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Assessment Tools of Sustainable Buildings Projects: A Review

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ABSTRACT

The construction industry is an important location to implement more environmentally conscious practices, and "Sustainable Buildings" play a crucial role in this quest. This industry is also an important site to execute these principles. The building industry is a significant place, so this is necessary. Since it has not been possible to do a large amount of research, it has not been possible to investigate the factors that inspire the market as well as the primary obstacles that stand in the way of the trend toward sustainable construction. The building industry in Iraq is currently in the process of transitioning to environmentally friendly practices, despite the fact that this change is presently underway.

In the context of this discussion, where the objective of the evaluation system is to conduct an analysis of three distinct areas: environmental and pollution concerns, economic factors, and social considerations, which include features such as the accessibility and quality of the assets.

The purpose of this research is to make a contribution to the existing body of information concerning the construction of environmentally friendly buildings in Iraq, throughout shedding light on the evaluation tools that are utilized to evaluate these kinds of construction, additionally, the research is being carried out with the intention of filling a gap that has been discovered in the existing collection of research.

1. Introduction

To examine the developing momentum of the sustainable building sector all over the world, comprehensive literature research had to be carried out first. The concepts of sustainability and green building are broken down into their parts to get started. These parts include an integrated design process, evaluation criteria, and strategies for putting sustainable practices into action [1].

The idea of "sustainability" has been gaining popularity ever since it was realized that "global warming" was a big problem to deal with. The initial definition of the word "sustainability" was developed in 1987 by the International Commission on Environment and Society [2].

The term "sustainability" in this context signifies the ability to fulfill current needs without jeopardizing the capacity of future generations to fulfill their own needs. The term "triple bottom line" denotes the objective of achieving a harmonious equilibrium between social and economic progress, together with environmental sustainability (Figure 1). This goal can be summarized as "achieving a win-win-win situation" [3]. This is the word that is used to represent the objective of reaching this equilibrium, and it is the word that is employed.

Since it became apparent that "global warming" was a significant issue, the concept of "Sustainability" has become increasingly. prevalent. The International Commission on Environment and Society established the first definition of the term "sustainability" in 1987 [4].

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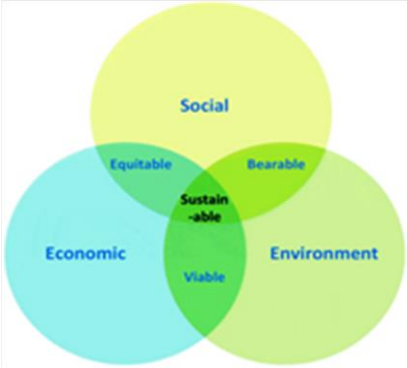

Figure 1. Sustainable Development [3]

According to this definition, "sustainability" is meeting the needs of the present generation without compromising the future generation's ability to meet their own needs. The objective of achieving a balance between social and economic progress as well as environmental sustainability is referred to as the "triple bottom line" (Figure 2). This is the word that is used to express the goal of achieving this equilibrium [4]. The topic of sustainable development was discussed concerning the construction of environmentally friendly buildings as part of the scope of this thesis. The design step, the construction step, the operational and service step, and finally, the destruction phase are the four key stages that a structure will go through in its lifetime.

As can be seen in Figure (2), sustainable building entails shifting away from processes that result in pollution and the consumption of non-renewable resources in favor of using resource-efficient ingredients and processes that are advantageous to the environment and society throughout the pre-building, building, and post-building stages of the construction process. This can be done to meet the requirements of sustainable building [5].

It is recommended that the building processes be evaluated at each of these three stages in order to gain a more comprehensive understanding of how the design, construction, operation, and disposal of a facility can impact the broader environment [6].

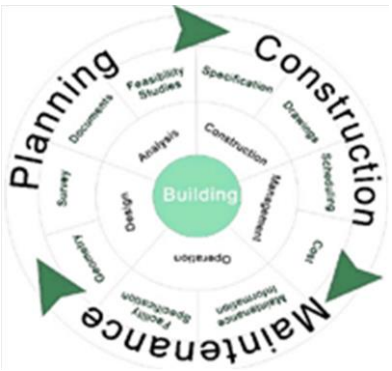

Figure 2. Life-Cycle of Sustainable Buildings [5]

Every project ends up with its own one-of-a-kind environmentally friendly solutions because every sustainable concept is constructed according to the specific needs of that project, which might vary greatly in terms of climatic conditions, geographic variables, environmental and social requirements, and the construction materials that are used. It is necessary to define the integrated design process to fulfill the description of sustainable construction [5].

It is vital to handle each of the sustainable construction strategies that are stated in the table that is placed above to produce a building that is sustainable in terms of the environment, the economy, and society. These approaches ought to be treated in a coordinated and unified fashion. The Integrated Development Process is a method that is used in the design phase to identify and address any issues that may have a big bearing on the project's long-term sustainable effectiveness [7].

This method is used to identify and address any issues that may have a substantial bearing on the project's long-term sustainable effectiveness. Utilizing an integrated design approach that promotes synergy between different fields of study and different technologies is one way to achieve substantial levels of building efficiency. This type of procedure can be seen in many modern construction practices. When coupled with a high-efficiency building envelope, such as stronger windows and greater insulation, reducing the size of the building's mechanical structure can be one approach to decrease expenses in this area [8].

During each stage of the design process, mechanical engineers, construction engineers, architects, and any other relevant professionals should work together to generate synergies and find additional options.

According to [7], every design decision must be based on a careful analysis of the costs and advantages associated with it. Integrated design, however, is about more than just getting everyone on the design team in the same room at the start of a project to agree on performance goals. It's also about creating a common vision for the work that needs to be done and enhancing the quality of connectivity and data used to notify it. Integrated design is about more than just getting everyone on the design team in the same room at the start of a project.

According to [9], the following are the most significant features of the integrated design methodology:

- Recruiting members for the design team who are interested in taking part in an innovative approach to the design and implementation of buildings.
- Establishing ambitious goals for the entire group and assessing their progress in light of those objectives.
- Bringing the group to the point where they have no costs.
- Include "thinking" time, such as charrettes, research, and other comparable activities at the beginning of the design process.
- Make sure that there is sufficient time for input and modifications before committing to the ultimate design conception.
- Include everyone in the project as much as possible.

For one to be able to comprehend the integrated design process, it is necessary to have previous knowledge of the traditional design process.

According to [8], the traditional method offers very few options for optimization, which frequently leads to problems in the later phases of the process. On the other hand, integrative design provides a wide variety of options for optimization from the very beginning of the design process, as can be seen in Figure (3). This can be considered an advantage of integrative design. Certification programs or grading tools, which are used to evaluate the performance of the building in question and to promote sustainable building practices and techniques, are another essential component of sustainable buildings. These programs and tools are also important features of sustainable buildings.

Figure 3. Possibilities for Design-Integrated Business-Defined [8]

These grading systems are continuously being enhanced with time in response to advancements in technology, expert knowledge, and trends in the industry. The acronym "BREEAM," which is an abbreviation for "Building Research Establishment's Environmental Assessment Method" was first introduced in the United Kingdom in the year 1990. Other examples of rating systems are "LEED," which was developed in the United States in 1998, and "CASBEE," which stands for "Comprehensive Assessment System for Building Environmental Efficiency", and was developed in Japan in 2001[9].

2. Sustainable Building at Construction Projects

It is indisputable that the sustainable construction movement is experiencing accelerated growth worldwide. The concepts of Sustainable Building or Sustainable Methods have a significant historical background, originating from a response to both environmental conservation efforts and an energy crisis. The physical environment of Iraq

is currently undergoing a rapid process of change, which can be attributed to various factors. One notable outcome of this transformation is the increasing interest in the development of environmentally friendly structures. Numerous principles associated with the phrase sustainable building have been previously examined and implemented in construction projects, considering the prevailing design perspective of the present day. The origins of these beliefs can be traced back to a time well before the year 5000, indicating a substantial historical precedence. The comparative analysis of conventional and modern houses was conducted as part of a research study aimed at exploring strategies for developing energy-efficient structures in a hot and arid region of Iraq [10].

The design standards encompass several key principles, namely the selection of site, inter-building spacing, alignment, building envelope, and shape. Based on the results of the investigation, it is evident that historic dwellings exhibit lower average temperatures throughout the hot summer period in comparison to modern homes [10].

2.1 Rating System of Sustainable Building

The objective of the total quality assessment system, also known as "TQA", is to evaluate three distinct aspects: environmental and energy pollution considerations; investment economic reasons and equity; and social demands, such as the accessibility and quality of the places. The goal of the system is to create a comprehensive framework for the environmentally responsible construction of buildings. In addition, the term "TQA" refers to multi-criteria assessment systems [11].

The "Building Research Establishment Environmental Assessment Method" (BREEAM), which was created in the United Kingdom, the "Leadership in Energy and Environmental Design" (LEED), which was created in the United States, the "Comprehensive Assessment System for Built Environment Efficiency" (CASBEE), which was created in Japan, the "Sustainable Building Tool" (SBTool), and the "Green Building Index" (GBI), which was created in Malaysia, Hong Kong, and other Asian countries are all examples of multi-criterion systems [11]. The "Building Environmental Assessment Method" (BEAM), which was created in Hong Kong, the "Australian Building Greenhouse Rating" (ABGR), the "Green Home Evaluation Manual" (GHEM) of the Chinese Three Star, the "United States Assessment and the Rating System" (STARS), and the "South African Sustainable Building Assessment Tool" (SBAT) [12].

Multi-criterion frameworks are what help to help quantify how sustainable a building is; while frameworks help to identify sustainable construction requirements, multi-criterion frameworks are what help to help quantify how sustainable a building is. while frameworks help to identify sustainable construction requirements, multi-criterion frameworks are what help quantify how sustainable a building is. In the evaluation, there are a total number of points up for grabs, and each strategy is worth a different amount of those points. When it comes to sustainability, total quality assurance (TQA) is the collection of findings that result from analyzing the factors [13].

It also adds that the system's summing process is crucial because it assigns rankings to components that have been positively evaluated. It is generally intelligible and may be executed in steps for each criterion, which enables a building to be evaluated at different stages from design to design and over the entirety of the construction as accurately as possible [13].

According to [14], the three basic categories of multi-criteria that should be considered are metrics, assessment frameworks, and evaluation of research instruments. The most prevalent kind of multi-criteria is measurement, sometimes known as metrics. Evaluation frameworks can be thought of as models of evaluation that are interrelated to one another and standardized. These models provide a set of tools that can be utilized in the process of contrasting a variety of various project options. These instruments can be classified as either reduction tools or non-reduction tools, according to [14].

The evaluation of research tools helps analyze and provide prospective solutions for common challenges encountered throughout the construction of a residential structure. These simplistic methods involving non-reductionist instruments involve a multi-criteria analysis that involves partly subjective analytical equivalents [12].

A cost-benefit analysis was used to assess output by minimizing the challenging structure according to fewer variables and combining its properties. This allowed for fewer variables to be taken into account when evaluating the output [12].

According to [14], performance indicators are used to determine whether or not a building is environmentally sustainable. These indicators include the Ecological Level (such as the Environmental Impact), the Building Level (such as Zero Energy), and the "Building Environmental Level".

2.2 Designing the Sustainable Building Assessment Tools

There are more than 600 different types of sustainability assessment systems that can be found all over the world; however, according to [15], none of these types of evaluation systems will be successful if they are used in countries in which they were not originally designed to function. Because of the people for whom it is being made, each instrument has to be adapted specifically to take into account the climate of the area in which it will be used. When attempting to achieve sustainability, it is frequently necessary to provide comparisons of actual individual projects that have been examined by each technique. This sort of direct evaluation of the rating categories present inside each system is not only difficult but also expensive to carry out.

According to [16], the frameworks of sustainability evaluations can range anywhere from an overall energy efficiency assessment to a performance evaluation that considers multiple dimensions. Therefore, the viability of the building ought to be reviewed for every sub-element, including the services, the system structure, and the construction as a whole; consequently, the requirement for various evaluation and ranking tools has to be evaluated.

These differences between systems have, as a result of the implementation of the Sustainable Building Alliance, led to the formation of common assessment categories and an improvement in the systems' ability to be compared to one another [16].

In light of the life cycle assessment (LCA), the United States National Institute of Standards and Technology (NIST) analyzed the LEED system. As a result of their findings, the LEED system's constrained scientific marker system, which is not a legitimate sustainability evaluation regulation, was discontinued [17].

LEED is constantly being improved to further expand the building's capacity for reducing its impact on the environment. The LEED-NC rating system is currently in use for the design of homes as well as the construction of new structures such as schools, dwellings, hospitals, data centers, and warehouses, among other types of facilities. Additionally, there are LEEDs available for external plans, LEEDs that may be applied to existing structures, and LEEDs that can be applied to new property improvement projects [18].

BREEAM has developed over the years, where the (BREEAM-NC), a guide with more than 400 pages that may be used for urban, private, residential, and industrial structures, including construction modifications, was initially published on a BREEAM 20 pages long and deals with a variety of issues [18].

This guide may be utilized for urban, private, residential, and industrial structures, including construction modifications. The BREEAM is suitable for use in existing non-residential facilities, as well as in BREEAM communities designed for the sustainable design of new communities' master plans or redevelopment projects; the certification can also be used for the refurbishment of already-existing buildings as long as they meet the international renovation and fit-out technical requirements [19].

Nonetheless, it encourages the adaptation of these instruments in nations that have not yet built their resources, with a particular focus on environmentally responsible building practices.

3. Advancement of Criteria for Rating Sustainable Buildings

The past progression of sustainable building evaluation approaches around the world is depicted in Figure (4) below. Initially, such categorization was released in the year 1990 in the United Kingdom with the term BREEAM.

An increasing number of categorizations has started expanding in many nations with a range of techniques for rating sustainable buildings in line with the environment, economic capacity, and social capacity of the country in question [21].

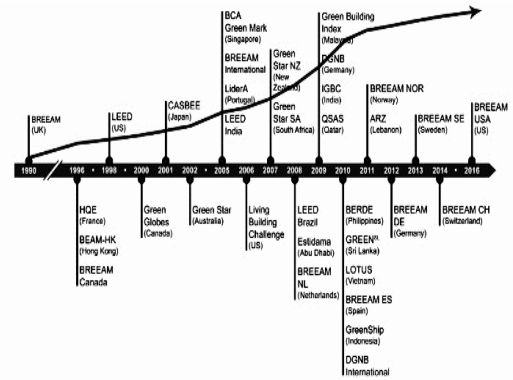

Figure 4. Advancement of Criteria for Rating Sustainable Buildings [21]

3.1 BREEAM

The Building Research Establishment Environmental Assessment Method, also known as "BREEAM", was developed by the "BRE" and served as a template for the design of sustainability evaluation instruments all over the world, like as the "Green Star" at Australia and the "HK-BEAM" at Hong Kong [22].

"BREEAM" is the largest environment in the globe evaluation and inspection framework for structures. Since 1990, it has been used in more than (425,000) facilities with BREEAM evaluation tools accredited, and about two million have been allowed for review. This framework is used in more than fifty nations [23].

"BREEAM" is an extensive system for the measurement and definition of buildings. Within this system, which is used to provide recommendations for the best practices in the construction sector, "BREEAM" has a broad framework, as shown in Figure (5) "BREEAM" evaluates the energy performance of buildings in the following locations [24]:

- Management: The regulation of general management, the oversight of site management, and matters of procedure.
- Energy: concerns over the environment and the cost of running energy.
- Pollution: taking into account both air and water contamination.
- Health and wellbeing: factors to consider for both indoor and outdoor health and wellbeing.
- Transport: carbon owing to transportation.
- Land use, as indicated by the green and brown areas of the region.
- Ecology: the preservation of the ecological advantage and the enhancement of the place.
- Materials: environmental impacts associated with the use of various construction materials.
- Water: the quantity and quality of water that is consumed.
- Innovation.

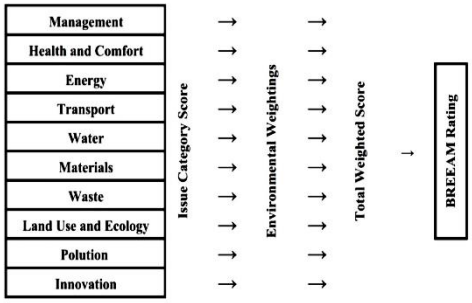

Figure 5. BREEAM Scoring Estimate of UK [24]

The "BREEAM" application requires an examination of the above categories in terms of practice and results, which allows for the award of credits in the 10 grades [24], a method to measure the "BREEAM" values of Great Britain.

Each category has its own unique set of prerequisites, which are outlined in Table (1), and the contributions can either be qualities or products derived from the aforementioned parameters. During the national advisory

process that was carried out in the UK [25], the weightings were developed. These characteristics are added up to produce a cumulative ranking that can be strong, very strong, or exceptional. The level of this ranking is determined by the cumulative total.

Table 1: Credits Weighting of BREEAM [25]

Criteria	Weightings %
Management	12
Health and Comfort	15
Energy	19
Transport	8
Water	6
Materials	12.5
Waste	7.5
Land Use and Ecology	10
Pollution	10
Innovation	10

3.2 DGNB

Means "German Sustainable Building Council" in its native language. The “DGNB” is a non-profit organization in Stuttgart which have been working to promote livable cities and structures since its inception in 2007. To put it simply, this means constructing our surroundings with forethought. To foster an appropriate awareness of quality as a basis for accountable and sustainable engagement in the building and estate industry is central to our mission [26].

In addition to its efforts in Germany, but also throughout the rest of worldwide, the “DGNB” works to advance environmentally responsible construction practices through several different means, including the following [26]:

- The “DGNB” has grown to become Europe's largest organization for sustainable construction thanks to the dedication and support of its about 2,000 participants.
- The different elements that define sustainable consideration, construction, and building management can be translated into practical implementation through qualifications of sustainable constructions, building the inside, and areas.
- Facilitating comprehension of the prerequisites for green construction by providing access to the “DGNB” Academy's offerings.
- By use of the “DGNB” Navigator, a web-based resource that provides details on a wide range of eco-friendly building materials.
- By engaging in R&D efforts, as well as encouraging a continuous awareness of the concerns concerning sustainability in the building industry, we may make strides forward in this area.

The DGNB's guiding principles are based on an all-encompassing view of sustainability that takes into account ecological, financial, and social considerations. Our end goal takes into account both the environment and the economy. Therefore, the DGNB views sustainability as being associated with high quality and long-term success [27].

By creating a system of accreditation that can be used as a planning and optimization tool to assist all parties engaged in the construction process in adopting holistic green effectiveness, the DGNB has made green construction more feasible, measurable, and equitable. Sustainable projects are assessed by using a battery of certification standards that are tailored to specific types of construction and design strategies, as shown in Figure (6).

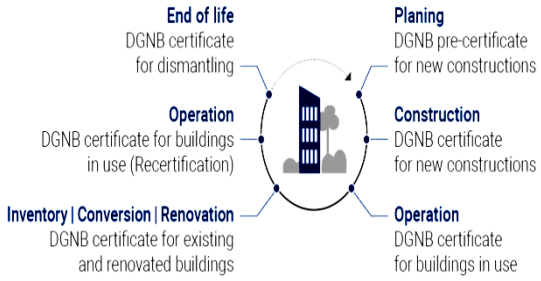

Figure 6. Process of DGNB [27]

3.3 LEED

According to [28], this was initiated in the year 1998 by the United States Green Building Council (USGBC), along with various other parties involved. Their goal was to stimulate demand for environmentally friendly structures. In terms of the US Green Building Council (USGBC), the Leadership in Energy and Environmental Design (LEED) rating system is the second most popularly utilized sustainability evaluation tool in the entire world.

There is a grand total of twenty thousand projects that have received certification. and registered under the "LEED" rating system. During the actual construction of the building, the members of the design team will be the ones in charge of determining how far along the "LEED" certification path their project has progressed without the assistance of specialized consultants. It has a strong basis in scientific research, and its use can be directly related to its demand [29].

The LEED evaluation consists of three stages, which are as follows:

- Pre-requirements: the criteria that need to be met before the proposal can be reviewed.
- Core qualities refer to the specific attributes for which recognition is given when the standards of the initial five criteria are met or surpassed.
- Innovation credits: performance credits that are now being provided; significant credits that have been distributed in the past.

According to [30] to offer a methodical and uncomplicated structure for assessing the overall performance of a construction and to achieve sustainable development goals, the "LEED" evaluation was created through a consistency process involving a key actor. The various sustainability classes are evenly weighted, different points are taken into account, and the credits allocated to each form are joined together. The construction sector was able to increase its abilities and understanding of SD with the use of these evaluation methodologies [31].

However, [32] suggest that the "BREEAM" evaluation range is greater and that its standards are harder to comply with the "LEED" criteria. This means that the "BREEAM" technique, in comparison to "LEED", is a lot more thorough method. The evaluation criteria are outlined in Table (2), which may be found here.

Table 2: Division of LEED Points [32]

Criteria	Attributes
Sustainable Location	26
Quality of Water	10
Environmental and Energy	35
Products and Materials	14
Interior Quality of Climate	15
Innovation	6
Regional Priority	4

3.4 GREEN STAR

Green Star is an assessment system that was first introduced in 2003 by the Sustainable Building Council of Australia. It has achieved global renown and is responsible for setting the standard for healthy, adaptable, and advantageous buildings and environments. The Green Star certification program has been tailored to suit the unique climate conditions of Australia. As a result, it has successfully granted certification to several environmentally conscious fit-outs, buildings, households, and communities across the country [33].

- Decreasing the negative effects of greenhouse gases.
- Improving both our health and the general standard of our lives.
- Rebuilding and conserving the ecosystems and uniqueness of our planet is a priority.
- Increasing the level of resilience in communities, constructions, and fitting.
- Creating a more sustainable industry and transforming the marketplace.

Additionally, there are four different Green Star assessment tools, and together they offer a way of certification for the planning and building of buildings, as well as for their operations, fitting, and societies. The "Sustainable Building Council of Australia (GBCA)" is responsible for the development of these tools, which are still undergoing further development despite having been created with extensive input from both the construction sector and government agencies as shown in Figure (7).

Figure 7. Performance of GREEN STAR [33]

3.5 SBTooL

The third party utilizes the framework for building efficiency assessment that is provided by the "SBTooL" concept. This allows the third party to develop evaluation systems for a variety of distinct geographical criteria and facility kinds. Additionally, the rating system toolbox may be something that is taken into consideration [34].

Before the results of the SBTool can be interpreted in any meaningful way, the primary focus of the tool is on the idea of tailoring a grading system to specific regional needs.

According to [35], the system has a typical structure that identifies local context conditions and establishes great weights and benchmarks in local non-commercial organizations.

The "SBTool" sustainable building approach was established as part of an international initiative to create a more environmentally friendly construction environment. This initiative involved the involvement of over 20 different governments.

[35], the tool has been designed so that countries can construct their local rating systems to correct local climate circumstances and languages. This has been made possible by the development of the technology. It is beneficial to users in a variety of areas and nations who are taking part in this evaluation process since it assists them in representing diverse goals, technologies, and cultural traditions and values[36].

Because of this, national groups can improve their standards and weightings by employing a variety of methodologies, such as the analytical hierarchy system, which is illustrated in Table (3) [37].

Table 3: SBTooL Environmental Credits [38]

Criteria	Weightings (%)
Location Choosing, and Project Managing	7.6
Energy and Products Utilization	21
Environmental Factors	25.2
Interior Quality of Climate	21
Quality of Services	15.1
Elements of Socioeconomic	5
Elements of cultural and behavioral	5

3.6 HQE

It is a benchmark for green construction everywhere; it also takes into account local considerations that may vary from nation to nation or even municipality to municipality. The worldwide building environmental evaluation methodology incorporates both universally applicable standards and a degree of flexibility to accommodate locally-specific certification norms.

Non-residential constructions (warehouses, stores, hotels, etc.), multi-family and single-family dwellings, and entire communities can all get "HQE" authorization, as can urban development and design. Focusing on health, relaxation, and the quality of the interior environment, it strives to achieve ecologically friendly goals [38].

It is possible to obtain "HQE" authorization for a variety of building types, including residential, financial reasons, managerial, or service facilities that are now being constructed, as well as buildings that are already in production and urban design and development initiatives. On the foundation of performance measurements, it encompasses the entirety of a building's lifecycle, beginning with the design process and continuing until its completion.

At each of the project's main phases, impartial third-party Inspectors will evaluate whether or not the project's objectives have been met [38]. The energy, environment, wellness, and comfort are the four pillars upon which the certification is built as shown in Figure (8).

On a scale ranging from 0 to 4 stars, an evaluation is performed for each topic. The total number of stars collected across all four categories contributes to the final score for the project.

Figure 8. Rating of HQE [38]

3.7 CASBEE

The "Comprehensive Assessment System for Built Environment Efficiency" is a sustainable construction management approach implemented in Japan. Its rating instrument employs a weighting system that enables the positioning of environmental concerns in the context of a conditional environment. The "CASBEE" was developed in Japan.

"CASBEE" is an evaluation instrument that was developed by the government of Japan and is administered by the Ministry of Building, Infrastructure, and Transportation. Its purpose is to evaluate the total environmental performance of a building [39]. The 80 different "CASBEE" sub-criteria are broken down into four categories: energy conservation, resource efficiency, the local environment, and the indoor environment. These four categories make up the four primary components of "CASBEE".

In addition to this, these groupings have been reorganized into two primary groups known as Q (quality) and L (loading) [40]. Instead of merely applying qualities points combined, the "CASBEE" encompasses the notion of constructing ecological effectiveness; the execution of its particular plan to achieve the final results is differentiated from the other evaluations by excluding the weighting factors that are used for the classification of the various types of buildings [41].

The aforementioned evaluations typically center around the outcomes of a survey conducted among key stakeholders, including designers, building residents, and customers. The execution of its particular plan to achieve the final results is differentiated from these other evaluations. Following that, an analytical hierarchy evaluation is performed on the responses [42].

4. Concepts of Sustainable Buildings

A concept structure, as described by [43], is a structured representation, either visual or textual, that elucidates the key elements or fundamental concepts to be investigated in a research project, either by graphical means or in the form of a story. Similarly, the primary focus of this research is to examine the roles and responsibilities of facilities executives in regard to the various ingredients of sustainable buildings. The project manager has never wavered in their dedication to the administration of the buildings and the services that are associated with them. Even at this late date, he continues to concentrate on the environmental problems posed by buildings [43].

However, it is crucial to determine the specific activities required to guarantee the construction of environmentally-friendly structures, improve the health and well-being of those who use the building, and give economic gain over the structure's life cycle are not yet known.

A conceptual framework offers a concise and precise elucidation of the steps necessary in accomplishing the goal of a study. The framework should incorporate noteworthy breakthroughs that are pertinent to the study and illustrate how these discoveries tackle each area of the research in a comparable fashion.

To build the conceptual framework of this study, research requirements were defined, a comprehensive review of the pertinent research was carried out, and a content assessment of three documents ("BREEAM-NC", "LEED-NC", and "ISO 15392") was carried out.

This study aimed to determine the fundamental components necessary for a building project to be classified as ecologically sustainable. In addition, a content analysis was conducted to determine the precise roles carried out by the facilities manager in different parts of sustainable buildings.

The emphasized components served as the basis for defining the role of the project management in sustainable building. Study is supported and directed by a theoretical framework that sets out the definitions of ideas, hypotheses, norms, attitudes, and theories. The aforementioned texts are commonly regarded as providing the standards for environmentally friendly constructions and provide assistance for this study.

The theoretical framework establishes the foundation for providing a specific research

problem that directs the research study being undertaken in alignment with the research issue, this input has enhanced the comprehension of the research subject [42].

The framework is the initial stage in determining the definition of a sustainable building and the involvement of the facilities manager in acquiring sustainable buildings in the context of Iraq [43].

One of the major obstacles now faced by the built environment in Iraq is the presence of inadequate design, insufficient construction specifications, the utilization of potentially dangerous building materials, and inadequate building servicing and management. The framework offers a comprehension of the approach that will be used to resolve this issue [44].

5. Project Management's Contribution to Sustainable Construction

Project management is a method that facilitates sustainable organization by managing workplaces over their whole lifespan. Its purpose is to enhance productivity and efficiently support company operations [45].

Facilities management, as defined by the "Facilities Management Association of Australia (FMAA)," refers to the efficient administration of building operations in both public and commercial enterprises. It includes a broad spectrum of tasks, such as strategic and operational planning, regular physical upkeep, tidying, and overseeing environmental sustainability matters [45].

The "European Facilities Management Network", or "EuroFM", describes facility management as the amalgamation of many processes inside an organization to uphold and advance services that bolster and augment the efficiency of the organization's primary activities. This word was coined and adopted by European professionals in the FM sector [45].

Furthermore, the "International Facility Management Association (IFMA)" and the British Institute of Facilities Management (BIFM) include the integration of individuals into the workplace, along with other procedures, in their definition of FM. This is exemplified in the Facility Management (FM) model developed by the International Facility Management Association (IFMA) and can be seen in Figure (9).

As stated by reference [45], the term refers to the amalgamation of various disciplines to enhance the efficiency of the built environment by integrating people, location, process, and technology. Furthermore, it is defined as "the incorporation of procedures within a company in the constructed environment to uphold and enhance the agreed-upon facilities that bolster and enhance the efficiency of the company's main operations, while managing the effects that these procedures have on individuals and the workplace" [47].

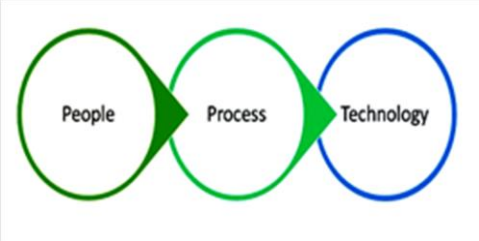

Figure 9. People Process Technology [47]

Project management can be thought of as a profession because its primary focus is on assisting clients in accomplishing their objectives. Moreover, the business and profession place a strong emphasis on the need to maintain positive relationships with clients.

6. Planned Future of Sustainable Construction in Iraq

The term "sustainable development" refers to an ongoing movement to lessen the negative effects of human activity on the environment as a whole. Sustainable development relies heavily on green buildings being one of its primary techniques. The building industry in Iraqi cities is plagued by the inadequacy of building practices and its reliance on traditional approaches, all of which contribute to adverse effects on the environment, increased consumption of electricity and natural materials, and a generally poor human quality of life [48].

The process of transforming towards the implementation of green construction in Iraqi settlements is essential, but it is hindered by a lack of understanding of the most significant issues that stand in the way of this transformation and acceptance. This has prompted research into the most significant issues, to develop a vision and recommendations for overcoming these challenges [49].

7. Sustainable Buildings and Challenges of Implementation

Green construction is a worldwide response to the emerging understanding that humans play a crucial role in accelerating global warming. Over forty percent of all carbon dioxide pollution worldwide might come from buildings; this gas is one of the key suspects in the occurrence of global warming. The United States, Canada, Western Europe, and Japan accounted for over 80% of global greenhouse gas pollution in 2017. In the not-too-distant future, this situation will have shifted significantly [50].

Taking into account the norms of the surrounding belonging, green buildings work for environmental harmony, efficiency in the use of resources, and the satisfaction of the building's occupants. All parties involved in the unified development approach are considered in green structure design. This includes the building shareholders, designers, engineers, specialists, construction organizations, material producers, contractors, service technicians, and inhabitants [51].

The key to a successful green building project is using high-quality materials that will boost the owner's return on investment [52]. During the last twenty years, there has been a dramatic shift in public opinion towards environmentally friendly structures.

By providing thought leadership and transforming the market, the World Green Building Council (World GBC) helps to create green buildings and sustainable communities around the world [53].

The goal of the World GBC is to ensure that all buildings and communities are eco-friendly so that people everywhere can live well now and in future generations. The four fundamental concepts of eco-friendly construction are as follows [54]:

- Efforts to lessen energy consumption.
- Reducing the severity of emissions and environmental degradation.
- Lessening the waste of energy and the consumption of scarce materials.
- Reducing the risk of internal environmental and health problems.

8. Sustainable Buildings Practices in Developing Countries Challenges

The building sector has been an essential factor in the growth and development of every nation. There is abundant evidence that the industry plays a significant role in fostering economic expansion in each and every nation it operates in [55].

It is considered that the building business in both developed and developing countries throughout the world is having a negative effect on the environment. This is the case despite the fact that the construction sector has made a significant contribution to the growth of each nation [56].

The degradation of land, the extensive use of energy, and the pollution that have been prevalent in recent years are all indications of this phenomenon [57]. The construction sector is essential to the social and economic development of any nation, but the activities that it engages in are a significant contributor to development that is not sustainable, and the influence that it has on the environment is unsettling, as stated by [58].

According to [59], there has been a growing consensus among scientists and academics that the rate at which the earth's resources are being utilized is causing the earth's ecosystem of support to deteriorate.

The concept of sustainable building was presented as a means of making the processes, operations and practices of the building sector more profitable, socially, and environmentally friendly [60].

This was done with the intention of reducing the negative impact that the activities of the building industry have on the environment. Due to the necessity of ensuring

that future generations will be able to satisfy their requirements by incorporating concepts of sustainability into the process of meeting present demands, the introduction of sustainable buildings became required [61].

Utilizing sustainable building materials in the delivery of building assignments has become an absolute necessity in order to accomplish this remarkable feat [62].

[63] proposed that in order to realize a sustainable built environment, the building industry ought to transform the construction procedure from linear to cyclic, wherein the assumption of a life-to-life process be made. Given the three aspects of sustainability—social, environmental, and economic—it has been determined that the majority of developing countries' construction practices are not sustainable [64].

The perception, awareness, and methods of developing sustainable buildings, alternative energy, resource efficiency, and environmentally friendly structures have all been the subject of much research [65].

9. Conclusion

The objective of this research is to provide clarification in the expansive field of building ecosystem evaluation tools by doing an analysis and categorization of the current tools. Comparing the tools and outcomes is challenging, if not unattainable.

For instance, the tools are specifically developed to evaluate various categories of structures, with each tool focusing on different stages of the lifespan of a building. Additionally, these systems rely on distinct databases, criteria, and questionnaires.

An individual survey is clearly necessary, the determinants impacting the selection of the instrument must be disclosed. The primary inquiries revolve around optimizing the utilization of the tools' outcomes and evaluating the impact of the tools and their findings on decision-making processes. In order to conduct a thorough analysis of the advantages of the tools, it is necessary to clarify these topics. The advancement of the tools would bring in additional advantages from it.

In addition, environmental assessment systems commonly incorporate the projected lifespan of a facility while conducting assessments. Nevertheless, it is accepted without any more examination. An in-depth analysis should be conducted to examine how the operational lifecycles of products and buildings impact the outcomes of the environmental evaluation.

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