereas 3Star is a government-led one, so they have a different mentality behind them. LEED focuses on high-tech equipment and added green solutions whereas 3Star on preserving as much as possible on a low cost.

- *What is the major point where 3Star wins over LEED according to the literature review?*

In 3Star a degree to a building is only awarded after one year of its operation and after the actual efficiency of the proposed innovations have been tested, measured and recorded. This makes 3Star's environmental contribution more reliable, more valuable and more realistic than LEED's.

- *What are the biggest determents to choose each of these two certificates?*

The questionnaire shows that professionals in China are not keen on pursuing any certificate in general and put themselves in additional "trouble" unless the client asks for it or it is obligatory to do so.

LEED is majorly avoided because of the difficulty in meeting its requirements. Plus, literature suggests that it is especially difficult to find appropriate and certified green-high-tech appliances in China and this constitutes one more burden on top of struggling to meet basic inquiries for LEED. In 3Star's case, the questionnaire shows that professionals believe it is expensive to apply or get it, and that's why it is avoided, but that, as mentioned before, cannot be true. Indeed, considering the number of people that answered which are actually not familiar with it, and the fact that literature proves that 3Star costs much less than LEED, this result remains dubious. It must be noted that equal number of people in the questionnaire, think other reasons are deterring them to apply for it and no one expressed what these are, so they weren't taken into serious consideration.

A most probable cause to avoid 3Star though merges from the literature review and it results to be the fact that the developer doesn't know from the beginning whether his efforts to achieve the certification will be successful or not, and if yes, at what degree.

That's why LEED is probably more attractive to a developer: it makes it sure that what is predicted will be actually achieved and "what you pay is what you get".

- *How much actually are building professionals informed about LEED and 3Star in China?*

The questionnaire results make it obvious that professionals in China are more familiar with LEED than 3Star. Most of them haven't heard of the later at all. It is clear, that professionals are little informed about 3Star and a severe confusion and lack of information about it exists.

- *Is the hypothesis that these two certificates complement each other more than competing each other true?*

Literature review proved that many differences and many similarities between the two certificates exist. The main similarities are their main areas of concern and common goal of sustainability, and main differences are their different reasons of creation and the way they are run. Each of them being useful for different user purposes and demands, they both result to be necessary for the Chinese green building market. What the questionnaire adds to these findings is that in addition to what the literature proves, construction professionals also think these two mostly complement each other instead of competing.

Chapter 6: *Conclusion*

6.1 Introduction

The aim of this paper was to understand which the best green certification for China is. In this chapter it will be investigated whether this aim and the objectives set at the beginning have been met. Limitations will be explained and future predictions, recommendations, and advice regarding LEED and 3Star but especially on how should China consider and promote its green building aspirations will be given in the end.

6.2 Conclusions

The *first objective* of this dissertation was to present and compare LEED and 3Star considering their structure and usage and other factors affecting them. The literature review gave the possibility to conclude that there are obvious differences between the two systems when it comes to the social and political backgrounds. They have many differences in terms of their implementation process but the core concepts they are examining are the same. This similarity comes mostly to the fore when it comes to point allocations of the users' attempts to achieve their desired certifications (Kibert, 2008).

The *second objective* was to investigate the green building market in China and how these two rating systems fit in it. The research showed that green building in China is an issue that is lately in the foreground and that a number of efforts have been made so far. The Chinese government pushes now on a "greener" direction and includes green building into this agenda. 3Star green building certification is one of these efforts. LEED is still the most prevalent system but both certificates are growing fast.

According to both literature review and the questionnaire results, choosing to adopt a green building certification proved to be mostly a financial gain concern than an environmental sensibility in China and that many barriers next to incentives exist concerning this.

Literature review suggests that these two certification systems target very different market segments: LEED targets very high end commercials and luxury residential, while 3Star focuses on government projects, as well as housing projects. As brand name recognition is important for corporate headquarters in high-end commercial projects, and developers for these types of projects can afford expensive technologies, they will benefit more from LEED and as standard commercial projects and public buildings will benefit from university expert consultation and a focus on simpler and cheaper solutions they will more benefit from 3Star.

The *final objective* is to prove that these two certificates are actually both necessary in China and complementing each other instead of competing. The literature review revealed that both programs are necessary and in fact complementary as far as a building's green performance is concerned. Where one system fails to include an aspect the other one comes to close the gap.

When it comes to choose one of the two systems one could say that it depends on the final purpose of the developer and the type of the building. If worldwide acknowledgement and benchmarking or adaptability and standardization are sought, then LEED appears to be the one to choose. If more local comprehensiveness, better Chinese context fitting or a more economical solution is being sought, then 3Star comes to fulfill this purpose. If overall green performance is the most important goal, then the two systems complement each other. To conclude, they are both necessary to cover all the concern areas and purpose of a green building in China.

6.3 Explanation of Limitations

Limitations to write this paper proved to be much more than expected. The major limitation was in the literature chapter regarding 3Star. 3Star is a relatively new certification and there are not enough academic references about it in English language. Apparently, being a system destined for China only, it doesn't intrigue international academics to comment on it. Most of the comments found were on internet sources, blogs or organization sites where the author stays anonymous.

The same difficulty was found when intended to interview related people. They were either reluctant because they didn't speak English or didn't want to express their thoughts to a third unknown party. Lack of people wanting to be interviewed was the primary reason not to have led an interview based research for this work. Moreover, many of the questionnaires weren't returned because they were in English language and though the structure and language was kept as simple as possible it constituted a serious determent for a busy professional to answer it.

As for the questionnaire results, they cannot be considered as scientifically valid. The aforementioned barriers and the small return rate make the results unreliable. 18

returned questionnaires are not a very representative percentage of population for the construction market in China or any other population type. This population sample was only presenting the building construction professionals' side and not the clients'. Clients were unreachable and unwilling to participate in the research. Regarding the professionals mentioned, they were mainly working for private companies and not for governmental companies or organizations or for an academic organization such as a university or college. So the Government's side and the Chinese academics' side remain mostly unknown. A considerably big part of the people that answered the questionnaires didn't know 3Star at all so their answers about it solely or comparative answers of the two systems should be considered unreliable and they can only be counted as guesses or superficial perceptions.

The biggest problem faced was 3Star's structure, its lack of forms and schemes and the non-transparent procedure that it follows to certify buildings. This made direct comparison of point allocation and other comparisons with LEED an almost impossible task.

This research should have included a bigger number of people involved and be made in greater depth but this was not possible in such a short time portion designated for this dissertation. Last, it was extremely difficult to spot clients' opinion about these certifications. Whether "small" or "big", they were whether impossible to track or unwilling to speak. The professionals' view though, hopefully include in a certain degree clients' needs and preferences, as in fact, clients are the primary force that lead professionals.

6.4 Predictions & Recommendations

The biggest motivation applying for a green certification in China is proved to be profitability, so thanks to the financial incentives given by the government it is more likely that one would chose to pursue a 3Star certification against LEED in the future. 3Star system is more close to the Chinese reality and the most important; it is in Chinese language- so much more available to a broader portion of professionals and more appealing to Chinese clients. As per LEED, it will probably keep its position among internationally oriented buildings in China thanks to its worldwide brand

recognition and continue to be the major adversary and complementary to 3Star. Unless a third or more certification system takes unexpectedly the lead in the future, these two will be the ones that will prevail and hopefully advance, adjust and adapt more to the Chinese green building market taking it to higher levels of achievements.

What is most important for China's green future is not whether LEED or 3Star prevails. Most important is that substantial and effective measures that would help the environment are taken. In China the market moves when the government pushes. By including the environment's protection as a priority in the latest five-year plan a big step towards a greener future has been already taken. Whether the set goals will be met by applying for LEED or 3Star makes no big difference.

The truth is increased construction costs associated with energy efficient buildings that use advanced technologies give developers little incentive to comply with energy codes. So, to promote energy efficiency compliance in buildings in China, carrot and stick policies should be adopted. A strict command and control system can supervise and enforce the compliance rate in new constructions with market incentives encouraging developers to exceed the standards of building codes and create market opportunities for new and efficient technologies at the same time (Chmutina, 2010). According to Zhou (2012, CBR), because the green building and energy efficiency labels are still voluntary for the majority of buildings, such programs are not likely to reduce energy consumption in China on a large scale. If there's a mandatory program, then that can definitely reduce energy use. Whether green building will play a large role in meeting these goals remains to be seen, but advocates remain optimistic that the green building market will continue to grow in China. Still, some think the Chinese government will have to implement stronger policies before mainstream developers build green projects on a larger scale. "The only way that can happen is from the top down," says Bisagni. "The government has to give direction about what green building has to be." (CBR, 2012)

As the Secretary of Energy of China, Steve Chu (2012) states, the path to finding solutions is to bring together the finest, most passionate minds to work on the problem in a coordinated effort, so hopefully LEED and 3Star will coexist and complement each other for a better and "greener" future of China.

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APPENDICES

Appendix 1:

LEED information and clarifications

LEED has evolved since its original inception in 1998 to more accurately represent and incorporate emerging green building technologies. LEED NCv1.0 was a pilot version. These projects helped inform the USGBC of the requirements for such a rating system, and this knowledge was incorporated into LEED NCv2.0. LEED NCv2.2 was released in 2005, and v3 in 2009. Today, LEED consists of a suite of nine rating systems for the design, construction and operation of buildings, homes and neighborhoods. Five overarching categories correspond to the specialties available under the LEED Accredited Professional program. That suite currently consists of:

Green Building Design & Construction

- LEED for New Construction
- LEED for Core & Shell
- LEED for Schools
- LEED for Retail: New Construction and Major Renovations
- LEED for Healthcare

Green Interior Design & Construction

- LEED for Commercial Interiors
- LEED for Retail: Commercial Interiors

Green Building Operations & Maintenance

- LEED for Existing Buildings: Operations & Maintenance

Green Neighborhood Development

- LEED for Neighborhood Development

Green Home Design and Construction

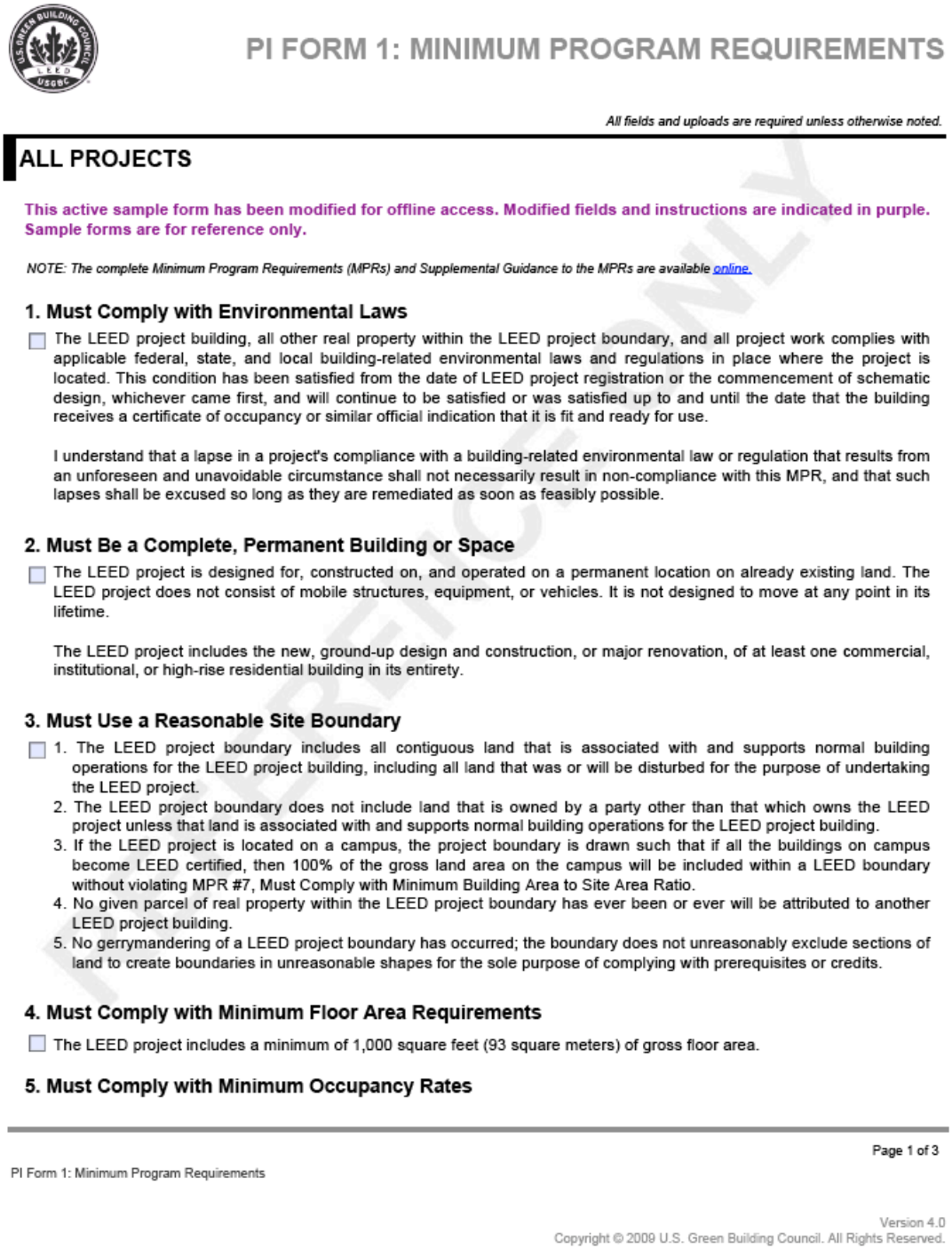
- LEED for Homes

After four years of development, aligning credits across all LEED rating systems and weighting credits based on environmental priority, USGBC launched LEED v3, which consists of a new continuous development process, a new version of LEED Online, a revised third-party certification program and a new suite of rating systems known as LEED 2009. In response to concerns that LEED's requirements are cumbersome and difficult to learn, in 2009 USGBC supported the development by BuildingGreen, LLC of LEEDuser, a third-party resource that contains tips and

guidance, written by professionals in the field, on applying LEED credits and the LEED certification process. (Source: Wikipedia and USGBC)

Appendix 2:

LEED Minimum Program Requirements Sample Form



PI FORM 1: MINIMUM PROGRAM REQUIREMENTS

All fields and uploads are required unless otherwise noted.

ALL PROJECTS

This active sample form has been modified for offline access. Modified fields and instructions are indicated in purple. Sample forms are for reference only.

NOTE: The complete Minimum Program Requirements (MPRs) and Supplemental Guidance to the MPRs are available online.

1. Must Comply with Environmental Laws

☐ The LEED project building, all other real property within the LEED project boundary, and all project work complies with applicable federal, state, and local building-related environmental laws and regulations in place where the project is located. This condition has been satisfied from the date of LEED project registration or the commencement of schematic design, whichever came first, and will continue to be satisfied or was satisfied up to and until the date that the building receives a certificate of occupancy or similar official indication that it is fit and ready for use.

I understand that a lapse in a project's compliance with a building-related environmental law or regulation that results from an unforeseen and unavoidable circumstance shall not necessarily result in non-compliance with this MPR, and that such lapses shall be excused so long as they are remediated as soon as feasibly possible.

2. Must Be a Complete, Permanent Building or Space

☐ The LEED project is designed for, constructed on, and operated on a permanent location on already existing land. The LEED project does not consist of mobile structures, equipment, or vehicles. It is not designed to move at any point in its lifetime.

The LEED project includes the new, ground-up design and construction, or major renovation, of at least one commercial, institutional, or high-rise residential building in its entirety.

3. Must Use a Reasonable Site Boundary

☐ 1. The LEED project boundary includes all contiguous land that is associated with and supports normal building operations for the LEED project building, including all land that was or will be disturbed for the purpose of undertaking the LEED project.
2. The LEED project boundary does not include land that is owned by a party other than that which owns the LEED project unless that land is associated with and supports normal building operations for the LEED project building.
3. If the LEED project is located on a campus, the project boundary is drawn such that if all the buildings on campus become LEED certified, then 100% of the gross land area on the campus will be included within a LEED boundary without violating MPR #7, Must Comply with Minimum Building Area to Site Area Ratio.
4. No given parcel of real property within the LEED project boundary has ever been or ever will be attributed to another LEED project building.
5. No gerrymandering of a LEED project boundary has occurred; the boundary does not unreasonably exclude sections of land to create boundaries in unreasonable shapes for the sole purpose of complying with prerequisites or credits.

4. Must Comply with Minimum Floor Area Requirements

☐ The LEED project includes a minimum of 1,000 square feet (93 square meters) of gross floor area.

5. Must Comply with Minimum Occupancy Rates

Page 1 of 3

PI Form 1: Minimum Program Requirements

Version 4.0

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☐ The LEED project serves 1 or more Full Time Equivalent (FTE) occupant(s), calculated as an annual average, and will use LEED in its entirety, OR the project serves less than 1 annualized FTE and optional credits from the Indoor Environmental Quality category will not be attempted.

6. Must Commit to Sharing Whole-Building Energy and Water Usage Data

☐ I commit to sharing with USGBC and/or GBCI all available actual whole-project energy and water usage data. This commitment will start upon certification acceptance or on the date that the LEED project begins typical physical occupancy and will continue for at least 5 years. I understand that sharing this data includes supplying information on a regular basis in a free, accessible, and secure online tool, OR allowing USGBC to access the whole-project metering facility where such meters are in place, OR taking any action necessary to authorize USGBC, GBCI or their designee to collect project information directly from service or utility providers. I will use reasonable efforts to ensure that this commitment carries forward in the event that the building or space changes ownership or lessee.

Furthermore, I understand that the purpose of data collection is for research and to aid in improving the LEED program. I understand that any whole-project energy and water usage data that is made publicly available shall be presented in an aggregate form with no identifying project-specific characteristics.

Furthermore, I understand that if my project does not have meters in place that measure energy and/or water usage for the entire LEED certified gross floor area, I will not be required to supply energy and/or water usage data unless and until such meters are installed. I understand that if the LEED project is altered, sold, assigned or otherwise transferred in such a way that the data for the original LEED project becomes impractical to collect, I will no longer be required to provide the data or provide access to the data.

Select one of the following:

- ○ **Option 1.** Share Data through ENERGY STAR's Portfolio Manager Tool and the USGBC Release Form
- ○ **Option 2.** Project Owner Commitment to Apply for LEED for EB: O&M Certification
- ○ **Option 3.** Share Data Through Approved Format

7. Must Comply with a Minimum Building Area to Site Area Ratio

☐ The gross floor area of the LEED project building is no less than 2% of the gross land area within the LEED project boundary.

Required Signatory PIf1-5. Owner/Agent*

All information provided on this form indicating that the LEED project is in compliance with all of the Minimum Program Requirements is true and accurate to the best of my knowledge.

Select one of the following:

○ **Owner/Agent* Signature.** Provide a digital signature affirming the required signatory statement in gray directly above.

OR

○ The project team will provide the following documents in Upload PIf1-RS below:
1. A copy of PI Form 1, signed and dated by the owner, AND
2. A document with all relevant PI Form 1 required signatory statements, copied directly from the form, signed and dated on owner letterhead.

**If signed by the Agent, provide the following additional required information in the Special Circumstances section below: 1) Describe specifically how the Owner was/will be informed of the critical elements and ongoing requirements described above, and 2) Provide supporting documentation, if any.*

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REFERENCE ONLY

ADDITIONAL DETAILS

☐ The project team is claiming an exemption from Minimum Program Requirement 6: Must Commit to Sharing Whole-Building Energy and Water Usage Data.

☐ Special circumstances preclude compliance with the Minimum Program Requirements as outlined in this form.

SUMMARY

PI Form 1: Minimum Program Requirements Completed:		Check Compliance

REFERENCE ONLY

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Appendix 3:

LEED v2009 Scorecard (Sample for New Construction & Major Renovations)

LEED for New Construction and Major Renovations (v2009)

SUSTAINABLE SITES		POSSIBLE: 26
SSp1	Construction activity pollution prevention	REQUIRED
SSc1	Site selection	1
SSc2	Development density and community connectivity	5
SSc3	Brownfield redevelopment	1
SSc4.1	Alternative transportation - public transportation access	6
SSc4.2	Alternative transportation - bicycle storage and changing rooms	1
SSc4.3	Alternative transportation - low-emitting and fuel-efficient vehicles	3
SSc4.4	Alternative transportation - parking capacity	2
SSc5.1	Site development - protect or restore habitat	1
SSc5.2	Site development - maximize open space	1
SSc6.1	Stormwater design - quantity control	1
SSc6.2	Stormwater design - quality control	1
SSc7.1	Heat island effect - nonroof	1
SSc7.2	Heat island effect - roof	1
SSc8	Light pollution reduction	1

WATER EFFICIENCY		POSSIBLE: 10
WEp1	Water use reduction	REQUIRED
WEc1	Water efficient landscaping	4
WEc2	Innovative wastewater technologies	2
WEc3	Water use reduction	4

ENERGY & ATMOSPHERE		POSSIBLE: 35
EAp1	Fundamental commissioning of building energy systems	REQUIRED
EAp2	Minimum energy performance	REQUIRED
EAp3	Fundamental refrigerant Mgmt	REQUIRED
EAc1	Optimize energy performance	19
EAc2	On-site renewable energy	7
EAc3	Enhanced commissioning	2
EAc4	Enhanced refrigerant Mgmt	2
EAc5	Measurement and verification	3
EAc6	Green power	2

MATERIAL & RESOURCES		POSSIBLE: 14
MRp1	Storage and collection of recyclables	REQUIRED
MRc1.1	Building reuse - maintain existing walls, floors and roof	3
MRc1.2	Building reuse - maintain interior nonstructural elements	1
MRc2	Construction waste Mgmt	2
MRc3	Materials reuse	2
MRc4	Recycled content	2

MATERIAL & RESOURCES (CONTINUED)		
MRc5	Regional materials	2
MRc6	Rapidly renewable materials	1
MRc7	Certified wood	1

INDOOR ENVIRONMENTAL QUALITY		POSSIBLE: 15
EQp1	Minimum IAQ performance	REQUIRED
EQp2	Environmental Tobacco Smoke (ETS) control	REQUIRED
EQc1	Outdoor air delivery monitoring	1
EQc2	Increased ventilation	1
EQc3.1	Construction IAQ Mgmt plan - during construction	1
EQc3.2	Construction IAQ Mgmt plan - before occupancy	1
EQc4.1	Low-emitting materials - adhesives and sealants	1
EQc4.2	Low-emitting materials - paints and coatings	1
EQc4.3	Low-emitting materials - flooring systems	1
EQc4.4	Low-emitting materials - composite wood and agrifiber products	1
EQc5	Indoor chemical and pollutant source control	1
EQc6.1	Controllability of systems - lighting	1
EQc6.2	Controllability of systems - thermal comfort	1
EQc7.1	Thermal comfort - design	1
EQc7.2	Thermal comfort - verification	1
EQc8.1	Daylight and views - daylight	1
EQc8.2	Daylight and views - views	1

INNOVATION		POSSIBLE: 6
IDc1	Innovation in design	5
IDc2	LEED Accredited Professional	1

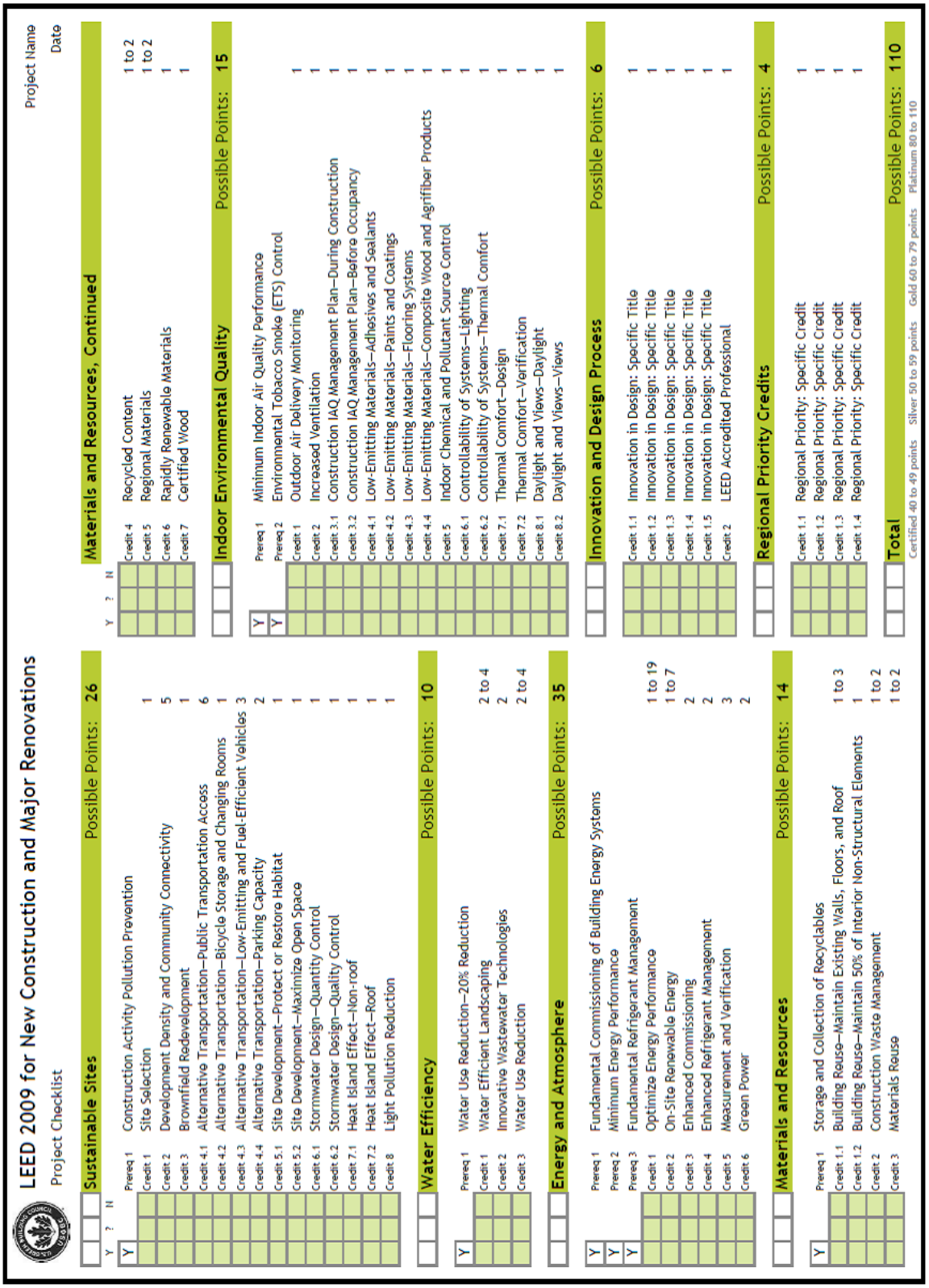
REGIONAL PRIORITY		POSSIBLE: 4
RPc1	Regional priority	4

TOTAL	110

40-49 Points	50-59 Points	60-79 Points	80+ Points
CERTIFIED	SILVER	GOLD	PLATINUM

Appendix 4:

LEED v2009 Project Checklist (Sample for New Construction & Major Renovations)



LEED 2009 for New Construction and Major Renovations

Project Checklist

Project Name

Date

Y	?	N			
Sustainable Sites				Possible Points:	26
Y			Prereq 1	Construction Activity Pollution Prevention	
			Credit 1	Site Selection	1
			Credit 2	Development Density and Community Connectivity	5
			Credit 3	Brownfield Redevelopment	1
			Credit 4.1	Alternative Transportation—Public Transportation Access	6
			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
			Credit 4.4	Alternative Transportation—Parking Capacity	2
			Credit 5.1	Site Development—Protect or Restore Habitat	1
			Credit 5.2	Site Development—Maximize Open Space	1
			Credit 6.1	Stormwater Design—Quantity Control	1
			Credit 6.2	Stormwater Design—Quality Control	1
			Credit 7.1	Heat Island Effect—Non-roof	1
			Credit 7.2	Heat Island Effect—Roof	1
			Credit 8	Light Pollution Reduction	1
Water Efficiency				Possible Points:	10
Y			Prereq 1	Water Use Reduction—20% Reduction	
			Credit 1	Water Efficient Landscaping	2 to 4
			Credit 2	Innovative Wastewater Technologies	2
			Credit 3	Water Use Reduction	2 to 4
Energy and Atmosphere				Possible Points:	35
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
			Credit 1	Optimize Energy Performance	1 to 19
			Credit 2	On-Site Renewable Energy	1 to 7
			Credit 3	Enhanced Commissioning	2
			Credit 4	Enhanced Refrigerant Management	2
			Credit 5	Measurement and Verification	3
			Credit 6	Green Power	2
Materials and Resources				Possible Points:	14
Y			Prereq 1	Storage and Collection of Recyclables	
			Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
			Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
			Credit 2	Construction Waste Management	1 to 2
			Credit 3	Materials Reuse	1 to 2

Y	?	N			
Materials and Resources, Continued					
			Credit 4	Recycled Content	1 to 2
			Credit 5	Regional Materials	1 to 2
			Credit 6	Rapidly Renewable Materials	1
			Credit 7	Certified Wood	1
Indoor Environmental Quality				Possible Points:	15
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
			Credit 1	Outdoor Air Delivery Monitoring	1
			Credit 2	Increased Ventilation	1
			Credit 3.1	Construction IAQ Management Plan—During Construction	1
			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
			Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
			Credit 5	Indoor Chemical and Pollutant Source Control	1
			Credit 6.1	Controllability of Systems—Lighting	1
			Credit 6.2	Controllability of Systems—Thermal Comfort	1
			Credit 7.1	Thermal Comfort—Design	1
			Credit 7.2	Thermal Comfort—Verification	1
			Credit 8.1	Daylight and Views—Daylight	1
			Credit 8.2	Daylight and Views—Views	1
Innovation and Design Process				Possible Points:	6
			Credit 1.1	Innovation in Design: Specific Title	1
			Credit 1.2	Innovation in Design: Specific Title	1
			Credit 1.3	Innovation in Design: Specific Title	1
			Credit 1.4	Innovation in Design: Specific Title	1
			Credit 1.5	Innovation in Design: Specific Title	1
			Credit 2	LEED Accredited Professional	1
Regional Priority Credits				Possible Points:	4
			Credit 1.1	Regional Priority: Specific Credit	1
			Credit 1.2	Regional Priority: Specific Credit	1
			Credit 1.3	Regional Priority: Specific Credit	1
			Credit 1.4	Regional Priority: Specific Credit	1
Total				Possible Points:	110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

Appendix 5:

Questionnaire Cover Letter

Dear Sir/Madam,

Dissertation Survey Questionnaire

I am a post-graduate student of Heriot-Watt University of Edinburg, pursuing an MSc in Real Estate Investment & Finance. I am currently writing a dissertation about Green Building Certifications preferred in the Chinese building market and my area of investigation is LEED (USA) and 3Star (China).

The aim of this research paper is to identify the reasons why a design/construction professional or developer who is active in the Chinese market would choose to pursue one of these two certification systems in China and why.

I would be really grateful if you spent 5 minutes of your time to answer this short questionnaire I'm sending you.

For confidentiality reasons, the individuals and companies' names will not appear on the dissertation. Each company will be treated anonymously and the information will only be used for the purpose of this dissertation.

It would be greatly appreciated if you could send me your answers back by February 20th 2013 via email.

Should you ask for a copy of the survey result, it would be sent to you by April 15th when the dissertation will be completed.

Thanking you in advance,

Best Regards,

Marina Voynas

Architect

Email: marinavoynas@yahoo.gr or mv62@hw.ac.uk

Mob: 0086 186 2161 5710

Appendix 6:

Survey Questionnaire Questions

SECTION 1

General Info

Name of Company……...

Number of Employees……

Approximate Annual Turnover……

Your Position at the Company…..……

1. Which sector does the company belong to?

-Private

-Public

2. The nature of the company is:

-Architectural Design Company

-Construction/Development Company

-Both

SECTION 2 (Please tick your preferred answer)

1. Are you familiar with the LEED Certification (USA)?

-Very familiar

-Somehow familiar

-Not familiar

2. Are you familiar with the 3Star Certification (China)?

-Very familiar

-Somehow familiar

-Not familiar

3. Has your company ever applied for any of the above certifications for a project in China?

-Yes, LEED

-Yes, 3Star

-Yes, both

-No, none

4. In your opinion what is the reason for applying for a green building certification such as the above? (Number from 1 to 6 in order of preference)

-Long term building operational cost saving

-Publicity

-Environmental concerns

-Market obligation/competitiveness

-Better design

-Other (Please specify)……

SECTION 3

LEED

1. In your opinion, which is the major quality of LEED that makes it worth applying for? (Number from 1 to 5 in order of preference)

-Worldwide brand recognition

-Ease of application and procedure of obtaining

-Reliability of results

-Its market driven background

-Other (Please specify)……..

2. In your opinion, what is the major reason for a company to ignore LEED? (Number from 1 to 6 in order of preference)

-High cost of obtaining the certificate itself

-Difficulty meeting its requirements

-Increase in the initial building cost

-Questionable contribution in environmental concerns

-Significant alteration of the building's design

-Other (Please specify)……

3STAR

1. In your opinion, which is the major quality of 3Star that makes it worth applying for? (Number from 1 to 5 in order of preference)

-Brand recognition in China or Asia in general

-Ease of application and procedure of obtaining

-Reliability of results

-Its academic background

-Other (Please specify what)……..……..

2. In your opinion, what is the major reason for a company to ignore 3Star? (Number from 1 to 6 in order of preference)

-High cost of obtaining the certificate itself

-Difficulty meeting its requirements

-Increase in the initial building cost

-Questionable contribution in environmental concerns

-Significant alteration of the building's design

-Other (Please specify)……

SECTION 4

1. Do you believe that LEED and 3Star:

-Are competing against each other

-Are complementing each other

-Are irrelevant to each other

2. Any additional thoughts or suggestions about LEED and 3Star please note below.

Thank you for your time!

Appendix 7:
Questionnaire Results

*Which sector does the company belong to?	
-Private	15
-Public	3
*The nature of the company is:	
-Architectural Design Company	13
-Construction/Development Company	0
-Both	5
*Are you familiar with the LEED Certification (USA)?	
-Very familiar	3
-Somehow familiar	9
-Not familiar	6
*Are you familiar with the 3Star Certification (China)?	
-Very familiar	1
-Somehow familiar	7
-Not familiar	11
*Has your company ever applied for any of the above certifications for a project in China?	
-Yes, LEED	3
-Yes, 3Star	
-Yes, both	
-No, none	15
*In your opinion what is the reason for applying for a green building certification such as the above?	
Long term building operational cost saving	4
Publicity	2
Environmental concerns	4
Market obligation/competitiveness	8
Better design	2
Other	2
*In your opinion, which is the major quality of LEED that makes it worth applying for?	
Worldwide brand recognition	4
Ease of application and procedure of obtaining	4

Reliability of results	3
Its market driven background	5
Other	1
Don't know	1
*In your opinion, what is the major reason for a company to ignore LEED?	
High cost of obtaining the certificate itself	3
Difficulty meeting its requirements	9
Increase in the initial building cost	5
Questionable contribution in environmental concerns	1
Significant alteration of the building's design	1
Other	2
*In your opinion, which is the major quality of 3Star that makes it worth applying for?	
Brand recognition in China or Asia in general	7
Ease of application and procedure of obtaining	2
Reliability of results	3
Its academic background	0
Other	1
Don't Know	5
*In your opinion, what is the major reason for a company to ignore 3Star?	
High cost of obtaining the certificate itself	5
Difficulty meeting its requirements	2
Increase in the initial building cost	3
Questionable contribution in environmental concerns	1
Significant alteration of the building's design	0
Other	2
Don't Know	5
*Do you believe that LEED and 3Star:	
-Are competing against each other	3
-Are complementing each other	8
-Are irrelevant to each other	5
Don't Know	1