Master in European Construction Engineering 2012-2013

DGNB®
Deutsche Gesellschaft für Nachhaltiges Bauen e.V.
German Sustainable Building Council

Certification of Sustainable Buildings

Systems Comparison & related demands on Project Management with special focus on the German sector

Final Dissertation

Francisco Villegas Ruiz

CERTIFICATION OF SUSTAINABLE BUILDINGS

Comparison of Certification Systems & related demands on Project Management with special focus on the German Sector

Final dissertation of the Master program in European Construction Engineering

Francisco Villegas Ruiz

Final Dissertation developed in THM University of Applied Sciences (Germany), under the supervision of Professor Dirk Metzger.

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Abstract

This report aims to clarify the main differences, strengths and weaknesses existing between the most used certification systems for sustainable buildings in the German sector, BREEAM, LEED and DGNB, in order to assist investors and stakeholders. In a second phase, the management problems presented by these systems have been analysed, presenting a time study of the application of the different criteria inside DGNB, the most used among them in Germany, in order to clarify the implementation of this assessment method. Moreover, the role of the Project Manager in charge of this process has also been studied, determining finally the need for a professional central to this process.

KEYWORDS: SUSTAINABILITY, PROJECT MANAGEMENT, DGNB, BREEAM, LEED, CERTIFICATION PROCESS.

Research Statement

The first stages of the Master program in European Construction Engineering, with a clear focus on sustainability in the construction industry, provided me with the first ideas towards developing a final dissertation focused on this matter. Under my point of view, new technologies and materials have been the main focus of researches and general attention for many years, whereas management issues have prevailed as not so important matters. For this reason, the idea of studying sustainability in the construction industry, mixed with a management focus resulted in the possibility of accomplishing a dissertation about green building certification systems.

Developing this report in the THM University of applied sciences, led me to carry out this work under theoretical assumptions and the guidance of Professor Dirk Metzger, expert in management. The German focus of the report outlines my personal interests in this sector, and sought the opportunity to know the working scheme from a general point of view of the construction industry in this country.

In the search for information in order to develop the report, updated data has been a must, in order to create an actual current status of the topic. Moreover, the interviews and surveys conducted provide the dissertation with fresh knowledge in this sense.

Acknowledgements

The development of this report has represented an intensive task during the last few months. Along this time, there have been many people involved directly or indirectly in it, supporting me both technically and personally. It is time now to express my gratitude to them, as clearly their contribution has been determinant for achieving my goals.

First of all, thanks to the staff from THM University of Applied Sciences involved in the Master, for their welcome to Germany, taking care of me from the first days in Giessen. Among them, I have to express my special gratefulness to Professor Dirk Metzger, who gave a shape to my work guiding me through it and making me look at this topic in the long run, arising on me a special interest on this topic. Apart from this, thank you so much for your support outside the academic environment, it has been really significant for me.

I also have to thank to all the professionals who took part in the survey carried out, and specially to Mrs. Theresa Lehman, Mr. Tom Liebel, Mrs. S.L., Mrs. Lamia Messari-Becker and Mr. Lee Mason, whose contribution to this report through the interviews was highly valuable.

Finally, thanks to my family, who from the distance has been always ready to listen to me, with kind words to say at every moment and especially to my parents, who have supported me in every sense since I started this year far from home.

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LIST OF ACRONYMS

AE: *Awareness & education credit*
BRE: *British Research Establishment*
BREEAM: *Building Research Establishment Environmental Assessment Methodology*
DGNB: *Deutsche Gessellschaft für Nachhaltiges Bauen (German Sustainable Building Council)*
DIFNI: *Deutsches Priveates Institut für Nachhaltige Immobilienwirtschaft (German Private Institute for Sustainable Real Estate)*
DVP: *Deutscher Verband der Projektmanager in der Immobilien und Bauwirtschaft (German association of project managers in the real estate and construction industry)*
EA: Energy & Atmosphere
GBCI: *Green Building Certification Institute*
GIB: *Green infrastructure & buildings credits*
HOIA: *Honorarordnung für Architekten und Ingenieure (Regulations on Architects' and Engineers' Fees)*
ID: *Innovation & Design*
IEQ: *Indoor Environmental Quality*
LCA: *Life Cycle Assessment*
LCC: *Life Cycle Cost*
LEED AP: *Accredited Professional*
LEED-CS: *Core and Shell development*
LEED-EB O&M: *Existing Buildings Operations and Maintenance*
LEED-NB: *New Buildings*
LEED-ND: *Neighborhood Development*
LEED: *Leadership in Energy & Environmental Design*
LL: *Location & linkage credits*
MR: *Materials & Resources*
NPD: *Neighborhood pattern & design credits*
PM: *Project Management*
PM's: *Project Managers*
RP: *Regional Priority*
SLL: *Smart location & linkage credits*
SS: *Sustainable Sites*
U.S.: *United States*
UK: *United Kingdom*
USGBC: *United States Green Building Council*
WE: *Water Efficiency*

CHAPTER 1 Introduction

1.1 Background

The need for sustainability improvements in the construction sector has been largely outlined in the last years. This need is in part driven by the general concern among society with environmental issues and for this, showing to potential customers the sustainable features of a building has become a rising activity. Certification systems accomplish this activity as they aim to qualify sustainable buildings, showing their overall performance according to established standards. Nevertheless, the application of these methods is still not wide spread and thus, there are still many issues to handle and areas to research about this matter.

1.2 Aims & Objectives

The aim of this report is to analyse the procedure to implement a certification system for sustainable buildings located in Germany and the implications of project management practices in this process.

For this, the first step will be based on a comparison between the most representative certification systems available in the German market. This comparison will outline the main differences, strengths and weaknesses of the certificates in order to support stakeholders when deciding which system to choose for their purposes.

Afterwards, the attention of the report will go to one of these certification systems, preferably the most used and illustrative from the previous ones in Germany, paying attention to key issues that will determine the process along the project and its final implementation. For this, the management process of the certification will be studied in order to determine the role of project management in the certification stage as well as the professional in charge of this process.

1.3 Research Methodology

The methodology to be followed alongside this final dissertation will consist basically of literature review. The main problem that holds this methodology lies in the fact that results obtained will have to be taken into account from a theoretical point of view, as there is not a physical “living” model (building works) that could be targeted as an objective of this report, where the different phases of the certification could be applied.

With regards to the source of data used, journal articles from recognized databases (web of knowledge, Engineering Village, etc.), specialized books and magazines as well as a general browse on the Internet, together with the information provided by the official websites of the different certification institutions will be consulted in order to establish the basis of the report scheme.

Apart from those, personal interviews with experts in the field, as well as a survey among professionals in the world of certification systems will conform a really important source of information.

1.4 Limitations and Scope

The development of this kind of research from a theoretical point of view represents the main limitation of the report, as mentioned in “Research Methodology”. Although this, the responses from the survey and the different interviews contribute with practical experience from professionals and experts from the certification systems sector.

The German sector is presented as the main scope of the research, reason why general German procedures in the construction sector, such as construction phases or delivery method, have been used in the last stages of the report.

With regards to the analysis of the different certificates, these are the limitations to be considered:

- The economical impact of the certifications in projects has not been considered (fees for registering, auditors, etc.).
- In order to conduct the comparison, the typology of building chosen has been “New Office Buildings”.
- The selected schemes from each certificate are those corresponding to the best option to fit the typology of building, considering the available documentation on the official websites of the systems.

In the case of the management stage:

- The proposed management of the different criteria is based on the analysis of the criteria of the DGNB Certificate, according to the information gathered from this organization.

1.5 Dissertation Report Outline

Previously to the research phase, an introduction is presented, so as to establish general ideas about sustainability and its integration in project management, showing the importance of proper management practises in sustainable projects.

After this, the different steps to be faced in the research will be:

Firstly, a brief analysis of the different certification systems represents the state of the art, specifying those that can be applied in Germany. At the end of this step, the research questions are formulated in order to open the door to the subsequent exposition.

To begin with the completion of the aim of this report, there is a comparison between certification systems. Similarities and differences between the diverse certificates conform the basis of this frame.

The next stage consists of the study of the DGNB certification system in Germany. In this phase the report focuses on the management aspects of the certification, and more precisely, on the analysis of the correct implementation alongside the project of the different criteria inside the certificate with regards to time. Project management issues are determined as a result of this study.

In the last phase, the role of the Project Manager is clarified taking into consideration the results from the previous analysis.

CHAPTER 2 Current Status

2.1 Concept of Sustainability

"Sustainability is the concept of a lasting forward-looking development of all economic, ecological and social aspects of human existence. These three pillars of sustainability are interdependent and require a balanced coordination". This is the definition given to sustainability by the Enquete Commission of the German Bundestag on the "Protection of Humanity and Environment" (1994).

In the same sense, another well-known definition for sustainable development is that formulated by the Brundtland Commission in "Our Common Future": Sustainable development is the one that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations World Commission on Environment and Development, 1987).

Even so, it has not been until sustainability has reached the conscience of society that it has not started its own revolution. Continuous global warming news, alongside with a noticeable decrease in the quality of life due to health threats has boosted this inflection point. It is clear that society is the one who has to face the economical issues that arise as a result from climate damages, which as a matter of fact have risen considerably when comparing two periods: 1990-2000 and 1950-1990, as can be observed graphically in Figure 2.1 (Bauer et al., 2010).

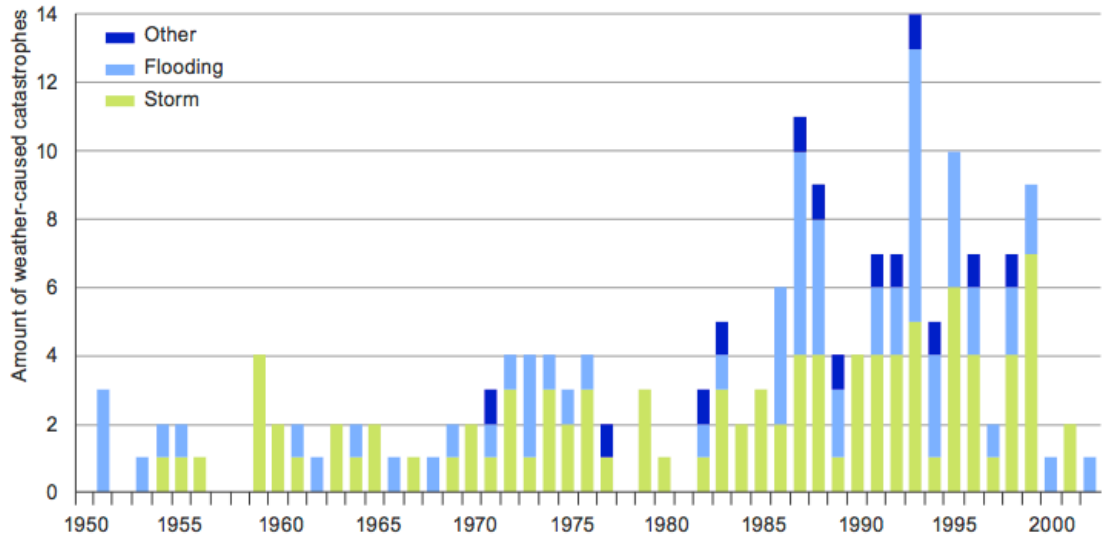

Fig. 2.1 Weather-caused catastrophes from 1950 to 2000 (Bauer et al., 2010)

Apart from this, there is another important reason for sustainability to grow important among society, which is oil prices. Considering the soaring prices (see figure 2.2), energy consumption has become a real issue nowadays, and for this, sustainability by means of energy saving and efficiency has turn into a key factor (Bauer et al., 2010).

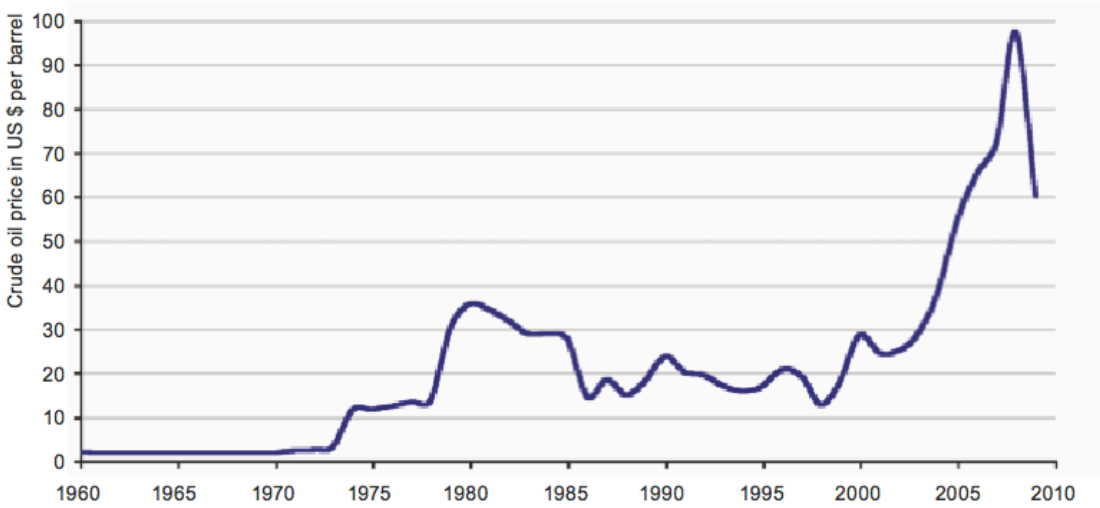

Fig. 2.2 Increase of crude oil prices (Bauer et al., 2010)

Furthermore, sustainable development has received in the latest decades an important support from relevant researches carried out from the economical point of view by developed countries, such as the Stern Report (U.K.) and the Garnaut Report (Australian Federal Government), which outlined that if nothing changed in the business methodology, specially with regards to CO2 emissions, both environmental and economic disasters would appear in coming years (Reed et al., 2009).

2.2 Sustainability in Construction

Construction as a whole represents a huge influence from humankind on ecosystem (Union Internationale des Architectes/American Institute of Architects (UIA/AIA) World Congress of Architects, 1993). More precisely, it has been stated that buildings are accountable for up to 40% of energy usage globally, and according to Perez-Lombard et. al (2008) this rate goes on ascending. Furthermore, the construction industry is responsible at the same time for a considerable amount of CO_2 emissions, which are directly linked to the global climate change (Yudelson, 2007).

With these concepts in mind, and focusing on the building environment, it is easy to realize the role and influence that construction has on the sustainable development issue. As a consequence, Sustainable buildings appear as a solution to the assurance of our planet's resources. To obtain this, it must be taken into account three different aspects: architecture, land use and urban planning. The main objective consists of achieving the maximum quality in architecture and simultaneously preventing a misuse of natural resources (Ebert et al., 2011).

In connection with the aforementioned concern with regards to sustainability in society, plenty of different strategies have emerged in order to quantify, test and monitor environmental effects of Sustainable buildings (Eberl, 2010). At this point, is where assessment methods appear, as optional and effective tools used to palliate these effects. There are numerous motivations for the success of these certificates apart the sustainable effect on buildings, such as marketing for owners and investors, aiding in policy-making towards society concern, motivation for reaching higher goals beyond compulsory standards, etc. The basic core of these methods is based on a system where points are granted to a building when comparing its performance with a prefixed list of criteria, normally built over standards. (Lee, 2013).

2.3 Certification Labels

Certification systems are the transposition of sustainability to the main phases of the construction of a building, planning, design and construction. The main aim is to contribute with an extensive evaluation of the environmental features of the project, making use of a variety of valid goals and criteria in order to reach, or go beyond, environmental standards (Ding, 2008).

The elaboration of these certification systems supposed a milestone in evaluating sustainability. They provide the opportunity to evaluate a building from a general point of view, as a whole, combining traditional concepts attached to Green Buildings such as energy efficiency, with the aid of guidelines that mirror current regulations and standards of the country where is being applied. Evaluation processes at early stages of the project result in important tips to be implemented in the design phase, which will lead the final building towards a sustainable-performance achievement. Finally, when finished, these certificates give the chance to final users to understand the level of sustainability of their new property and at the same time, documentation gathered will act as a significant guidebook for maintenance operators (Ebert et al., 2011).

The Building Research Establishment's Environmental Assessment Method (BREEAM) was the first of its class to appear in the market (1990), and determined the bases for the following certification methods. It was ten years later when the United States Green Building Council (USGBC) released another worldwide known assessment method, the Leadership in Energy and Environmental Design (LEED). Between these two systems appeared the French certificate HQE (Haute Qualité Environnementale) in 1996, although almost all the documentation available for this certificate is in French, fact that clearly slowed down its international progression (Ebert et al., 2011). From then onwards, plenty of new systems have been developed according to national standards and local environmental conditions, also searching in some cases to go into further details and beyond minimums fixed by current regulations, aiming high levels of sustainable performance (Vierra, 2011).

Some relevant certification systems are CASBEE (Japan), MINERGIE (Switzerland), HQE, Escale, (France), EU GreenBuilding Programme (Europe), GBAS, Three Star (China), Green Star, NABERS (Australia), HKBEAM (Hong Kong), GBTool (International), AQUA (Brazil), Green Leaf (Canada), DGNB, BNB, TÜV Süd SCoRE (Germany), VERDE (Spain), Green Globes (U.S.), Protocollo Itaca (Italy), etc. (Reed et al., 2009), (Ebert et al., 2011). Figure 2.3 shows a graphic compilation of the many different certification systems used worldwide (Reed & Krajinovic-Bilos, 2013).

Many of these new certification labels clearly reflect the basic lines established by BREEAM and LEED. Furthermore, the evolution of certification systems has already been pointed out, and differentiated into 1st and 2nd generation certificates (Reed & Krajinovic-Bilos, 2013).

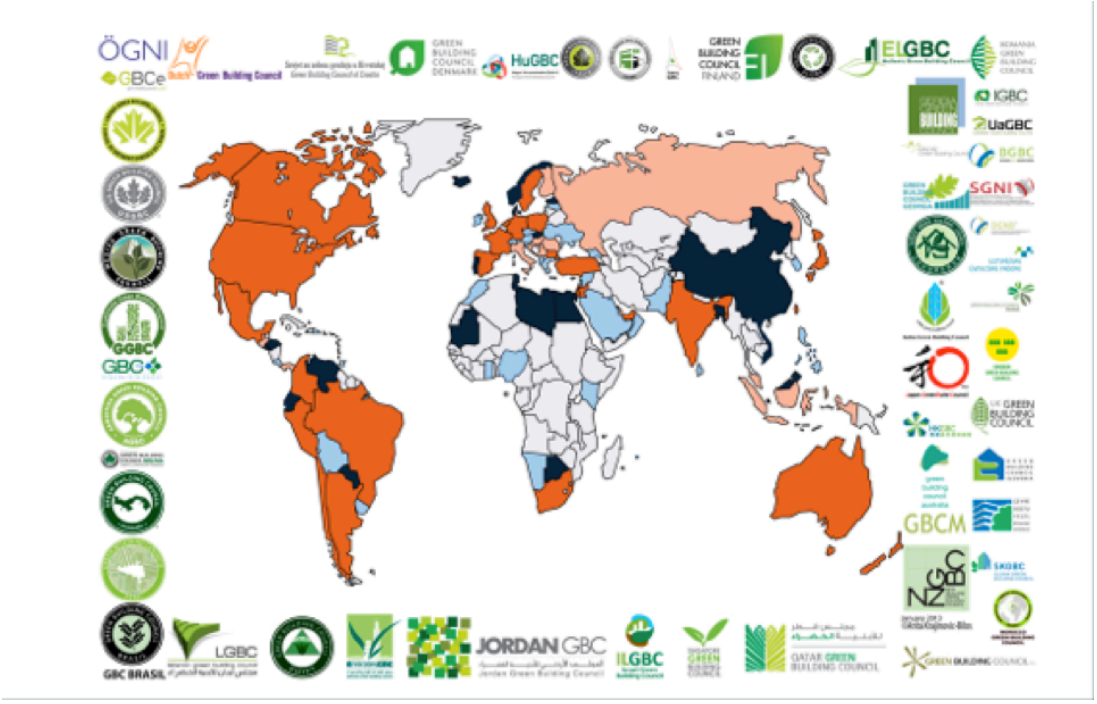

Fig. 2.3 International Rating Tools (Reed & Krajinovic-Bilos, 2013)

First generation certificates, such as BREEAM and LEED, based their assessment in the evaluation of "green" related aspects, whereas second generation certificates have a wider view of the quality assurance of the building, involving technology, economical and social aspects, location, etc. Second generation Certificates, for example DGNB, have the clear advantage of being able to follow the good lines established by first generation ones, inheriting the knowledge and experienced gathered by the firsts and adding a wider overview (Ebert et al., 2011). Figure 2.4 shows the evolution of Certification systems, and the possible appearance of a third generation in the assessments.

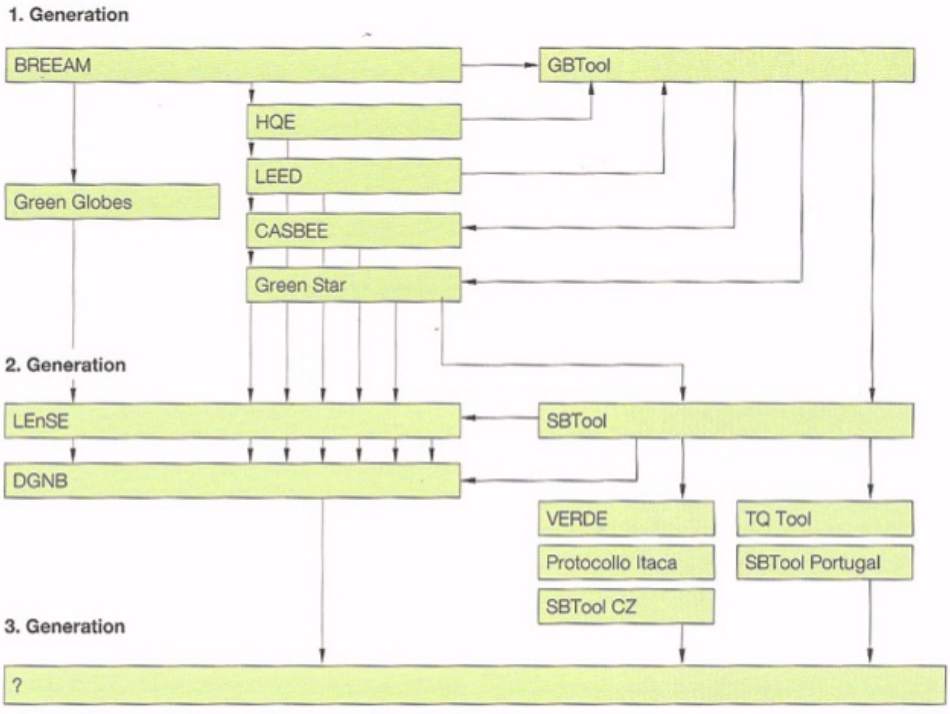

Fig. 2.4 Evolution of Certificates (Ebert et al., 2011)

2.4 The German market

The focus of the report is the German market, and with regards to that, the certification systems that are leading in this sector are LEED, BREEAM and DGNB (Reed & Krajinovic-Bilos, 2013). For this reason, an extensive explanation of these systems will be developed in the next part, in order to describe the three systems, their structure and working scheme.

CHAPTER 3 Systems Description

After the exposition of the main issues related to certification systems, a complete description of the most relevant assessment methods working within the German sector will be conducted, including BREEAM, LEED and finally DGNB. This description aims to highlight the main features of each system in order to establish a common structure that will aid both in the comparison to be made in the research stage and the integration of project management in the certification process.

3.1 BREEAM (Building Research Establishment Environmental Assessment Method)

This certification method was the first one to appear in the market, by the year 1990. It could be considered the father of all the certification methods, as it established common criteria generally used by subsequence systems. The British Building Research Establishment (BRE) started its development in the United Kingdom at the end of 1980's.

It was conceived as an assessment method for national buildings, both office and residential. Its later development towards a wide scope of building typologies turned this system into one of the most used worldwide. According to Breeam.org more than 250.000 buildings have been already certified all over the world, being used in more than 50 countries (2013). Although this, its main focus remains in the UK market, as it has an important support from authorities, who established that, for instance, every residential building finished over 1 May 2008 would need to be certified in harmony with the BREEAM system. If not, the owner would have to present a document to the customers in order to express that the building followed certain standards but that it did not succeed in achieving BREEAM certification.

At an international level, different agreements are being established in order to expand even more this assessment method globally. Normally, the contacts are held with the so-called Green Building Council of each country (BRE, 2013).

3.1.1 Rating systems and certification process

There are different certification schemes, depending on the typology of the building, and also, depending on the country of application. The following schemes are divided into those than can be found in the UK, and other adapted schemes including International.

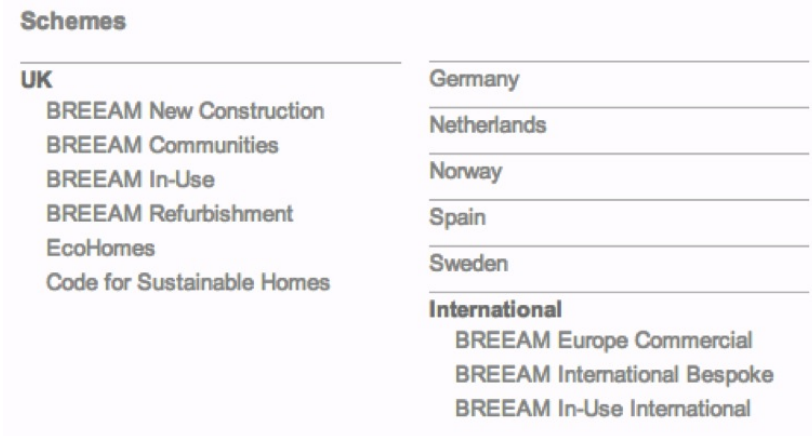

Fig. 3.1 Schemes of BREEAM

Apart from those, adapted BREEAM schemes can be found in Germany, Netherlands, Norway, Spain, Sweden and finally an International scheme, ain Figure 3.1 (BRE, 2013).

The assessment methods proposed by BREEAM differ from national (UK) and international schemes, in order to adapt to the various needs of each nation. In the main, it could be said that all the systems cover both design and construction phases.

For instance, the assessments in the UK are the following:

- *Design and Procurement:* in this case, the evaluation occurs within the planning stage.
- *Post Construction:* Once the building is concluded, there is an exam of the evaluation carried out in the previous phase (if it was done), in order to assure that the basis of the Breeam methodology have been successfully carried out.
- *Fit-out:* Particularly used for lease goods in retail and office buildings.
- *Management and Operation.*

In contrast with BREEAM UK, BREEAM Europe only includes two phases of assessment, Design & Procurement and Post Construction.

The evaluation during the first stage, comprising planning & design will only be in connection with the desired level of quality. For this reason, and as there is not a physical entity to assess, the exam will be based upon the documentation presented, which will need to be as thorough as possible, meaning this the final design. If the design accomplishes the requirements of BREEAM, a pre-certificate will be awarded.

On the other hand, it is also possible to conduct the assessment once the building is finished. In this case, there are two possible paths: either the project has a pre-certificate or it does not. If a pre-certificate has already been awarded, the evaluation process will embody a review of this in order to assure that the outputs are still correct. Another possibility is to conduct a whole assessment once the building is completed.

As a summary, the main steps to follow in order to proceed with the assessment and certification of a building with BREEAM would be:

- Register the project (either in design or already built) according to the BREEAM scheme that suits the best to it.
- Compile all the documentation needed in order to proceed with the rating system. This process is really important, as the final certification will be based on the documentation provided.
- Provide the information gathered to an accredited assessor, who will actually carry out the rating.
- Once the rating is finished, it will be submitted (with all the documentation of the project) to BREEAM, where it will be validated.
- In case no discrepancies are found, the owner will receive the final certification (or pre-certificate) of the building.

Note that in this system the participation of the accredited assessor is compulsory. (Ebert et al., 2011).

3.1.2 Documentation requirements

With regards to the required documentation, it must be highlighted that the needs for the BREEAM systems will be more or less the same than for other certification

systems. In general, all the records that can be captured during the construction phase: photographs, technical measurements of performance (acoustic, thermal, etc), technical specification of materials, official documents (e.g. Energy certificates), etc. All this information will be the basis for the accredited assessor when rating the building. (Ebert et al., 2011).

3.1.3 System structure

For the accomplishment of the assessment, the system is divided into a two steps procedure.

The first stage consists of a rating process, where credits are awarded in nine different sections. Each section contains a range of criteria to be met; it is important to highlight that depending on the scheme the criteria can be different, although the most important ones remain in all the schemes. On the whole, the highest marks belong to the energy efficiency aspect of the building. The general sections are:

BREEAM Section	Weighting (%)	
	New builds, extensions & major refurbishments	Building fit-out only
Management	12	13
Health & Wellbeing	15	17
Energy	19	21
Transport	8	9
Water	6	7
Materials	12.5	14
Waste	7.5	8
Land Use & Ecology	10	N/A
Pollution	10	11
Innovation	10	10

Table 3.1 Weighting factors (BRE Global Limited, 2012)

Note that the shown percentages belong to the scheme BREEAM Europe 2009.

Once the marks for each criterion are awarded, a percentage is calculated in relation with the maximum possible scores (number of credits) for it. This percentage is then multiplied by a weighting factor, to obtain a corrected percentage. The sum of all corrected percentages from each section will give the final performance of the building. This figure, compared with the levels established will give the final evaluation.

Note that to obtain the final evaluation, the building must reach a minimum number of credits in individual sections. For example, to achieve a “Good” level, apart from obtaining more than 45%, the building will have to have at least 1 credit in “Building user guide” and “High frequency lightning” (Ebert et al., 2011).

3.1.4 Certification Level

There are five different levels achievable in the BREEAM certificate, Pass, Good, Very Good, Excellent and Outstanding.

Apart form the general performance determined in the percentage shown in Figure 3.2, it is also necessary to accomplish some minimum points in individual categories. In the Outstanding level, if achieved, further documents with a review of the project must be provided to BRE, who will have rights to publish it. Some examples can be seen in Figure 3.3, corresponding to the Manual of the International scheme from BREEAM 2013.

BREEAM Rating	% score
OUTSTANDING	≥ 85
EXCELLENT	≥ 70
VERY GOOD	≥ 55
GOOD	≥ 45
PASS	≥ 30
UNCLASSIFIED	< 30

Fig. 3.2 Rating Levels for BREEAM (BRE Golbal Limited, 2013)

BREEAM issue	PASS	GOOD	VERY GOOD	EXCELLENT	OUTSTANDIN
Man 01: Sustainable procurement	One credit	One credit	One credit	One credit	Two credits
Man 02: Responsible construction practices	None	None	None	One credit	Two credits
Man 04a: Stakeholder participation	None	One credit (Building user information)	One credit (Building user information)	One credit (Building user information)	One credit (Building user information)

Fig. 3.3 Minimum BREEAM standards by rating level (BRE Golbal Limited, 2013)

The criterion differs from one scheme to another, and especially between the different versions of BREEAM internationally. This differences respond to the distinct needs of each country towards sustainability, as for example water use cannot have the same weighting in rainy areas than in arid ones (Ebert et al., 2011).

3.1.5 Guidelines

Depending on the scheme selected, the standards and guidelines may vary substantially. As a general rule, schemes in the UK will be attached to local standards, whereas BREEAM Europe for example refers to ISO or EN standards, excluding expressly national rules. Anyway, a list of comparison between different standards has been developed by BREEAM in order to assist cases where no national rules can be found.

Apart from the standards, BRE has developed a series of books and tools seaking the aim of supporting sustainable techniques and guidelines in construction works.

As final overview, the actual aim of BREEAM is to further its expansion globally, through the development of new schemes in many countries (European countries, Gulf States, etc.). Furthermore, recent agreements with different organizations over Europe seek to develop an international assessment method for the European market (Ebert et al., 2011).

3.2 LEED (Leadership in Energy & Environmental Design)

At the end of the 90's the U.S. Green Building Council developed this assessment method in order to implement the LEED certification amongst the building industry so as to raise competence in the further improvement of sustainable construction. Since

2000, when LEED certification for New Buildings (LEED-NB 2.0) was released, a range of procedures were elaborated to cover diverse building typologies; both in the sense of refurbishment, new construction or buildings in use and in the typology itself such as hospitals, schools or shopping centres. To aid the USGBC, since 2008 the Green Building Certification Institute (GBCI) has taken care of the certification process, training and global business of LEED (Ebert et al., 2011).

The expansion of this certification since its implementation has been really significant, specially thanks to some authorities within the U.S. who fixed as minimum level of achievement silver certification for new buildings. More than 40.700 buildings have been already certified up to 2013, from which around 34.000 certifications belong to U.S. buildings (USGBC, 2013).

3.2.1 Rating systems and certification process

The available rating systems represent the different possibilities in order to proceed with the proper scheme for certification purposes, depending on the typology of the building. The systems are:

- New Construction
- Existing Buildings
- Core & Shell
- Commercial Interiors
- Retail
- Homes
- Neighbourhoods Development
- Schools
- Healthcare

(USGBC, 2013)

There are slight variances among the range of systems in reference to the certification process. In this sense, for instance, in a New Construction project, there may be a previous step within the **design phase** in which an assessment is carried out, obtaining feedback from the GBCI. In this stage there are no pre-certificates, just a design review of the project, with the acceptance or rejection of the credits that allegedly will be implemented in the construction phase. Once the building is finished, the certification process will conclude with the review of all the proper documentation and the award of the final certification (Ebert et al., 2011).

On the other hand for example, in the LEED-CS (Shell & Core), the systems does conceive a pre-certificate. In this case, this pre-certificate is awarded at an early stage of the design, and mostly based on a declaration of intentions towards the credits to address. Marketing purposes motivate this procedure. As mentioned before, at the end of the construction phase, the final certification will be awarded after documentation review.

As a final example of the small variances among these systems, a brief comment about LEED-EB: O&M (Operation & Maintenance). For existing buildings the certification process is divided into two main stages: Implementation and performance period. During the implementation, the certificate tries to analyse the accomplishment of the credits by checking, for example, manufacturer's specifications on devices or materials used in the construction; whereas on the performance phase, which takes part three months later (or twelve in the case of the energy efficiency criteria), a review of the measures already analysed is the key activity. In this kind of certification, a "Recertification" process is compulsory each 5 years, although it does not mean a full certification repetition, but a checkpoint.

The role of the accredited assessor in the LEED certification is quite different from the one in the BREEAM system, as here his participation in the project is not compulsory. That means that the owner (or representative) can deliver directly to the GBCI the

documentation needed for the certification. Nevertheless, the USGBC highly recommends including an accredited assessor (LEED AP), as they declare that his formation and knowledge in the field will assure a successful achievement of the highest certification and thus the best sustainable features for the project (Ebert et al., 2011).

On the whole, the certification process will follow the next stages:

Fig. 3.4 How to certify a building project (USGBC, 2013)

1. **Choosing** the proper systems for the building
2. **Registration** the project and payment of fees
3. **Submission** of documentation (and payment of review fee)
4. **Review** of the project by GBCI
5. **Certification** award depending on the scores (USGBC, 2013).

3.2.2 Documentation requirements

The documentation needed is based on a group of pdf forms to fill in for each individual criterion. All the documents will be submitted to the online platform of LEED, in English. This documentation will give precise details of the accomplishment of each specification in the criteria of the system. In some cases, it will be necessary to attach to these pdf forms some extra documents in order to support the information provided (photographs, material manufactures' certificates, plans, etc.) (Ebert et al., 2011).

3.2.3 System structure

The main structure of this assessment method is divided into seven different areas, although in some cases (LEED-ND and LEED Homes) there may be small variances. In contrast with other rating systems, LEED certification levels are achieved directly by the total sum of points gained. This means that no weighting factors are used and in each category there is no percentage use (either you fulfil the requirements of the individual criteria and so the whole points or you get no one; with an exception in WE-3, EA-1 & EA-2). With this, the different areas, with the range of points achievable depending on the system, are the following:

- Sustainable Sites, SS (21-28)
- Water Efficiency, WE (10-14)
- Energy & Atmosphere, EA (33-37)
- Materials & Resources, MR (10-14)
- Indoor Environmental Quality, IEQ (12-19)

- Smart location & linkage credits SLL (27) (LEED-ND)
- Neighborhood pattern & design credits NPD (44) (LEED-ND)
- Green infrastructure & buildings credits GIB (29) (LEED-ND)

- Location & linkage credits LL (20) (LEED-Homes)

- Awareness & education credit AE (3) (LEED-Homes)

- Regional Priority, RP (4) (BONUS CRITERIA)
- Innovation & Design (6) ID (BONUS CRITERIA)

For each certification system, there are also some pre-requirements that must be gained to obtain the certification. These pre-requirements act as minimum level to achieve, which suppose that its fulfilment does not add points and are independent on the level of certification that will be finally awarded (USGBC, 2013).

3.2.4 Certification Level

Summing up all the points achieved in each individual criterion, plus the innovation and regional points, will give a final score. The awarded levels are those presented in Figure 3.5:

Fig. 3.5 Certification level for LEED-NC (Source: LEED Core Concepts and Strategies online course)

(USGBC, 2013)

3.2.5 Guidelines

As this system was firstly developed with a focus in the American building sector, all the references are made to U.S. standards. However, some countries have adapted to scheme to their specific circumstances, among which stay Brazil, Italy, Canada, etc.

The aim of this assessment method in the future is the continuous improvement of the different systems, and development of new ones for specific building typologies.

Moreover, in future versions, LEED will change its approach to the energy performance from energy cost savings to reduction in primary energy demand. Apart from that, the USGBC is analysing and developing new versions where greater importance will be given to LCA (Ebert et al., 2011).

3.3 DGNB (Deutsches Gütesiegel Nachhaltiges Bauen)

The DGNB certification system was firstly introduced in 2007 in Germany. It represented a late response to the actual situation of the market with regards to sustainability, as other certification systems such as LEED or BREEAM had already a great expansion and development. DGNB is considered a second-generation certificate, the main reason relies on the fact that not only a social-economic-ecologic view has been taken into account, but also some other aspects that represent a step forward in the concept of sustainable building; technology and special attention to processes and site.

The development of this certification started with the backup of two organizations. On the one hand the German Sustainable Building Council (DGNB) and on the other hand the Federal Ministry of Transport, Building and Urban Development (BMVBS). Both institutions collaborated in the redaction of the first list of criteria to follow in order to implement the certification. After the first version of this certificate, both entities decided to split their cooperation. From then onwards, DGNB developed the certificate with the same name focused on the private sector and its growth in the international market, whereas the Federal Ministry (BMVBS) developed the BNB certificate (Bewertungssystem Nachhaltiges Bauen) for the public sector. For the purposes of this report, special attention will be paid to the DGNB certificate as it represents the comparable system with the ones already described and holds at the same time an economic background (private sector) in relation with sustainability.

The German Sustainable Building Council (DGNB) is, as mentioned before, the responsible for the development of the DGNB certificate for sustainable buildings. This organization takes care of every aspect related to the certification process, training of auditors, quality assurance, updates, etc.

Several requests from international partners contributed to the expansion and further progress of this assessment method outside Germany. This process of internationalization of DGNB has been done in accordance with a list of criteria mainly based in European standards. Only in some fields where no standards were found at a European level, German standards were taken into account (e.g. fire prevention and protection)

As for the organization of this entity, three different business areas can be found:

- DGNB Academy, which will take care of the training and education system for any kind of specialist that want to deal with the DGNB certificate.
- DGNB System, which will be in charge of the management of the certification and all the processes attached to it.
- DBNB Navigator, its main aim is to offer guidance in the field of products and its relation to sustainability.

(DGNB, 2013), (Ebert et al., 2011)

3.3.1 Rating systems and certification process

As with the other certification systems, DGBN certificate has been adapted in order to attend the needs of a wide range of building typologies. As a result, a variety of schemes have been developed in order to certify many different constructions in Germany and Internationally. As an example, the schemes developed for Germany are:

EXISTING

- Office and administrative buildings
- Retail buildings
- Industrial buildings
- Residential buildings

NEW

- Educational facilities
- Office and administrative buildings
- Office and administrative buildings (with modernization measures)
- Retail buildings
- Hotels
- Industrial buildings
- Hospitals
- Laboratory buildings
- Tenant fit-out
- Assembly buildings
- Residential buildings
- Small residential buildings

NEW DISTRICTS

- Urban districts

(DGNB, 2013)

In connection with the certification process, this system establishes as compulsory the commissioning to an auditor. This auditor will be the connection between the owner of the building and DGNB.

As a general overview, the process for the assessment with a DGNB certificate follows a series of stages as follows:

1. Register the project in DGNB
2. Defining the aims and objectives
3. Pre-certification (not compulsory)
4. Gathering information regarding Planning and Construction phases
5. Assessing both the documentation submitted and the construction
6. DGNB Certification

(Ebert et al., 2011)

3.3.2 Documentation requirements

Concerning the project documentation needed for the certification process, this will depend on the typology of project and working certification scheme, as it will be DGNB the one that will determine the kind and extend of paperwork to present. In general terms, according to DGNB, the 80% of the documents requested for the certification process already exist in any building project during the planning and construction stages. This means that this percentage of documents to be presented, just need a classification step, where everything is clearly organized and easy to follow. So, organized documentation criteria alongside the planning and construction phase suppose another feature of this certification process (Ebert et al., 2011).

3.3.3 System structure

The system structure for the DGNB certificate is based, as mentioned previously, in five main areas, contributing to the final evaluation and a parallel assessment of Site quality, with no weight in the final mark. The main areas, and their maximum percentages are:

Fig. 3.6 System structure (DGNB, 2013)

- Environmental Quality (22,5%)
- Economic Quality (22,5%)
- Sociocultural and Functional Quality (22,5%)
- Technical Quality (22,5%)
- Process Quality (10%)
- Site Quality

(Ebert et al., 2011)

3.3.4 Certification level

Once the whole evaluation has been performed, the final scores will determine the certification level achieved by the building. There are three possibilities:

Total Performance Index	Nominal Performance Index	Awards
from 50%	35%	Bronze
from 65%	50%	Silver
from 80%	65%	Gold

Fig. 3.7 Performance indexes (DGNB, 2013)

The overall performance of the building is not enough to achieve a certain level. There must be a minimum percentage passed in the first 5 quality areas so as to obtain the final level. These percentages are 65% for gold, 50% for silver and 35% for bronze.

With regards to the internationalization of the certification system and further comparison between buildings, it must be taken into account that the bronze certificate is the result of the accomplishment of predominant construction procedures in the country where it is being applied, whereas the gold certification fixes the reference in neutral environmental and market indexes, so that, according to DGNB, an international comparison between buildings in different places in the world is actually possible (USGBC, 2013).

3.3.5 Guidelines

With regards to the standards and guidelines used, it must be said that alongside the German market, this certification aims to act as a boost to the national standards, tools and procedures towards sustainable buildings. In the international development of this tool, European standards and norms were used as basis for its configuration almost exclusively, resorting to German rules in exceptional cases (Ebert et al., 2011).

CHAPTER 4 Problem Definition

All along the project life, since the very beginning of the design concept to the finishing phase of construction, there are still some issues to be solved in the role of certificates, as their path is still not completely clear and thus, the integration of project management in this process. Moreover this management issue is magnified by the fact that there is not a common procedure for certificates, mainly because there are several differences between them along its implementation such as the criteria considered, as it will be outlined. For the purposes of this report, two main areas of problems will be targeted in this part and tackled in the next chapters.

4.1 Existence of different certificates

Nowadays there is a noticeable existence of a wide variety of certification systems spread all over the world. This fact is obviously accompanied by the rising attention to sustainable development in the construction industry and more precisely within the real estate sector. These systems answered to the need of assigning a level of sustainability to a building, to measure it, representing at the same time a comparison tool.

Notwithstanding, there is still a concern, especially within international investors, with regards to the equivalence between these rating systems among buildings located in different countries and therefore, the possible comparison of the level of sustainability between them. These differences are based on the fact that each rating tool, in each country, uses as guideline for establishing the set of criteria of the system the building standards, or codes, of this country. Obviously, these standards are not the same between countries, being more restrictive in some of them and less in others. For instance, a 6 Star building, the top certification level of Green Star (certification system in Australia), is not equivalent to an Outstanding building, the top certification level of BREEAM (Reed & Krajinovic-Bilos, 2013).

On top of that, and according to Reed et al. (Reed et al., 2011), this misunderstanding could suppose a real obstacle towards a general comprehension of these systems by investors, owners, etc. that would result in added problems to sustainable investments in the building industry.

As already stated, the focus of this report is the German market, and with regards to that, the certification systems that are leading in this sector are LEED, BREEAM, DGNB and BNB. The differences of the latter two have been already explained, although as a summary, it could be said that basically DGNB is economically driven whereas BNB is a public certification for public buildings (Reed & Krajinovic-Bilos, 2013).

Although the application of these certificates is done inside the same country (Germany), some considerations have to be made. The scheme used in the case of BREEAM is BREEAM Europe, as the adaptation of BREEAM DE is still only available in the scheme “In-use”; DGNB is a “local” certificate and the LEED certificate is based on an international scheme, which means that the standards used are not those from Germany. For this reason, there would be enough conditions to notice that a comparison of these certificates would aid in clarifying the main variances between them in their respective application in the German market. In addition, there is an extra circumstance in this part, the international structure of DGNB. In 2010 the European Union initiated a program named “Open House”; its main aim is the research towards transparency among certification systems in Europe. In that scenario, and according to

Chairman Manfred Hegger from DGNB “Around 80 per cent of the criteria that were selected for the Open House list are ones that are also implemented in the DGNB certification system. This shows that our system is very suitable for international use.” (2012).

4.1.1 Posed Problem

The existence of three Certification systems in Germany with different scope, not only in the criteria adopted but also in the standards followed, may lead to misunderstandings among investors and stakeholders; for this, a comparison of these systems will be conducted in order to clarify differences, strong points as well as weaknesses and general features so as to aid these investors and stakeholders of the building industry in choosing the best system for the purposes of their projects. Moreover, a study of the market penetration of the three certificates will be conducted in order to analyse their acceptance up to now in this country.

4.2 Project Management & Certifications

For the analysis of this problem the basis of the role of Project Managers will be exposed in the first part, in order to introduce secondly the integration of project management in the certification process.

4.2.1 The Project Manager

The improvement of sustainability in the construction sector as a whole, will find its way through a proper change in traditional disconnected stages in the management process. For this, the boost of creative paths in procuring, designing, constructing, using and maintaining represent the final aim of this industry in the way to sustainable construction. Innovation must focus on increasing stakeholders’ expectations regarding cost, time, quality, safety and ecology (Griffith, 2002).

Sustainability is the result of the correct implementation of the previous milestones, and it must be highlighted that the economical balance is a key aspect for a green project to be feasible, representing at the same time one of the main barriers in achieving sustainable buildings (Bradley Robichaud & S. Anantatmula, 2011).

All the aforementioned points are managed from a singular point of responsibility, through the figure of the project manager. This figure is the one in charge of reaching these major aims of a project (scheduling, control of funds, scope of work, quality assurance, etc.) and thus, the key performer towards sustainable building processes (Arditi & Ongkasuwan, 2009).

Thinking about the main aims of sustainable buildings there are some concepts that cannot be missed such as lowering energy consumption, protecting the environment, improving indoor healthy, etc. To accomplish these goals, it is clear that the role of the project manager, single point of responsibility as outlined before, is vital as his influence in each phase of the project is noticeable and determinant in order to push the project towards them. Moreover, as it will be shown in this chapter, the impact of sustainable buildings in productivity is a fact; this considered together with the reduction in energy consumption along the life of the building highlights the importance of taking into consideration the lifecycle of the building since the very beginning of the design stage. For this, the integrated design approach, which implicates the inclusion of architects, engineers, land planners, building owners, etc. in the design phase, represents another reason why the role of the project manager in sustainable buildings is so important (Kubba, 2010).

4.2.2 Adding the certification process

When it comes to talk about the integration of a certification process into a project, things get tight. Assessment methods not only consist in analysing a building's performance in all the senses, but also aiding in decision-making during the design stage. As a result, certifications must be integrated and thus will suppose a change in the processes of the project considered. Those changes have resulted into the incorporation of new specialists to the construction process such as auditors, sustainability consultants, etc. (Ebert et al., 2011) that will deal with the project manager.

This integration of new members to the project team needs to be done as soon as the project starts, as it is from this point when aspects such as comfort, energy efficiency or barrier-free access can effectively be combined into a whole and change the design, being specially in this stage when changes in the project definition will really influence positively in cost as seen in Figure 4.1 According to these considerations, taking into account final costs, both of construction and operation of the building, will turn into a general cost efficiency of the project that as mentioned, can easily be achieved by targeting and solving as much issues as possible in early stages of the project (Hegger et al., 2007).

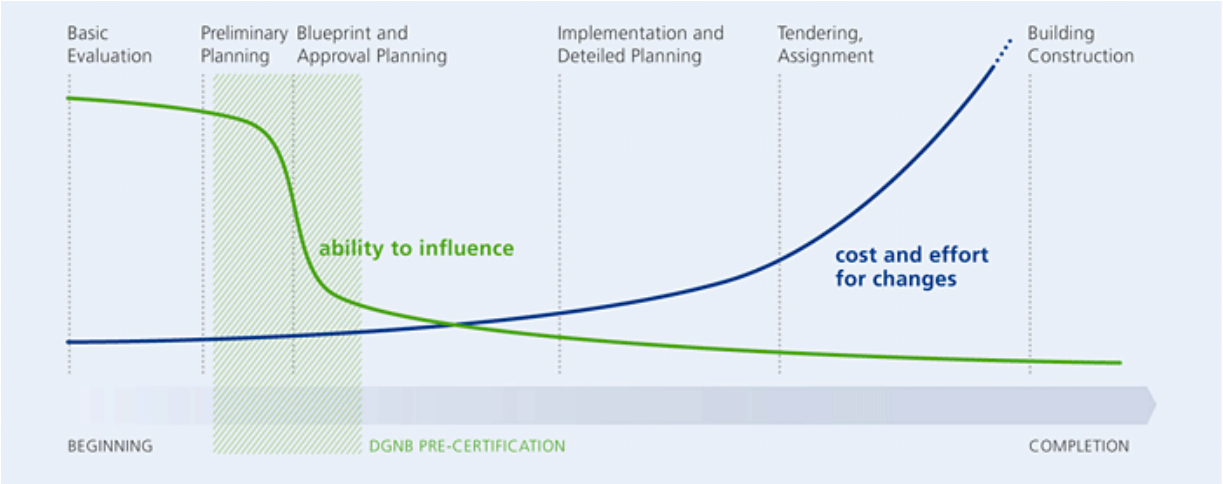

Fig. 4.1 Relation between time of changes in the project and related cost (DGNB, 2013)

Furthermore, still from the economic point of view, according to a survey carried out by Roland Berger Strategy Consultants in 2010 in the German sector, more than 60% of those asked claimed that value of sustainable properties was either remaining or even increasing thanks to cost reductions in both energy and operation & maintenance of these buildings (Henzelmann et al., 2010). At the same time, according to the research carried out by Miller et al. (2009), taking a LEED certified building as study object, it was proved that a healthier environment (natural light, indoor air quality, etc.) resulted in lower absenteeism and higher productivity whiting employees, which in the end means economic benefits. Roland Berger's survey mentioned before, also outlined the willingness of investors to pay around 8,5% more for sustainable buildings, statement that ratifies the added value to these properties.

4.3 Further Research

Nevertheless, although the importance of this topic has been highlighted by many researches, there is a lack of detailed information regarding the actual issues involved in the certification process and the role of PM's; on account of that, a personal

research has been carried out based on a series of interviews with different experts in certification systems and also, a survey with a final number of 40 responses with general questions about the certificates and the process of their implementation in a project. The graph below shows the different profiles of the professionals who completed the survey and their roles in the projects in which they were involved.

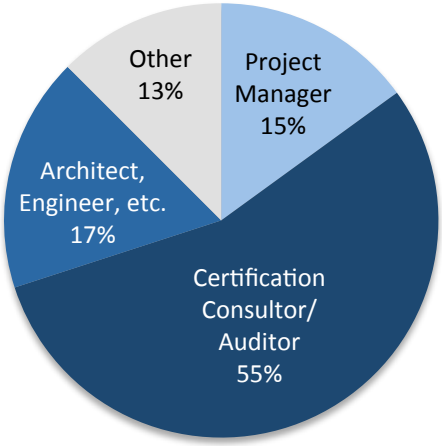

Fig. 4.2 Profile of professionals taking part in the survey

The research in this phase aids in trying to understand the actual role of Project Managers dealing with the certification process and at the same time, targeting issues related to this activity. A summary of the main questions and relevant answers is presented as the basis to conform the current status of this topic, highlighting at the same time the actual issues found.

4.3.1 Role of Project Manager

Question: *Do you think that project management can effectively optimize the certification process? Which are the main benefits of applying PM?*

According to Theresa Lehman (LEED expert), the documentation related to this certificate needs to be integrated into the project management process form the on-set, and if integrated from the beginning, it certainly optimizes the certification process. Moreover, the importance of the delivery method is highlighted, mentioning at the same time that the construction firm should be a stakeholder at the table from the on-set planning.

If this does not happen, and the construction firm is coming into the design process late in the game, or at the end of design, the different steps to be followed by this figure are explained, saying that they need to start the LEED documentation process with clarifying the bids of the material suppliers and subcontractors, writing language related to LEED into the contracts and purchase orders, requiring LEED submittals to be part of the shop drawing process, and not authorizing payment until proper documentation is received. Besides, the contractor needs to hold a LEED kick-off meeting in conjunction with the Commissioning kick-off meeting for the field personnel so they have an opportunity to be educated about LEED and the requirements they need to satisfy. Many other activities have to be considered in schedule and finally, if done correctly, and people are given the opportunity to be educated, the LEED documentation process integrated into the overall project management process yields success certification of the project.

Along the same lines, Lee Mason (BREEAM expert), answered positively to this question, arguing that an effective Project Manager can drive other members of the project team to produce evidence on time, with everyone understanding their responsibilities with regards to this process.

To the same question, S.L. (LEED expert) did not doubt at all with an "Absolutely". After it, it was specified that his company only had highly **skilled professionals** as Project Managers. In addition, and with the significant help of these Project Managers, they have customized a LEED certification process, including **milestones** and **specific deliverables**, which have served them well on over 400 projects thus far.

This customization of the process and the definition of milestones and specific deliverables within the certification process are of key importance and will be analysed at the end of this part.

According to Lamia Messari-Becker (DGNB Expert), certifications cannot be successfully completed without control. This is a process that must be accompanied not only technically and goal-oriented, but strongly steered. Moreover a consideration is given to whether an **internal** or **external** control (**classic Project Manager**, inside the organization of the client or a **Project Manager exclusively** focus on the **certification process**, respectively) of this process is an advantage, declaring that this fact has to be analysed individually. Both cases represent positive aspects, as the external control has the independency from the planning process and its guidance and thus no conflicts with his own scope of work, and the internal control has also the advantage of having all planners contractually committed to the client.

The last answer to this question belongs to Tom Liebel (LEED Expert), who stated "Not necessarily", explaining that Project Managers can optimize only if they are **central to the process** and not merely watching others working in this certification process.

4.3.1.1 Posed problem

So far, with the analysis of the answers to the first question, there is a really interesting point to be highlighted, the role of a Project Manager in the certification process. First of all, it must be taken into account that all the experts agree on the fact that PM's can actually optimize the process, but going further in this direction, some of them referred to "**skilled professionals**" acting as PM's and customizing the process, "**external control**" with benefits such as the independence and lack of conflict with the own scope of work and finally PM's which are "**central to the process**" of certification.

An interesting question arises out of this problem: Should Project Managers be focused on the certification process, acting as external control? or should they act with the classical approach of Project Manager involved and managing all the aspects of the project including the certification process?

The response to the question posed will be developed at the end of the implementation phase, as further explanations and implementations with regards to the certification process are needed to answer this question.

4.3.2 Main problems during the certification process

Going further, the answers to the next three questions of the different interviews can be compiled, as are intimately related: *Which are the main problems that PM's have to face when dealing with the certification process? from the PM's point of view, which are the hardest steps to implement in order to obtain a certificate? and, In certified projects*

that do not achieve high scores, is it because points were lost due to the fact that the different criteria were not applied in their correspondent phase during the project?

According to Theresa Lehman (LEED Expert), once again the delivery method is the central focus of the answer, stating that on "Hard bid" projects, the biggest challenge is that materials that are specified by the design team do meet the requirements of the credits/prerequisites and/or the LEED Scorecard does not align with the specification sections, or vice-versa. As overall, it is very difficult to deliver LEED documentation on a hard-bid project when not corrected specified. With regards to the hardest steps, the most difficult challenge is the beginning of the project, as the delivery method will be determinant. Many times, the construction firm is not a stakeholder at the table to start with and often times the budgets are not accurate, and constructability opportunities are missed.

For the last part, the reason for not meeting LEED award level goals is that the owner was not walked thru the sustainability goal-setting process correctly, or LEED was implemented late in design or potentially until the project was completely designed. Apart from that, having an inexperienced LEED Project Administrator guide the team through the process is equally as bad. This all results in bad design and construction documents, which essentially is handing a problem off to the construction firm.

The answer from S.L. (LEED Expert) to the first question is categorized in three main challenges: one internal and two external.

> Internally, rely on MS Excel as Project Management software, used to track process on projects. This resulted in a bad option, as the main issue, according to this Expert, has to do with **tracking** LEED-specific **assignments** and **requirements**.
>
> Externally, many issues have been related to Quality Control, and with the interaction in this aspect with the organization providing the certificate, specifically with tools, requirements and review comments.
>
> Externally, there is a constant situation of facing with the challenge of inexperienced and/or unenthusiastic project teams. Project Management can effectively develop its part, but cannot do everyone's work.

For the hardest steps to implement, getting team members to correctly complete their portion of the documentation was the highlighted issue. As possible reason for not achieving the goals with regards to the level of the certificate, setting them fairly low at the outset and the owner's lack of motivation to aim for higher goals were the most important ones.

According to Lee Mason (BREEAM Expert), many PM's do not fully **understand** the BREEAM **process** and therefore do not feel confident in asking individual members of the design team to produce information. They also have a lot of work to deal with and BREEAM can be a secondary consideration. In connection with the hardest steps to implement during the certification system, this expert highlights the early appointment of the BREEAM assessor and coordination with the client to commit to items. Finally, a positive answer was given to the last question with regards to factors preventing the achievement of goals, saying that **not fulfilling criteria in the correct phase can be a factor**. Many times a BREEAM assessor is appointed **too late in the process** for some credits requiring early action, e.g. Consultation; however a major factor pointed out was that people do not realise how **onerous** a requirement is, committing to it at Design stage and **not fulfilling** the **criteria** at Post Construction stage.

From the point of view of Lamia Messari-Becker (DGNB Expert), there are a few key problems related to the certification process, among these, special attention must be paid to **schedule**, responsibilities, management change and **documentation**. As hardest steps to implement, the tendering and implementation phases were outlined. According to this expert the most important step is to take the decision to certificate in the right moment, not just before bidding, but in the stage of identifying needs and basic evaluation; finishing the answer stating that this is "unfortunately, rarely the case". Once again, the last question receives an affirmative response, "this is true", arguing that in particular, the quality of the process, which already requires a lot of concepts and documentation of all the idea of sustainability during the design, cannot achieve the maximum possible points, although this would be possible. In general, the **complexity of the process** is not yet realized by many professionals leading with it, who still think that not changing or doing something different from the classic approach will still result in obtaining the certificate.

The last answers to this part of the interview come from Tom Liebel (LEED expert), who is really concise with regards to the first question saying that **clarity of objectives** and **follow-through** are the main problems that PM's face during the certification process. Moreover, the follow-through from all responsible parties represents at the same time the hardest step to implement. As for the last question, the answer was a clear "yes", explaining that typically, it is due to a **communication error** between team members or a lack of commitment from the ownership.

In the survey carried out, 50% of participants stated not having achieved the total credits targeted at the beginning of the project. In addition, this 50% went on to the question: *which were the main reasons for loosing scores?* The results show that 76% of the responses pointed out management reasons, divided into a 19% noting **not fulfilment of criteria** in the **correct phase**, 21% arguing difficulties related to the **documentation** process and 36% declaring problems related with a **lack of engagement** from contractor, architect, etc. The 24% remaining gave other reasons.

Among these other reasons, once again, specific documentation problems and lack of engagement were the most relevant. Apart from those, there were also important management issues emphasized, such as: "to know **where** to **apply** each part", "**predicting** feasible certification paths", "**information** and credits **during construction**", etc. Consequently, in a way or another, management itself is clearly the problem.

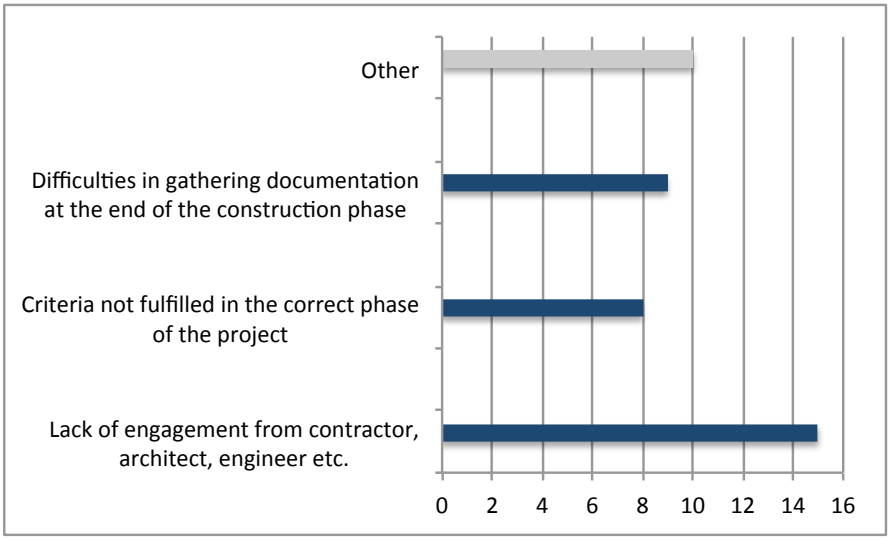

Fig. 4.3 Reasons for loosing scores

Another important aspect, as general overview of the certification process and its complexity, can be analysed from the answer to the question regarding the level of difficulty in the implementation of the certification process. As can be observed in the graph below, 60% of the respondents claimed that the certification process at least "took its time", in addition to that, 33% declared that the process resulted Hard, or Really Hard. This fact shows the real level of complexity of this process in its integration alongside projects.

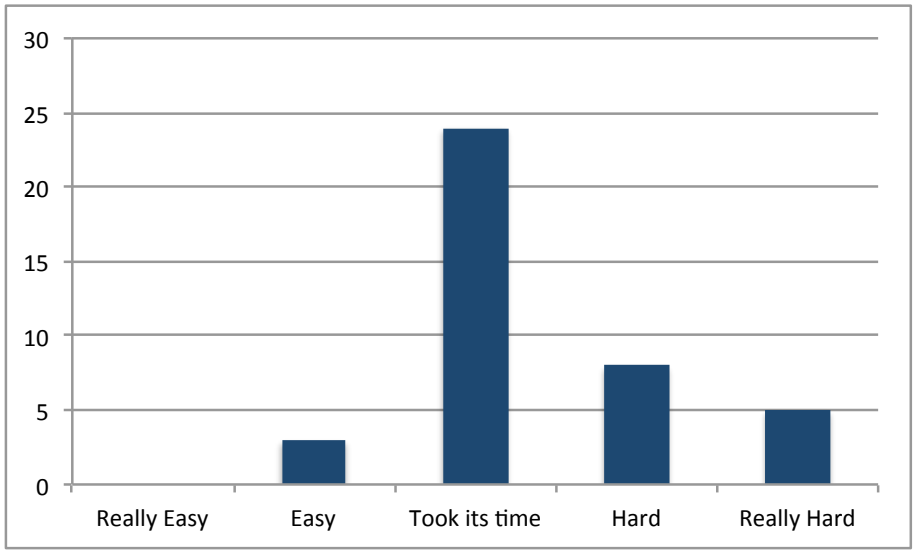

Fig. 4.4 Difficulty in the implementation of the certificate

4.3.2.1 Posed problem

As seen above, the implementation of the certification process is not a clear procedure so far. Many are the difficulties found within this process, and at this point, it is important to highlight some of them. It has been stated that there is a real need for **tracking** and **enhancing** the certification process, and that there are also problems linked to that activity (specially regarding software); at the same time, in some cases, the certification systems, and thus the process to implement them, are **not fully understood** by team participants (even PM's), fact that represents the level of **complexity** of these systems, pointed out by many experts. Adding to these facts the **scheduling** and **documentation** problems, results in a mix that raises the issue concerning **clarity** of **objectives** and **follow-through** mentioned before. As end point to this part, one of the responses from the survey, already stated, could summarize the aforementioned problems in "to **know where** to **apply** each part".

With this concept in mind, the question that appears is clear: When should every criterion be implemented alongside the project life? The final implementation of these criteria will determine the real accomplishment of the certification process successfully. At this point is where the labour of the Project Manager represents a decisive task, as its proper fulfilment will result in a successful certification. The answer from S.L (LEED Expert) to this matter resulted in the development in their company of a "customized" certification process, with milestones and deadlines. This development was done for the specific conditions of this firm, and under their experience. It is for this reason, that a generic study of the different phases and the criteria to be applied in each phase is needed. For this, a time study of these criteria with regards to the service phases according to HOAI will be conducted in order to determine the "deadlines" for their real implementation during the project, and consequently, the milestones where attention must be increased so as to obtain a successful result.

As for the criteria to be used, and taking into account the focus of the report on the German sector, the results of the comparison and the market penetration among BREEAM, LEED and DGNB will determine the one to use, in order to develop the study with the most representative certificate in Germany.

4.4 Problem Definition Summary

To finish this phase, a summary of the problems to be tackled in the next chapter is presented in the following lines:

4.4.1 Existence of different certificates

The existence of three different options as certification systems inside Germany may conduct to confusion among investors; moreover the international profile of LEED, the adaptation to the German market of BREEAM and the origins in Germany of DGNB create new situation in the market, with the need of a new comparison between these systems. In addition to that, a market penetration will also be conducted in order to analyse the acceptance of the assessment methods in Germany.

4.4.2 Project Management & Certifications

It has been already stated that the implementation of the certification process is still not a clear procedure. The level of complexity of this process, together with the need for clarity in the objectives, with the schedule as main point of attention, drives this report to the need of the development of a time study in order to determine deadlines and milestones for the different actions to be carried out in the correct moment.

At the same time, the role of the Project Manager will also be considered, as there are many possibilities to manage the integration of certification systems in a project.

CHAPTER 5 Systems Comparison

The comparison of these three systems starts with a general overview of the main differences with regards to their origins. It is clear that BREEAM, the first to appear, established the basis for the development of the other systems. The later appearance of LEED and many other systems has given DGNB the opportunity to learn from them, including some new aspects that resulted in considering the German system as a "second generation" certificate.

5.1 The process

The steps to be followed in order to achieve the certification are more or less the same for the three systems. Basically it could be summarized in:

- Registration
- Pre-certificate (optional)
- Assessment after construction
- Award of the certificate

The main difference that must be highlighted in the process, from a general point of view, is the inclusion of an accredited professional from the certification system. Both in BREEAM and DGNB, this figure is compulsory in order to achieve the certificate, as they are the professionals in charge of gathering all the documentation and in the final stage, of assessing the building according to this documentation.

On the other hand, LEED states that the collaboration of these professionals is not compulsory, but optional. In this case, extra "points" are awarded if finally an accredited professional from LEED takes part in the project.

5.2 The assessment

As mentioned above, an accredited professional carries out the assessment of the building, both in BREEAM and DGNB. After the assessment, the documentation is sent (by this professional and only by him) and further revised by a special body inside each organization, in charge of assuring the quality of the assessment.

In contrast, the LEED process in this respect is quicker (and may be easier), as the owner himself can prepare all the documentation needed and send it directly to the GBCI, which has also the peculiarity of being an independent organization from the USGBC, fact that should add independence to the results and thus, quality.

5.3 The content

This is probably the most important part in the comparison of the systems, as it is where all the areas covered by each certificate can be analysed. As it was shown in Chapter 3: Systems Description, each certification system has a wide variety of schemes to be applied, dependent on the typology of building.

For this reason, in order to proceed with a coherent order, the comparison of the systems will be based on the assumption of an offices building. In accordance to this

		DGNB New Office and administration buildings (2010)		BREEAM International New Construction (2013)		LEED New Construction and Major Renovations (2009)	
Ecology	Control of emissions/pollutants	LIFE CYCLE ASSESSMENT	7,88%	Mat01/ Pol01 / Pol02	11,75%	EAp3/EAc4	1,82%
	Use of materials & resources	08	1,10%	MATERIALS	5,17%	MATERIALS & RESOURCES	10,91%
	Waste management	48	0,87%	WASTE	6,82%	MRc2	1,82%
	Water use	14	2,25%	WATER *	6,69%	WATER EFFICIENCY	9,09%
Economy	Life Cycle Cost	16	13,50%	Man05	1,49%	NC	
	Suitability for conversion	17 / 28	9,00%	NC		NC	
Social, comfort & functional aspects	Safety in use	25	0,80%	Hea06	1,24%	NC	
	Handicapped accessibility	26	1,61%	Man04a	1,98%	NC	
	Geographic area influence	NC		NC		REGIONAL PRIORITY	3,64%
	Indoor air quality, thermal and visual comfort	18 / 19 / 20 / 22	8,84%	Hea01 / Hea02 / Hea03 / Pol04	9,18%	INDOOR ENVIRONMENTAL QUALITY	11,82%
	Acoustic comfort	21	0,80%	Hea05a	2,48%	NC	
	Controllability of systems	23	1,61%	NC		EQc6.1 / EQc6.2	1,82%
	Site efficiency	24 / 27 / 29 /	4,82%	NC		NC	
Technical aspects	Energy efficiency & Renewable energy	10 / 11	5,63%	ENERGY	17,27%	ENERGY & ATMOSPHERE	28,18%
	Fire & noise protection	33 / 34	9,00%	Pol05	0,51%	NC	
	Quality & maintenance	35 / 40 / 42	13,50%	NC		NC	
Architecture & innovation	Design aspects	31 / 32	3,21%	NC		NC	
	Innovation	NC		INNOVATION	9,09%	IDc1	5,45%
Management	Design management	43 / 44 / 45 / 46	4,78%	Man01	1,98%	NC	
	Construction management	49 / 50	2,17%	Man02 / Man03	3,47%	SSp1	-
	Commissioning	51	1,30%	Man01	0,99%	EAp1 / EAc3	1,82%
	Use of the building	47	0,87%	Man01	0,99%	NC	
Site features	Public Transportation & cyclist considerations	30 / 59		TRANSPORT	7,27%	SSc4.1 / SSc4.2 SSc4.3 / SSc4.4	10,91%
	Quality considerations	SITE QUALITY		LE01	2,73%	SSc1 / SSc2	5,45%
	Sustainable aspects related to site	06 / 15 **		LAND USE ***	8,89%	SSc3 / SSc5.1 / SSc5.2 SSc6.1 / SSc6.2 SSc7.1 / SSc7.2 / SSc8	7,27%

Table 5.1 Systems comparison

	Criteria Group
	Individual criterion
NC	Not Considered
%	Portion of the whole assessment

*It includes the criteria Hea04 “Water Quality”.
** It is placed in “Site features” as these criteria refer to site conditions. Although this, the credits are considered in “Ecology” in the calculation of general percentages presented in the table 5.2.
***It includes the criteria Pol 03 “Surface water run-off”

All the Criteria Groups for each system, including the individual criterion corresponding to the codes shown in the table can be found in the Appendix.

fact, the schemes to be compared will be DGNB: New Office and Administration Buildings 2010, BREEAM: International New Construction 2013 and LEED: New Construction and Major Renovations 2009. The reason for not choosing the adaptation of BREEAM DE (Deutschland) is that it is a scheme still in progress.

Table 5.1 shows the contrast in the level of importance given to each area by each certificate. The performance of each certificate in the different areas defined can be achieved ether by a single criterion (represented by its correspondent code; all the codes can be found in the Appendix) or by a group of criteria. To show this, different colours have been used in the table, so that single criteria are represented by a light green, with its correspondent code and a group of criteria is represented by a dark green, with its correspondent name of group according to the certificate to which it belongs. In the cases where there are no criteria considering one of the areas, the red colour with NC (Not Considered) has ben used.

Apart from this, a percentage of importance in relation with the whole certification is provided, in order to distinguish the relevance of each area in each system.

Before continuing with the analysis of the results shown in Table 5.1, there is one consideration that has to be pointed out. This table has been created under the assumption of a general overview of the systems. Each one of the schemes to be compared in the table, respond to different standards, units, procedures, etc. for this reason, it is really difficult to end up in a precise comparison among the criteria covered by each certificate and their equivalence. As a result, it must be clear that the conclusions to be obtained from the table aim to give a general perspective of the performance of each certificate in relation with the other ones presented.

5.3.1 General remarks

In order to obtain this general perspective, and before entering into some further details, Table 5.2 shows as a summary, the performance of the different systems, with the percentages in each area considered.

	DGNB New Office and administration buildings (2010)	BREEAM International New Construction (2013)	LEED New Construction and Major Renovations (2009)
Ecology	17,74%	30,43%	23,64%
Economy	22,50%	1,49%	NC
Social, comfort & functional aspects	18,48%	14,89%	17,27%
Technical aspects	28,13%	17,78%	28,18%
Architecture & innovation	3,21%	9,09%	5,45%
Management	9,13%	7,44%	1,82%
Site features	NI	18,89%	23,64%

Table 5.2 General performace

NC: Not considered by the system.
NI: Not included in the general assessment, but considered as independent area.

The most important consideration to be made at this point is the fact that DGNB does not include “Site features” in its general assessment, but as an independent consideration. Moreover, BREEAM and LEED give a relatively high importance to these aspects, fact that responds to the high variances in the percentages shown among the different fields covered. To show these variances, Figures 5.1, 5.2 and 5.3 represent graphically the portion of the total assessment taken by each category in the three certificates.

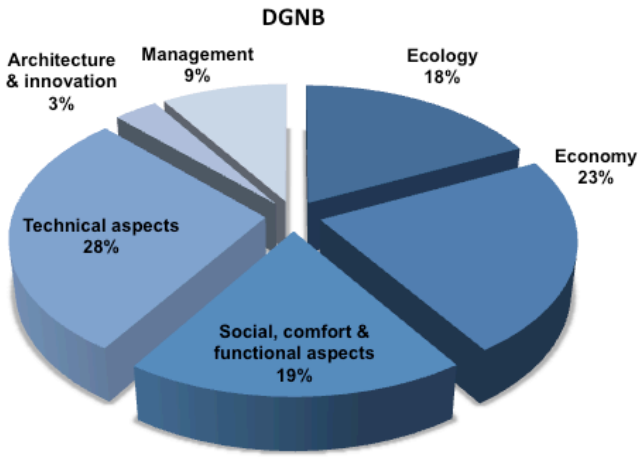

Fig. 5.1 Percentage of distribution of credits in the different areas in the DGNB Certificate

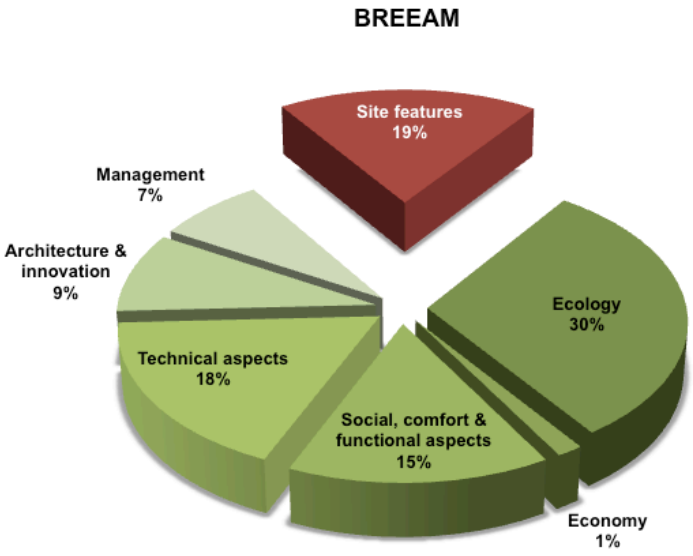

Fig. 5.2 Percentage of distribution of credits in the different areas in the BREEAM Certificate

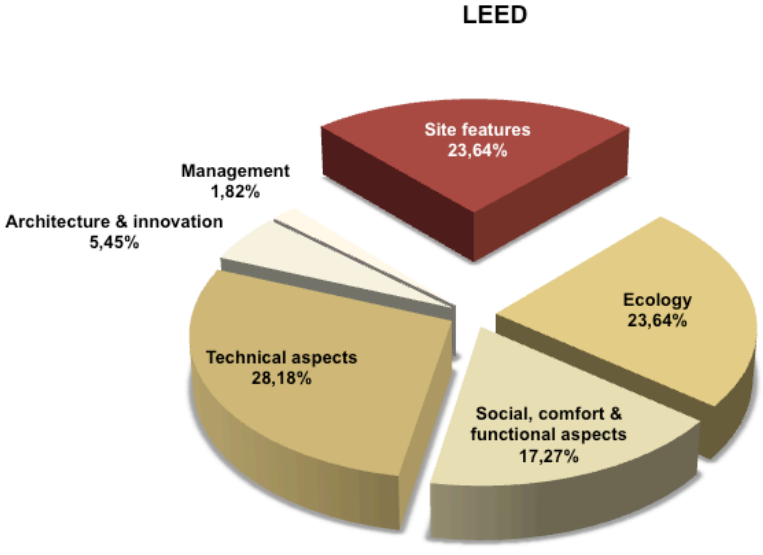

Fig. 5.3 Percentage of distribution of points in the different areas in the LEED Certificate

Some other points to be highlighted:

- There are no huge variances in the ecological area, although each one focuses on different aspects, in the end, the overall importance given to this matters is more or less equal among the three systems.
- Only DGNB considers the economical part with an important influence in the final certification level (up to a 22,5%). This version of BREEAM includes the consideration of Life Cycle Cost, with an importance of 1,49%. With regards to LEED, economical aspects are not considered in the assessment.
- In the field of Social, comfort & functional aspects the three certificates come again with similar percentages over the whole assessment (DGNB 19%, BREEAM 15% and LEED 17,27%).
- More attention is paid by DGNB and LEED to technical aspects, with almost the same importance (28,13% and 28,18%), slightly higher than BREEAM (17,78%).

5.3.2 Specific remarks

It is not the object to make a thorough analysis of the results obtained in Table 5.1; still, some aspects will be highlighted as important ones to be taken into account.

- Influence of the geographic area is considered as an aspect to award points only by the LEED certificate, with a general importance of 3,64% over its whole assessment.
- In the area of Technical Aspects, once again it can be observed how LEED and BREEAM go in the same direction whereas DGNB does not. The two first point out the relevance of the energy performance of buildings, 28,18% for LEED and 17,27% for BREEAM, which contrasts with the 5,63% of DGNB. On the other hand, Quality & Maintenance and Fire protection are not so important for BREEAM and LEED compared to DGNB that gives 13,5% and 9%(shared with noise protection) respectively.
- Innovation credits are only awarded by LEED and BREEAM. In contrast, DGNB considers the influence of Design in its assessment.

5.4 The weighting system

Two of the three systems implement a weighting system during the certification process, in order to reflect the different importance of some aspects compared to others. In the case of DGBN there is a so-called “Relevance Factor”, which ranges from 1 to 3 and is applied individually to each criterion.

For BREEAM, and in the scheme analysed, it is highlighted in the manual that the weighting factor (a percentage), in case of international assessments, will be developed for the first project to be assessed in each country, according to local conditions. This option provides the system with a specific focus, dependent on the particular conditions of the country where is used. In general, the weighting percentages for this certificate range from 6% (Water) to 19% (Energy); the same percentage is applied to all the criteria of the same criteria group.

LEED has ignored this consideration in its assessment, although it has a specific criteria related to the region where the building is located.

5.5 The Rating

The rating system adopted by these assessment methods is based on the same guidelines. There is a list of achievable points/credits that are awarded if the criteria considered are accomplished. The final marks are compared with the minimum points (LEED) or percentage of fulfilment (DGNB and BREEAM) in order to determine the final certification level achieved. Figure 5.4 shows the different levels required for each system and level. Note that in the case of LEED, the points have been adapted to a percentage value. Even so, this is an illustrative figure to show how the different levels are distributed in each system, and it must be clear that there is not a direct correspondence between rating levels in percentage of the three systems (an 80% of DGNB does not correspond to 80% of LEED or BREEAM) (Ebert et al., 2011).

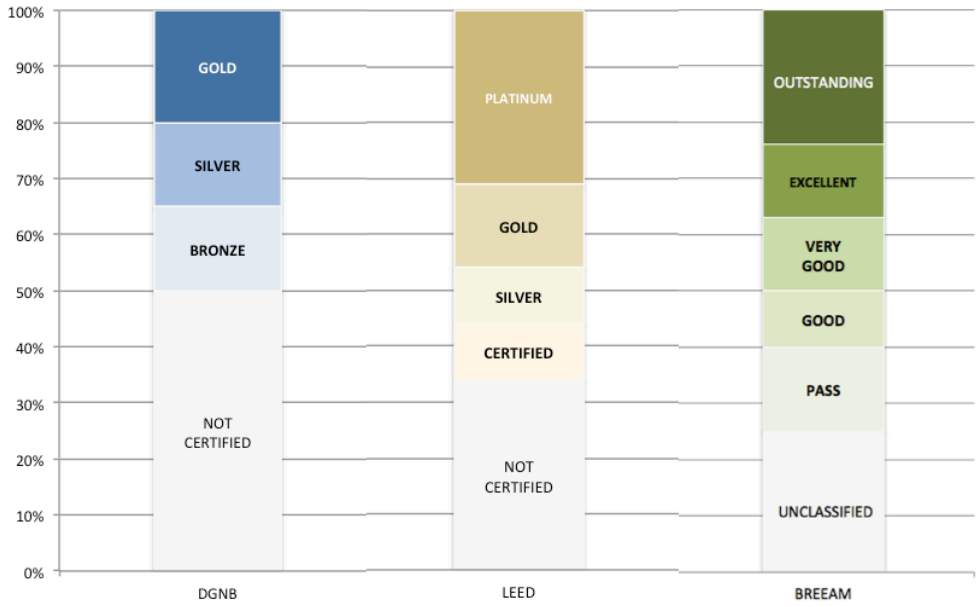

Fig. 5.4 Rating levels

Apart from the points/credits awarded, there is another concept to be taken into account, minimum requirements. The three systems establish as compulsory the accomplishment of certain criteria in order to achieve a certain level, although each one uses different methods to obtain this.

LEED establishes as compulsory the consideration of certain criteria in each criteria group, not awarding points for its achievement. “MRp1: Storage and collection of recyclables” and “WEp1: Water use reduction” are some examples of compulsory criteria, independently from the final level awarded.

In the case of BREEAM, a minimum of credits to be achieved in key standards is established, in order to guarantee the quality of the certification level awarded. As an example, in case of achieving an overall rating of “Excellent”, one credit must be accomplished, at least, in “Man01: Sustainable procurement”.

As for DGNB, the minimum performance is assessed based on minimum percentages in each “Quality section”. As a result, a minimum performance of 35% must be obtained in each one of the five categories of the system in order to gain a Bronze level, 50% for Silver and 65% for Gold.

Consequently, it can be observed that each system evaluates the minimum performance either from a general point of view, as DGNB, setting specific milestones

to be achieved in any case, as LEED, and finally establishing minimum requirements in certain criteria in the case of BREEAM.

In conclusion, the final rating is one of the points that may cause more conflict when comparing systems. On the one hand, LEED is not based on percentages, but on credits. In contrast, DGNB and BREEAM are both based on percentages, so confusion may appear when thinking that those percentages represent the same level of sustainability. Clearly, an 80% of fulfilment of BREEAM is not equivalent to an 80% in DGNB. The reasons have already been explained, and vary from the weighting system to the different standards followed by each assessment method. That is the main reason why it cannot be stated, from an objective point of view, if a "Silver" building from DGNB is equivalent to an "Excellent" from BREEAM, or even a "Gold" from LEED.

5.6 Market research

Finally, a market penetration research has been conducted, in order to determine the different acceptance of the certification systems analysed in the German sector. For this, a brief explanation in connection with the organizations of the sustainable labels is exposed, followed by the number of certifications according to these organizations.

5.6.1 BREEAM

With regards to the German territory, Difni (Deutsches Privates Institut für Nachhaltige Immobilienwirtschaft GmbH & Co. KG) is the National Scheme Operator of BRE in Germany, which is responsible for the adaptation of BREEAM International In-use to the so-called BREEAM DE Bestand. For this task, a special counsel was set with different relevant German stakeholders including relevant companies and independent consultants (BRE, 2013).

	BREEAM CERTIFICATE IN GERMANY					
	Outstandign	Excellent	Very Good	Good	Pass	TOTAL
BREEAM DE Bestand	0	4	12	18	2	36
BREEAM In-Use	0	1	3	31	11	46
Registered	38					

Table 5.3 Number of buildings BREEAM Certified or registered in Germany (Up to 15.02.2013)

As can be seen in table 5.3, according to Breeam DE (2013) 36 buildings have already been certified following this adaptation (BREEAM DE Bestand), whereas 46 have followed the procedure regarding BREEAM International In-Use. As future certifications, we can see that 38 projects have been registered and have entered the certification process. This numbers, give a total of 120 buildings all over Germany which have adopted the British certificate. Note that the buildings certified do not correspond to the scheme analysed (BREEAM International New Construction), as those buildings have only been certified in the scheme In-use (either with the adapted scheme or with the International one).

5.6.2 LEED

In the Leadership in Energy & Environmental Design procedure, its interest inside the German market has increased considerably since 2007, when the first building was LEED certified in this country. By the end of 2008 17 projects had already been registered. The strength of this label is its international applicability, specially considered by international companies, as it offers the possibility of creating a worldwide benchmark between buildings (Baumann et al., 2009)

	LEED CERTIFICATE IN GERMANY				
	Platinum	Gold	Silver	Certified	TOTAL
LEED	11	38	3	2	54
Registered	186				

Table 5.4 Number of buildings LEED Certified or registered in Germany (Up to 13.06.2013)

In this case, as shown in Table 5.4, and according to the USGBC (2013), there have been a total of 240 projects involved in the LEED Certification process until today (13.06.2013). It must be noticed that more than half of this buildings are actually immerse in the certification process nowadays.

As for the certification level, 11 buildings have received the maximum award of this certificate, Platinum. In the second level of awards, the gold certificate is the most reached by the buildings already certified in Germany by LEED, rising to 38 Gold Certified buildings. This contrasts with the 3 “Silver” and 2 “Certified” buildings, representing a minority in the LEED certification panorama of Germany (USGBC, 2013).

5.6.3 DGNB

In this case it could be assumed, even before carrying out the research, that the market penetration of the DGNB Certification system in Germany would be in major depth compared to both BREEAM and LEED. Being developed by the German Green Building Council together with the use of German standards and guidelines assures a perfect fit in this market.

	DGNB CERTIFICATE IN GERMANY			
	Gold	Silver	Bronze	TOTAL
DGNB CERTIFICATE	70	81	9	160
DGNB PRE-CERTIFICATE	80	112	8	200
Registered	308			

Table 5.5 Number of buildings DGNB Certified or registered in Germany (Up to 13.06.2013)

Table 5.5 shows the repercussion of the DGNB certificate in the building industry, presenting, as mentioned before, a higher launch in every aspect. With regards to buildings that already obtained their final certificate, a total of 70 constructions were awarded with the DGBN Gold certificate, more than 80 obtained the Silver level and only 9 of the total prevailed in the lowest certification.

The same projection of figures can be observed in the Pre-certification stage, where the DGNB Silver certificate is once more the most awarded. Nowadays there is almost the same amount of buildings registered as those that are in the middle of (or already finished) the certification process. The total figure of buildings connected to the DGNB certificate, as of today, rises to 668 projects (DGNB, 2013).

5.6.4 Discussion of Results

The total exposure of the described systems to the German market is shown in figures 5.5 and 5.6, where it can be observed the level of penetration of DGNB (%) compared to the other systems. There are many interpretations to these results.

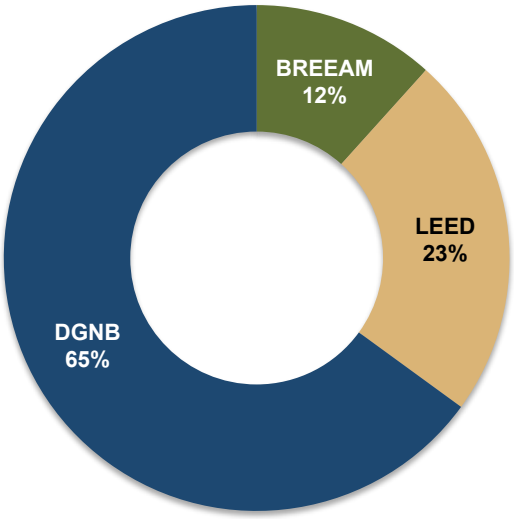

Fig. 5.5 Total number of projects linked to each certification system in Germany

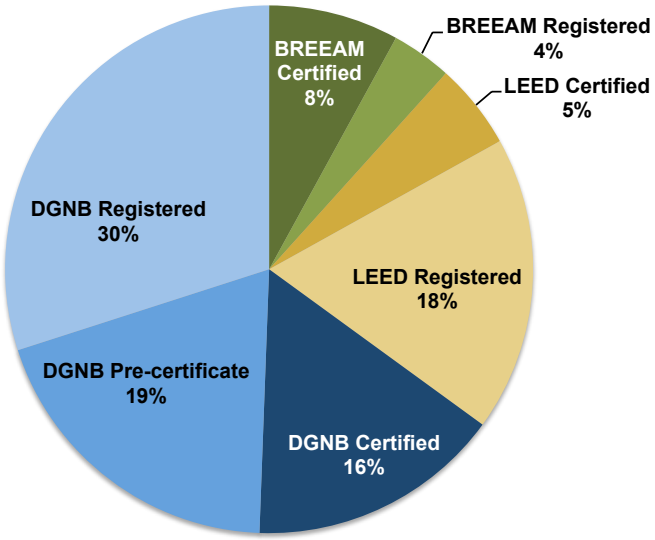

Fig. 5.6 Distribution of projects depending on the phase inside each certificate in Germany

First of all, being a German system represents a huge advantage compared to the other ones, although in the case of BREEAM, the recent development of a specific adaptation to Germany (BREEAM DE) may improve its future performance in this country. This advantage is basically based on the fact that DGNB is based on German standards, which results in an easier implementation and understanding by project team members.

Moreover, it has already been highlighted that the German certificate is a “Second Generation” class, which means that comprehends sustainability in a wider sense. Another important aspect to be considered is the “marketing effect” of being a German Certificate, which may suppose an important adding to all the aforementioned arguments in motivating these figures of performance of DGNB in the German market.

However, the simplicity of LEED, and the possibility of international direct comparison between buildings with this certificate, represent for it really valuable assets, that will probably lead to an important progression in the German market in a near future, fact that can be observed by the percentage of registered projects in the LEED Certificate (18%), much higher than those from BREEAM (4%).

5.7 Final remarks

In order to point out the main features characterizing these certificates, a SWOT analysis is presented in Table 5.6, aiming to draw attention to key points in each assessment method.

	DGNB	BREEAM	LEED
Strengths	- Second Generation - **Wider view of sustainability** - Economical considerations, LCC.	- **Most used globally** - More experienced - More adaptations worldwide	- **Ease of use** - No need of consultant/assessor
Weaknesses	- Complicated to implement	- Complicated to implement	- Does not consider aspects such as economy
Opportunities	- Good market penetration in Germany - International expansion	- Recent adaptation of BREEAM DE	- Can be implemented without adaptations -Fast market growth
Threats	- Simpler systems may result easier and thus have a better future	- Low penetration in the German market so far.	- Not updating the system to new trends (LCC)

Table 5.6 SWOT analysis of the certificates

As a summary, there are some aspects to remark from the different certificates. The strength of LEED, based on its simplicity compared to the other certificates presented, which makes of it a really attractive system. One of the key factors representing this simplicity is the fact that the owner himself can send the documentation to the GBCI and complete the process without any accredited professional. Apart from this, its international expansion is a reality, and it is partly due to the fact that it is conceived, although generally based on U.S. standards, as an international tool. Despite this, there are some aspects in which this certificate is behind BREEAM and DGNB, for example, the economic considerations in the form of Life Cycle Cost; aspect that will be probably be included in future versions of this tool, as the existence of different certificates not only creates confusion, but also improves the competence and improvement of the different systems.

BREEAM has the advantage of time, it was the first one to appear and thus is the most experienced (and most used globally). This can be observed by the multiple adaptations of this certificate existing all over the world; another important feature shown through its weighting system, for example, is the complexity of the certificate, which presents an advanced methodology with different weighting depending on the country, conditions, etc.

DGNB is a second-generation certificate, considering more aspects that the others, and as stated before, with a wider view of sustainability. It has been proved its success in the German sector, fact that represents the strength of this certificate. In addition to that, its international configuration assures at the same time good expectancies over its global expansion.

The market research has shown the performance of DGNB in the German sector, observing its high penetration in this market, as already stated. Taking this into account, and the fact that this certificate is more extensive, considering more aspects related to sustainability as a whole, represents the perfect framework to use this

certificate in the implementation of the next chapter. In this next stage, the integration of project management in the certification process will be analysed, paying special attention to the phases of the project, and the correspondence of these phases with the different actions to be implemented during the certification process.

CHAPTER 6 Project Management & Certifications

6.1 Integrating Project Management in the certification process

After the systems comparison, and taking into account the results obtained from that phase, it is time to proceed with the next stage in this report, the integration of project management in the certification process. As it was already outlined, the system used to develop this implementation part is DGNB (the scheme will be the same analysed in the comparison). The reasons are clear, and can be summarized in a few arguments:

- DGNB is the certificate most used in Germany (up to now), and thus, its influence in the construction sector among this country is bigger than the LEED and BREEAM.
- It is considered a second-generation certificate, fact that reflects its wider view of sustainability, considering new aspects inside this concept.
- The implementation of this certification process is complex and relatively new compared to the others.

In order to clarify this certification process, a study has been conducted so as to determine the most important phases alongside a project in what refers to the certificate. For this, each criterion considered by the assessment has been analysed, using the information provided by DGNB where the specific targets are defined (this catalogue can be found in the Appendix) and determining in which phase team members have to pay attention to them in order to succeed in achieving the available credits. Table 6.1 represents the results of the analysis graphically.

6.1.1 Previous considerations

There are some considerations that need to be pointed out, as they represent the basis upon which the study has been developed.

Firstly, the different phases of the project need to be highlighted. These phases should represent stages alongside a project life, dividing it in a way so as that the different steps reflect the interaction of all the professionals included in the process, considering also administrative tasks such as awarding contracts or permissions from authorities, as there are some criteria that are involved in those processes.

Taking this into consideration, and given that the focus of the report is the German sector, the phases proposed are those described by the DVP (Deutscher Verband der Projektmanager in der Immobilien und Bauwirtschaft) (2013), which is the German association of project managers in the real estate and construction industry, and have been subdivided into the stages proposed by the HOAI (Honorarordnung für Architekten und Ingenieure) as specified in section 15 (2013), where the different phases in which Architects and Engineers can take part during a project are represented. The final stages proposed are those observed in Table 6.1

Another important aspect is the type of project considered. As it was outlined previously, there is a determinant aspect of the project affecting the certification process, the delivery method. For the purpose of this report, and as main system used in the German sector, a Design-Bid-Build method will be considered.

CRITERIA GROUP	CRITERIA	Project Preparation	Planning	Construction preparation	Construction	Project completion
		Basic evaluation	Preliminary planning / Design / Planning permission	Execution drawings / Preparation of award contract / Participation in the awarding of contracts	Site supervision	Property Maintenance and documentation
Ecological quality*	01. Global warming potential					
	02. Ozone depletion potential					
	03. Photochemical ozone creation potential					
	04. Acidification potential					
	05. Eutrophication potential					
	06. Local environmental impact					
	08. Sustainable use of resources/ wood					
	10. Non-renewable primary energy demand					
	11. Total primary energy demand and share of renewable p. energy					
	14. Drinking water demand and waste water volume					
	15. Land-use.					
Economic quality	16. Building Life-cycle-costs					
	17. Suitability for third party use					
Sociocultural and functional quality	18. Thermal comfort in the winter					
	19. Thermal comfort in the summer					
	20. Indoor air quality					
	21. Acoustic comfort					
	22. Visual comfort					
	23. User influence of building operation					
	24. Quality of outdoor spaces					
	25. Safety and security					
	26. Handicapped accessibility					
	27. Efficient use of floor area					
	28. Suitability for conversion					
	29. Public access					
	30. Cycling convenience					
	31. Design & urban planning through competition					
	32. Integration of public art					

Pre-Certificate

Table 6.1 (I) Analysis of criteria and influence on project phases

	Starting point of criteria considerations in the project
	Developing phase of the criteria considerations in the project
	Finishing point of criteria considerations in the project
	Pre-certificate time-line

*The criteria missing in this section is currently under development, and not considered in the assessment of this scheme.

CRITERIA GROUP	CRITERIA	Project Preparation			Planning									Construction preparation									Construction			Project completion		
		Basic evaluation			Preliminary planning			Design			Planning permission			Execution drawings			Preparation of award contract			Participation in the awarding of contracts			Site supervision			Property Maintenance and documentation		
Technical quality*	33. Fire prevention																											
	34. Noise prevention																											
	35. Quality of building envelope's heat and humidity technology																											
	40. Ease of cleaning and maintenance																											
	42. Ease of dismantling and recycling																											
Process quality*	43. Comprehensive project definition																											
	44. Integrated planning																											
	45. Comprehensive building design																											
	46. Sustainability aspects in tender phase																											
	47. Documentation for facility management																											
	48. Environmental impact of construction site/process																											
	49. Prequalification of contractors																											
	50. Construction quality assurance																											
	51. Systematic commissioning																											
Site quality*	56. Site location risks																											
	57. Site location conditions																											
	58. Public image and social conditions																											
	59. Access to transportation																											
	60. Access to specific-use facilities																											
	61. Connections to utilities																											

Pre-Certificate

	Starting point of criteria considerations in the project
	Developing phase of the criteria considerations in the project
	Finishing point of criteria considerations in the project
	Pre-certificate time-line

Table 6.1 (II) Analysis of criteria and influence on project phases

*The criteria missing in this section are currently under development, and not considered in the assessment of this scheme.

6.1.2 Analysis of criteria and influence on project phases

Table 6.1 shows the results obtained after the analysis of the different criteria and their integration in the phases of the project. For this, a "Gantt Diagram" style has been adopted, with different bars indicating the length of the criteria considerations, when they start and when they end.

To represent these phases, start, development and end of each criterion, colours have been used in a graded scale. The most intensive ones highlight the beginning of the process, which aims to draw attention to the fact that in the indicated phase it is time to start taking into consideration the corresponding criterion. The next two colours in the scale represent the development, and ending part of these considerations. In the majority of cases, development is related to "monitoring" actions and ending to "documentation compilation", although this will be further analysed in "Discussion of results".

Notice that the table presents a red line at the end of "Planning" phase; this represents the last point in the time-line of the project to be able to receive the Pre-certificate. This fact will be commented on later.

To finish with the explanation of the working scheme of Table 6.1, highlight that the criteria missing in some of the Criteria Groups, fact that can be observed by the missing codes of the scheme (09, 12, and 13 in Ecological quality, for instance), are still in development phase and thus not considered in the assessment.

6.1.2.1 General remarks

There are relevant aspects to highlight while observing the final results of Table 6.1. In the criteria group "Ecological quality", it can be observed that the majority of the criteria have their start in the Planning phase, with high influence in the *Design* stage. In connection with the developing part, once again almost all of them have to be considered during the Construction preparation phase, finishing with the Construction phase. For the criteria inside "Economic quality", in general terms it could be said that they have a considerable influence alongside the whole project life.

Inside "Sociocultural and functional quality", almost all the criteria have a similar structure, with high relevance in the Planning phase (all of them "start" in this phase), and a divided development, between *Execution drawings* and *Site Supervision* and *Project Control & Documentation*.

Nonetheless, the shown tendency in the first three criteria groups, where as a general rule it could be said that criteria start in the Planning phase, are developed during Construction preparation phase and finish in the Construction phase, changes for the last three criteria groups. As a consequence, criteria in "Technical quality" present a higher relevance in the last phases of the project, with a majority starting in *Execution drawings* and finishing in *Project control and documentation.*

With regards to "Process quality", it can be observed the actual involvement of this criteria group in the whole project, from the very beginning to the last steps. This involvement is developed gradually, with some criteria taking care of the first stages and others focusing on the finishing steps of the project.

Finally, "Site quality" has an exclusive focus on site features, and has no influence on the building. To represent this, all the criteria considered have to be taken into account during Project preparation phase, which means, at the moment of deciding the actual spot to develop the project. As a remark, although it has been already mentioned, site assessment is an independent category and is not considered in the global assessment of the building.

As a summary, the influence of the certification process alongside the project life can be observed in Figure 6.1. There, it is represented the work load with regards to the certification process, and can be observed the phases in which most of the criteria start their influence (mostly in the Planning phase) and mainly, where there are more criteria to be considered at the same time (Accumulated criteria, mostly in *Design, Execution drawings* and *Site supervision*).

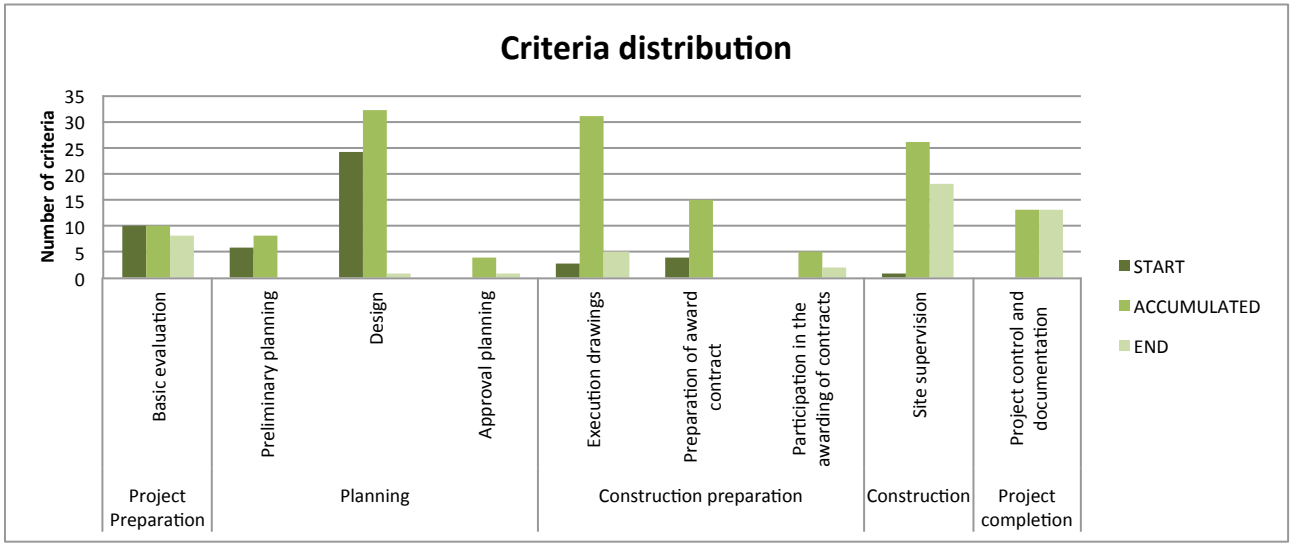

Fig. 6.1 General distribution of criteria alongside the project life

Nevertheless, there is a final remark that must be outlined, as it determines "qualitatively" the influence of the criteria alongside the project, depending on the phases. The red line that can be found at the end of the Planning phase in Table 6.1, defines the limit where decisions have to be made in order to obtain the pre-certificate as mentioned before.

As a result, there is a boundary for two acts: Decisions to be made and monitoring the implementation of those decisions. According to this, those criteria that started before this line will be divided into these two steps. Before this red line, all the considerations made about criteria starting after it are based upon a "planned decisions" stage. This one represents also a really important step in the process, as it happens at the same time that "Decision making" of other criteria; as a result, actually there is a greater amount of work that the one illustrated in Figure 6.1 during the Planning phase, as that graph does not consider the influence of this "Planned Decisions" in this phase. This fact represents once again the complexity of the certification, and the real need for a management analysis of the certification process like the one presented in order to foresee these situations. This process can be seen graphically in Figure 6.2.

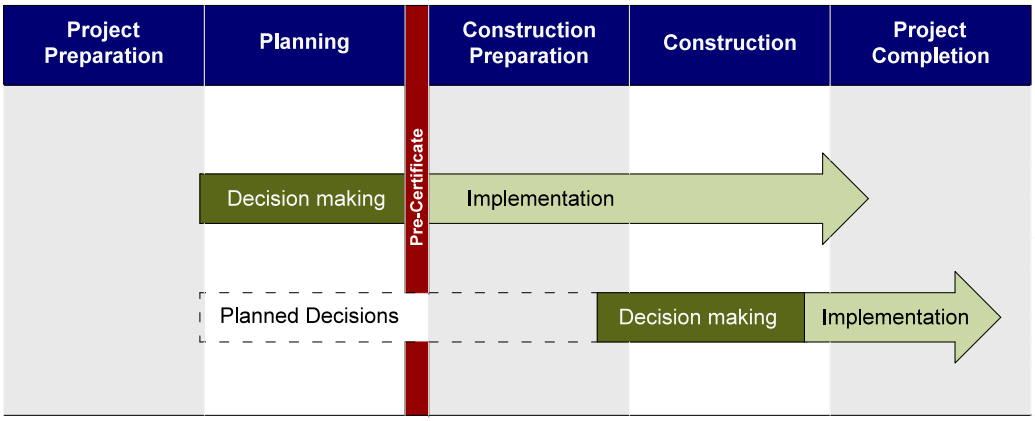

Fig. 6.2 Influence of Pre-certification in the criteria

It must be outlined that the Pre-certification is not a compulsory step in DGNB; although this, it should be considered as a compulsory step by team members due to the fact that its implementation improves the planning side of the certification process.

6.1.2.2 Specific remarks

Apart from the general remarks already mentioned, there are some spots in the analysis included in Table 6.1 that must be outlined. For instance, without considering the criteria included in "Site quality", there is only two criteria whose performance alongside the project starts and ends in one stage. These criteria are "Design & urban planning through competition" and "Comprehensive project definition"; and are involved in the early stages of the project, more precisely in *Basic evaluation.* This represents the need for taking into account the requirements of these criteria from the very beginning, in order to succeed in achieving the available credits for them. Actually, this situation reflects the importance of the first stages of the project, where many things have to be taken into account really early so as to start an organized process towards a successful accomplishment of the certification.

With regards to the criterion "Integration of public art", the table shows only a start point during *Design*, whereas its development and end are represented at the end, in *Project control and documentation*. This means that this criterion should be considered as a concept during the Design stage, although its real conception will be implemented in the last stages of the project.

As a final consideration in this part, only four criteria have been considered to have an influence during *Approval planning*, reason why there is an almost constant break in the "time-bars" of the criteria in this stage. A similar situation can be observed in *Participation in the awarding of contracts*. This fact has two points of view; on the one hand it represents the main focus of the certification system on the project itself, this

means focus on tangible targets. On the other hand, the perspective may be that the certificate includes an assessment over every aspect of the project, including those related to bureaucracy.

6.1.3 Managing the process

From the management point of view, each criterion should be dealt with as an individual process with different stages. Those stages are defined according to the "deadline" established by the Pre-certificate, so that different steps can be found:

- Before the Pre-Certificate "deadline": Starting point of the criterion and planned decisions if the criterion starts after this time spot.
- After the Pre-Certificate "deadline": Development & ending of the criterion

From the point of view of the team member responsible of the certification process (the project manager, central to the process or not), he will have to make sure that in each step, the process runs fluently and the correspondent stakeholders develop the different tasks properly.

In "Starting point" of the criterion, all the decisions with regards to the requirements of the certificate will be made. This is the key point where, having clear the targets, it is time to establish how to accomplish them, responsibilities and tasks linked to the criterion itself will be delivered and documentation will start being generated in order to support the decisions made.

The "Development" part of the criterion, generally after the Pre-certificate point, will basically act as a follow-through task, which will be based on monitoring the implementation of the decisions made and gathering documentation as it is produced.

As final step, compiling all the documentation to provide evidence will be done during the "ending" phase of the criterion. This documentation will be then assessed by the Accredited professional from DGNB in order to determine the level of the final certificate.

6.2 Role of Project Manager

It is time now to tackle the question in relation with the role of the project manager with regards to the certification process. In *6.1 Integrating project management in the certification process,* the different stages where each criterion should be applied and taken into account were defined. With this, it can be observed objectively the amount of tasks that happen at the same time during a project, with a special attention to the busiest phase, the *Planning*. As a result, figure 6.3 shows the distribution of these tasks, focusing on their starting point.

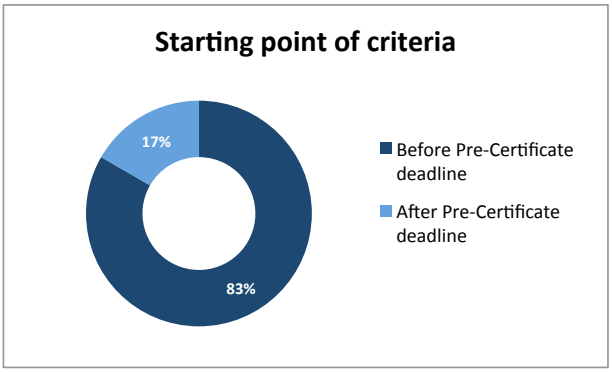

Fig. 6.3 Distribution of criteria according to their starting point

The graph shows that 83% of the criteria have their start before the Pre-certificate deadline, which means in the early stages of the project and mainly in the Planning phase. This percentage gives an idea of the amount of work to add to the normal tasks of a project manager (in case he

is the one in charge of dealing with the certification process), who will have to deal additionally to those described in *6.1.3 Managing the process.* It also shows the critical point that the planning phase represents for the purposes of the certification, as all the decisions made in this phase (and more importantly, those that are not made), will determine the final success of the certificate.

6.2.1 The actual involvement of Project Managers

In order to determine the actual involvement of Project Managers in the certification process, some questions were introduced in the survey carried out during the research phase, so as to obtain a general idea of the real involvement of this figure.

Analysing the responses obtained, to the question: *How would you evaluate the level of implication of the Project Manager in the certification process?* 53,85% of the responses gave a positive response with regards to their professional experience. One of the answers, outlined the importance of the Project Manager and his "capability of organizing and distributing tasks and also of collecting and delivering information through proper channels and **in time**, avoiding extra costs and **organization issues** which could put in danger the certification". On the other hand, 25,64% claimed that the involvement of the Project Manager in their cases was not satisfactory (the other 20,51% gave other responses, non determinant for this analysis). As an example, one of the negative responses claimed: "Since I was a separate consultant on the team, the Project Manager assumed I would manage the process, but without a Project Manager managing the process, it was hard to get team members to meet deadlines/prepare documentation. Project Managers should take on more responsibility in certification process".

Both answers show firstly, the importance of the figure of the Project Manager managing this process and secondly, the importance of defining each team member's responsibilities from the very beginning.

As a further step in this analysis, to the question: *Do you think that the role of the Project Manager in the certification process is determinant for its success? Why?* 68,42% of the responses were positive with regards to the question, whereas 31,58% were negative.

Examples of positive responses to the questions claimed: "The project Manager is crucial in the success of certification schemes as they hold the overall responsibility for driving the project. It is the project team's responsibility to achieve certification not the assessors", "The Project Manager should ensure that the certificate is an integral part of the progress of design and construction. This should be done by ensuring it is included in the design and construction programmes and that all design and progress meetings include a section and report on the certificate" or "The Project Manager is the one that gets the job done. All other consultants are just filling in the gaps. If the Project Manager fails to foresee the future, no one else will".

On the other hand, one of the negative responses explained that "Project Managers are useful in marshalling the team to a certain extent, however, most do not understand the certification process fully and end up simply being a conduit through which evidence is funnelled" other claimed: "No, they can chase evidence now and again but Certificates are such a low priority and they have so many other balls to keep in the air that they prefer not to gel involved".

6.2.2 The Project Manager central to the process

Up to now, there have been many different ideas analysed, which point out towards the figure in charge of the process. It is clear that this figure should have the abilities of a Project Manager (organization, delivering responsibilities, involving stakeholders, etc), his responsibilities with regards to the certification process clearly defined, and a deep knowledge of the various steps and milestones included in this certification process.

Moreover, as it has been already mentioned, the tasks to be performed by this figure represent a considerable amount of work, especially at the beginning of the project, where his participation and mediation are critical. For this reason, in the classical approach, Project Managers may find difficult to handle this new process due to their lack of knowledge or to an excess of work to deal with (or even both).

As a result, the desired figure to carry out this process control should be a Project Manager **central** to the process of certification, being fully responsible of the overall **control** of the certification, and with a direct connection and cooperation at the same time with the general Project Manager and the owner.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

After the analysis of the different certificates, the main features of each certificate have been explained, stating clearly differences, weaknesses and strengths of each system in order to assist investors and stakeholders in understanding these assessment methods. There are two main differences to highlight from the content of the three systems, the economic aspects and site features. These areas are handled in each certificate from a different perspective, and represent the higher variations in the view of sustainability of each system.

Apart from this, there are other relevant differences such as the weighting system, which is not existing in LEED and different between DGNB and BREEAM, and the rating system, for which it is important to remark the fact that the final certificate achieved by a building is not equivalent in percentage between systems (and 80% in LEED is not equivalent to an 80% in BREEAM or DGNB).

In order to culminate the conclusions of this part, it is important to make a final reference to the survey carried out. Figure 7.1 shows the results to the question *Why was the building certified?* Although the answer could have been figured out, it is important to state with numbers the real reasons behind the certification, among which the majority pointed out marketing purposes.

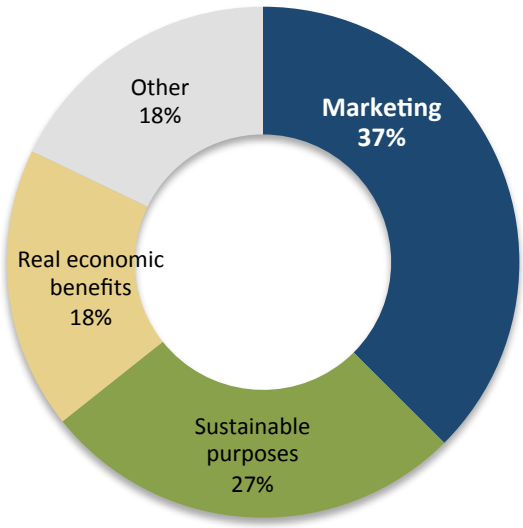

Fig.C.1 Reasons for certificate according to the survey

In connection with that, it can be assumed that the strength of a certificate will be based, basically on its sustainability aspects, but also strongly affected by its easiness of use. In this case, LEED certificate has a promising future not only in Germany, but in general all over the world, thanks to its simplicity compared to the other systems as already outlined in this report.

Although this, the new certificates such as DGNB hold the advantage of a wider view of sustainability, especially considering economical aspects. As a consequence, it is easy to imagine a scenario where the success of the German certificate is propelled by the analysis, organization and simplification of the implementation process of DGNB.

With regards to that scenario, the complexity shown by the certification process was the driver motivating the implementation of the second part of the report. The analysis of the different phases carried out, tries to simplify the process, fixing tangible milestones and stages where the amount of work is defined and consequently can be managed and distributed in a better way. This complexity is in this way measurable and outlines the importance of the certification process with regards to its involvement in the whole project.

Moreover, and as stated by many professionals through the interviews and surveys carried out, there is a need for a clear process with a defined professional who masters its implementation and at the same time holds the abilities typically addressed to Project Managers in order to fulfil the task of integrating project management into it as mentioned before. As a result, it has been determined that a Project Manager central to the process is the best option towards an efficient implementation of the certification and consequently, a successful result. This figure will be exclusively in charge of the certification process and directly linked to the general Project Manager and the owner.

Recommendations

In order to conclude the report, there are a few recommendations to consider for further research. In the area of analysis of the different certificates, and the equivalence/transparency between them, it could be positive to conduct the assessment of the same building using the three systems. In this situation, the results could be comparable from an objective point of view, as the conditions of the building, project, area, etc. would be the same for the three certificates. Furthermore, one of the aspects that have not been analysed in the report, economic impact of the systems on the project, could be also developed in order to determine in an equal situation its real repercussion.

On the other hand, from the management perspective of the certification process, an analysis of the impact of the type of delivery method of the project could show interesting results, as the Integrated Design, where the involvement of the constructor company is accomplished in the early stages of the project, appears to be an incipient project methodology in the construction sector.

Moreover, a real implementation of the management distribution of the criteria proposed would help in clarifying possible mistakes derived from the theoretical assumptions that have conformed this report.

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APPENDICES

APPENDIX A: *BREEAM International New Construction 2013, List of Criteria*

APPENDIX B: *LEED New Construction And Major Renovations 2009, List of Criteria*

APPENDIX C: *DGNB New Office And Administration Buildings 2010, List of Criteria*

APPENDIX D: *Interview And Survey Questions*

APPENDIX A: BREEAM International New Construction 2013, List of Criteria

CRITERIA	CREDITS	
04 Management		
Man 01 Sustainable procurement	8	TOTAL 22
Man 02 Responsible construction practices	2	
Man 03 Construction site impacts	5	
Man 04a Stakeholder participation	4	
Man 05 Service life planning and life cycle cost	3	
05 Health and Wellbeing		
Hea 01 Visual comfort.	1	TOTAL 11
Hea 02 Indoor air quality	4	
Hea 03 Thermal comfort	2	
Hea 04 Water quality WITH WATER	1	
Hea 05a Acoustic performance	2	
Hea 06 Safe access	1	
Hea 07 Minimising the potential damage of natural hazards		
06 Energy		
Ene 01 Energy Efficiency	15	TOTAL 27
Ene 02(a) Energy monitoring	2	
Ene 03 External Lighting	1	
Ene 04 Low and zero carbon technologies	2	
Ene 05 Energy efficient cold storage	3	
Ene 06 Energy efficient transportation systems	2	
Ene 08 Provision of energy efficient equipment	2	
07 Transport		
Tra 01 Public transport accessibility	4	TOTAL 10
Tra 02 Proximity to amenities	1	
Tra 03a Alternative modes of transport	2	
Tra 04 Maximum car parking capacity	2	
Tra 05 Travel plan	1	

08 Water

Wat 01 Water consumption	5	TOTAL 9
Wat 02 Water monitoring	1	
Wat 03 Water leak detection and prevention	2	
Wat 04 Water efficient equipment	1	

09 Materials

Mat 01 Life cycle impacts	6	TOTAL 11
Mat 03 Responsible sourcing of materials	3	
Mat 04 Insulation	1	
Mat 05 Designing for robustness	1	

10 Waste

TOTAL 6

Wst 01 Construction waste management.	3
Wst 02 Recycled aggregates.	1
Wst 03a Operational waste	1
Wst 04 Speculative floor and ceiling finishes	1

11 Land Use

TOTAL 10

LE 01 Site selection	3
LE 02 Ecological value of site and protection of ecological features	2
LE 04 Enhancing site ecology	3
LE 05 Long term impact on biodiversity	2

12 Pollution

TOTAL 18

Pol 01 Impact of refrigerants	8
Pol 02 Emissions	3
Pol 03 Surface water run-off WITH LAND USE	5
Pol 04 Light pollution	1
Pol 05 Noise attenuation	1

13 Innovation

TOTAL 10

Inn 01 Innovation	10

APPENDIX B: LEED New Construction And Major Renovations 2009, List of Criteria

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

INTRODUCTION/OTHER		POSSIBLE: 6
IDc1	Innovation in design	5
IDc2	LEED Accredited Professional	1
Introduction/Other	Introduction/Other	

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 C: DGNB New Office And Administration Buildings 2010, List of Criteria

CRITERIA FOR CERTIFICATION

New office and administration buildings, version 2010

OVERVIEW OF 6 FIELDS AND 63 CRITERIA

Ecological quality

01 Global warming potential
02 Ozone depletion potential
03 Photochemical ozone creation potential
04 Acidification potential
05 Eutrophication potential
06 Local environmental impact
07 Other effects on the local environment*
08 Sustainable use of resources / wood
09 Microclimate*
10 Nonrenewable primary energy demand
11 Total primary energy demand and share of renewable primary energy
12 Other uses of nonrenewable resources*
13 Waste by category*
14 Drinking water demand and wastewater volume
15 Land-use

Economic quality

16 Building-related lifecycle costs
17 Suitability for third-party use

Sociocultural and functional quality

18 Thermal comfort in the winter
19 Thermal comfort in the summer
20 Indoor air quality
21 Acoustic comfort
22 Visual comfort
23 User influence on building operation
24 Quality of outdoor spaces
25 Safety and security
26 Handicapped accessibility
27 Efficient use of floor area

28 Suitability for conversion
29 Public access
30 Cycling convenience
31 Design and urban planning quality through competition
32 Integration of public art

Technical quality

33 Fire prevention
34 Noise protection
35 Building envelope quality
36 Building services' backup ability*
37 Building services' ease of use*
38 Building services' equipment quality*
39 Durability *
40 Ease of cleaning and maintenance
41 Resistance to hail, storms, and flooding*
42 Ease of dismantling and recycling

Process quality

43 Comprehensive project definition
44 Integrated planning
45 Comprehensive building design
46 Sustainability aspects in tender phase
47 Documentation for Facility Management
48 Environmental impact of construction site / construction process
49 Prequalification of contractors
50 Construction quality assurance
51 Systematic commissioning
52 Controlling*
53 Management*
54 Systematic inspection, maintenance, and servicing*
55 Qualification of operating personnel*

Site quality

56 Site location risks
57 Site location conditions
58 Public image and social conditions
59 Access to transportation
60 Access to specific-use facilities
61 Connections to utilities
62 Legal situation for planning*
63 Possibilities for expansion / reserves*

* The scientific principles for this criterion are currently being developed. Changes were not made in the guidelines for new office and administration buildings, version 2009.

** Accounted for separately; does not affect a building's overall appraisal.

APPENDIX D: Interview And Survey Questions

Survey Questions:

1. Certification system used (LEED, BREEAM, DGNB)
2. Why was the building certified?
3. Level of certification achieved.
4. Did the building achieve the total of credits targeted at the beginning of the project?
5. Which were the main reasons for loosing scores?
6. How difficult resulted the implementation of the certification process?
7. Which were the main difficulties found during this process?
8. How would you evaluate the level of implication of the Project Manager in the certification process?
9. Do you think that the role of the PM is determinant for the success of the certification process?

Interview questions

1. Do you think that project management can effectively optimize the certification process? Which are the main benefits of applying PM?
2. Which are the main problems that project managers have to face when dealing with the certification process?
3. From the project manager's point of view, which are the hardest steps to implement in order to obtain a certificate?
4. In certified projects that do not achieve high scores, is it because points were lost due to the fact that different criteria were not applied in their correspondent phase during the project? Do you think this fact represents a real issue in the certification process? Why?
5. Which is the real level of influence in a project of accredited consultants/auditors from Certification firms, especially when their involvement in the project is compulsory in order to obtain the certificate?
6. As a summary, how important do you think is the role of project managers in the certification process? Why?