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Develop a flexible method to assess buildings hosting major sports events environmentally through the world

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Abstract Specific international institutions are responsible for managing and organizing major sports events besides choosing the hosting city for those events which is a difficult task, as there is a need for an appropriate decision using highly credible and justifiable mechanisms. Assessing the hosting city includes the assessment of sports buildings used in those events; however the diverse characteristics of countries aiming to host sports events raises the problem of obtaining fair environmental assessment results for the submitted projects. There are already a number of environmental assessment methods of buildings around the world and some were used to evaluate a group of major sports buildings in their countries. A particular version of Building Research Establishment Environmental Assessment Method (BREEAM) was used to assess the sports buildings hosting the Olympic Games in London 2012. However, it cannot be used outside England without the presence of several defects in the evaluation process, especially when dealing with different regional characteristics. Many countries are still without environmental assessment methods of their own, besides the unfairness in the comparison of results from available assessment methods among countries. Difficulty finding a standardized assessment method appears because of the spatial and temporal variables. The paper aims to show the importance of having a flexible method that could adapt to all the variables affecting environmental assessment of buildings with different characteristics and conditions of the countries hosting sports events as well as the different time periods, to get the utmost justifiable and precision results when choosing the hosting city.

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Introduction

People around the world, with their different cultures, are looking to sports events with great interest, as a source of excitement, joy, and mutual experiences, besides leading to social communication and cultural cooperation among

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countries. Various countries are interested in hosting sport events because of its economic, political and social benefits. It is considered a great opportunity for the hosting country and city to upgrade and to present itself to the world. It helps introducing them internationally, leading to a positive impact on business and tourism. Hosting sport events increases the attention to provide appropriate places and infrastructure to host those events, giving a positive impact on citizens as a result of close contact with other communities by gaining social and cultural experiences [1,2]. Choosing the hosting city of sport events is not an easy task. The duty of managing and organizing sport events depends on assessing the submitted applications to pick the hosting place carefully. Evaluating the projects is necessary according to specific criteria and guidelines. In the end, choosing the location is strongly related to the ability of the institutions in charge of taking an appropriate decision, in addition to the availability of the facilities according to a clear, credible, fair and highly accurate methodology.

There is a common relationship between the environment and sports, in terms of global attention upon influence. In other words, if sports attract people for fun and excitement, then linking environmental concerns with sports interest reflects the growing environmental awareness across the globe and raises the percentage of the active participation in both activities. When a city hosts international sports events, this will pay back several benefits in exchange for what is spent to host the event, including upgrading and adding value to the environmental constructions which can be monitored and evaluated. The environmental assessment of buildings is considered an integral part of the overall assessment of the urban environment, as it is associated with the effectiveness of those buildings to fulfill the users' needs, in addition to encouraging the demands for sustainable buildings, ensuring the best environmental practice integrated into the buildings. Besides all that, developing standards and levels beyond the ones required by traditional systems and providing innovative solutions would ensure minimizing the environmental impact of buildings on the environment [3].

Cities desiring to host sporting events are not obligated to provide an environmental assessment of their buildings within the introduced project, so they may provide that assessment voluntarily in the way they assume is appropriate, which is often in line with the different methods used in each of them. The above shows the existence of detractions in credibility and fairness of the evaluation results comparison, as well as the neglecting of the environmental assessment role in general, especially with the absence of a unified authority responsible of that assessment and an appropriate mechanism to compare the results. One of the most obvious examples of the weakness of the environmental assessment role when choosing the host cities for major sporting events is what happened in Rio de Janeiro 2012. There is no doubt that the incident which took place in downtown of Rio de Janeiro which is preparing to host the soccer world cup in 2014 and the Olympic games in 2016 increased the importance of the environmental assessment of buildings in the cities hosting such events, as three buildings collapsed in the city center, which sheds light on its aging infrastructure [4].

From the previous, the paper's objective is emphasizing the importance and capability of creating a flexible method that could spread throughout the world, with time to get the utmost justice and precision when choosing the hosting city. This objective can be achieved according to a number of steps. First of all, by determining the current status of the environmental assessment of sports buildings, then determining the problems in comparing the assessed results using one or more environmental assessment methods of buildings, then explaining the challenges facing a fair comparison for these results, hence, determining the current solutions for such challenges. Finally, proposing a solution with a flexible assessment method which can adapt with the impact of spatial and temporal variables to avoid the current defects and to ensure the utmost justice, credibility and transparency of the assessment results.

Organizing and managing major sports events

International institutions are entrusted to manage and organize different sports events, for example, the International Federation of Football (French: Fédération Internationale de Football Association) (FIFA), is the organizing institution for football around the world, based in Zurich, in Switzerland [1]. The International Olympic Committee (IOC), which is based in Lausanne, in Switzerland also, is the organization responsible for managing and running Olympic Games. Those institutions are handling many tasks, including choosing the location where the sports events are to be held, making sure of the preference of those sites compared to others, and to ensure the validity of the country and city for hosting such events [2].

Environmental assessment of buildings

Environmental assessment methods of buildings emerged across the world to determine the principles and standards that are targeted in the relationship between buildings and their environment. They are used in issuing assessment certificates granted for buildings that confirm their commitment to the environment according to specific classifications that puts them in competition with other buildings. The assessment includes assessing indoor environmental quality, sustainable sites selection and management, water and energy consumption efficiency, materials and resources selection and consumption efficiency, the potential re-use and recycling, besides other criteria which are used to judge the efficiency of the environmental performance of buildings. Building Research Establishment Environmental Assessment Method (BREEAM) is considered the first assessment method, which has been established through the Building Research Establishment (BRE) in the United Kingdom [5]. Several different methods appeared later in different places around the world, such as Leadership in Energy and Environmental Design (LEED) in the United States (1998), which was developed by the American Green Building Council (USGBC) [6]. There is also the Green Star which appeared in Australia in 2003 [7], and the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) which appeared in Japan in 2004 [5,8]. The previous four methods are considered to be the most famous and widespread methods in the world. Several versions of the assessment methods were issued to cover different building types, in terms of their functions and age. It is noted that different methods include environmental issues with different weights that represent the environmental importance of these issues according to specialized groups of construction specialists and academics [3,5,9].

A number of countries planned to catch up the first wave of environmental assessment methods by producing their own methods such as Promise E in Finland, Lider A in Portugal, Verde in Spain, and Green Pyramid Rating System (GPRS) in Egypt [10]. Local methods in different countries help governments to encourage and impose environmental compliance of buildings, as well as paying more attention to regional issues that belong to different countries without external influences. They provide the possibility of benefiting from local references such as energy codes, along with the possibility to take advantage of all the previous experiences in the assessment field without depending on specific legislations or institutions. A huge time is consumed to create these new methods, especially when using different resources of expertise, along with the difficulty of putting the local method in competition with the well-known and experienced methods. They also need a lot of time and effort to test them after their release and to use the feedback in developing the method [10,11].

Current status of the environmental assessment of sports buildings

It is noted that a number of sports buildings that received environmental performance certificates are located in the producing countries depending on the methods used for their assessment (for example, the American Airlines Arena, Amway Center and Philips Arena, got different classifications of LEED [12], while Edgbaston Cricket Ground, and National Indoor Sports Arena got different classifications of BREEAM). When London won the right to host the 2012 Olympic Games the organizing team undertook the environmental assessment of buildings into consideration, taking into account a detailed assessment that covers a range from the pre-games period to the post-games period. They got a special issuance of BREEAM for these projects, as the Olympic venues need to be evaluated in a different way from the available versions. This evaluation included studying the environmental impacts over the lifetime of buildings not during the games period only [13]. From the above, it is clear that the environmental assessment of sport buildings are linked to existing assessment methods in a limited number of countries that were also the pioneers in the environmental assessment field, which gives them the necessary ingredients and experience in assessment. However, they are also the countries hosting sports events the most [2], so there will be a focus on those countries, reducing the chances of other countries to host such events.

Problems comparing environmental assessment results of buildings hosting sports events

The assessment results of the buildings hosting sports events cannot be compared throughout the world and for different time periods without lacking accuracy and credibility for several reasons as mentioned below.

Problems comparing the environmental assessment results using different methods

The maximum required assessment level of sustainability varies between different countries, as it represents the best environmental practice available that can be accessed in each one, which differs significantly among them. Therefore, the maximum level of assessing items and environmental functions in each method vary according to the local experience and practice in each country. The goals pursued by the different methods to be achieved are variable, even with the common general principles among them [14]. Different practices among countries also lead to the emergence of many differences between these methods, and when exposed to the most famous and popular assessment methods, several differences appear in the assessed issues, weights used for evaluation, classifications, scoring ranges and the legislations used in evaluation. Some variations between assessment methods can be shown in the following table (Table 1) [7,8,9,15,16].

Comparative research done by BRE to give approximate values of different methods, namely BREEAM, LEED, Green Star, and CASBEE, revealed that when assessing buildings designed to get a high score in some methods, their evaluation scores may not match their scores in other methods. For example, if a building is designed in the UK to get a high score in LEED, it often gets just a good score with BREEAM [5] (Fig. 1). Another research that compared energy consumption in an office building in Dubai using BREEAM, LEED, and Green Star methods showed that the building which got a high score according to Green Star got a low score in BREEAM and fails to be classified in LEED, since those different methods are using different standards, measurement approaches and rating scales [6]. Environmental requirements in different assessment methods also depend on various assessment criteria, laws and codes used as references in each of them, which clearly can be shown between BREEAM, which is based on European legislation, and LEED, which is based on ASHRAE standards [5]. There is also a difference in the measurement approaches used to evaluate the items' requirements in the different assessment methods. For instance, assessing the efficiency of energy consumption in LEED mainly depends on improving the energy performance according to the percentage of improvement of annual energy cost, while BREEAM depends on the reduction of carbon dioxide emissions. In conclusion, totally different standard buildings are used in the evaluation of the methods in question [6,9,16].

There are various issues in assessment among current environmental assessment methods of buildings and their assessing ratios. For example, in LEED there are many items that cover issues not included in BREEAM. I return LEED deals insufficiently with the Ozone Layer depleted materials [5,9]. It is noted when comparing CASBEE and BREEAM items, for example, that there are 44 points in the first method that do not exist in the second one, because it is mainly focused on Japan regional issues, particularly in regard to earthquakes [5,8]. It is also noted when applying one method like Green Star upon the entire area of Australia covering different climatic zones; some items are not always applicable in some places, like the item of not using cooling towers, which is easily accessible in South Australia [7]. Some variations in the assessed applications appear in some environmental assessment methods too. Although LEED encourages the existence of sufficient parking lots and grants degrees for that, BREEAM for example grants degrees for minimizing those spaces to reduce emissions [3]. Calculating ways used to get the final scores of buildings also vary among different methods, while the most common way is by gathering the grades of each assessment item, as in LEED, BREEAM, Green Star and GPRS.

Table 1 Some comparative aspects between BREEAM, LEED, green star and CASBEE for multi-residential buildings in the same time period [7–9,15,16].

Comparative aspects Producer	BREEAM BRE	LEED USGBC	Green star GBCA	CASBEE JaGBC-JSBC
Evaluation areas and points obtained	2008/upgraded 2010 Management (10) Health and wellbeing (12) Energy (23) Transport (9) Water (8) Materials (17) Waste (8) Land use and ecology (10) Pollution (12) Innovation (10)	2009/upgraded 2011 Awareness & education (3) Indoor Environmental Quality (21) Energy & Atmosphere (38) Location & Linkages (10) Water Efficiency (15) Materials & Resources (16) Sustainable Sites (22) Innovation & Design Process (11)	2009 upgraded 2011 Building Management (18) Indoor Environment Quality (20) Energy (26) Transport (14) Water (12) Materials (31) Land use & Ecology (11) Emissions (18) Innovation (5)	2010 Quality of services (16.6%) Indoor Environment (16.6%) Energy (16.6%) Resources & Materials (16.6%) Outdoor environment on site (16.6%) Off-site environment (16.6%)
Classifications and related grades	Pass (30–45%) Good (45–55%) V good (55–70%) Excellent (70–85%) Outstanding (85–110%)	Certified (45–59 point) Silver (60–74 point) Gold (75–89 point) Platinum (90–136 point)	4 stars (45–59%) 5 stars (60–59%) 6 stars (75–105%)	Poor-C (0–0.49) Fairly poor-B^{-} (0.5–0.99) Good-B^{+}(1–1.49) Very good- A (1.5–1.99) Excellent-S (0.3−)
Used legislation	European and UK regulations	American regulations especially ASHRAE	Australian legislation and local protocols	Japanese legislation and codes

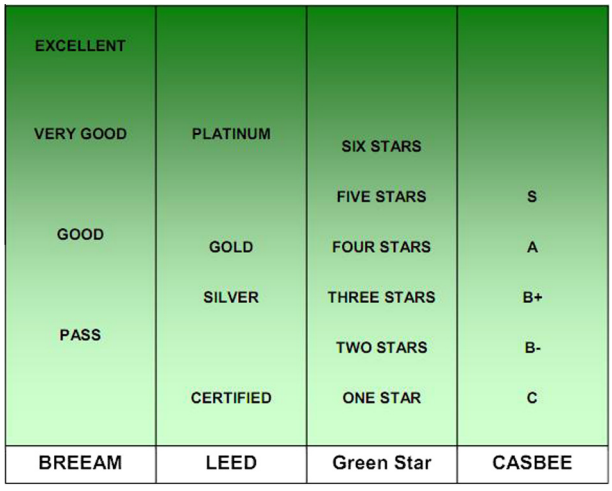

Fig. 1 Approximate values for different assessment methods used to assess buildings designed in the United Kingdom [5].

CASBEE and other methods show another way to calculate the final evaluation of the building, which depends on the output of the Building Environmental Efficiency (BEE) [8].

Problems comparing the environmental assessment results using the same method

Current assessment methods aim to achieve the best environmental practice available in buildings. Thereby, the maximum rating of buildings is given for a level of sustainability lower than 100%, meaning that the maximum grade is granted to a building which achieves a proportion of ideal sustainability which may change with time and available constituents [14]. Noted that the previous reason is the one that led to the ratios transfer of the classification rates used in BREEAM when a need to get a higher level of environmental performance appeared over time. So a final rate which is 'outstanding' was added after the rate 'excellent' and was the highest rate until 2008. The remaining classification rates were also modified which led to the emergence of a problem while comparing the building results before and after 2008 [9].

There are other problems which may lead to difficulty in comparing the building results from different versions of the same method, especially when using the final assessment degree in the form of numbers not percentages as in LEED, while assessing residential buildings in LEED was from 69 points in 2005, it became 136 points in 2011. There are also radical changes in the assessing versions for the same method over time resulting in the impossibility of locating the environmental performance of assessed buildings using an earlier version according to a later one, where for example, one area of evaluation may be separated in some versions and emerged in others during different time periods [17] (Table 2). In the issuance of residential buildings of LEED 2011 a factor known as 'Home Size Adjustment' is used to change the final classification assessment ranges of buildings depending on the buildings different sizes. So the rating of a building may start from 35 instead of 45 when the factor = −10, or start from 55 instead of 45 when the factor = +10 [16]. Changing these ranges of rating classification leads to the impossibility of comparing the environmental performance of residential buildings of different sizes with each other. Instead of changing the buildings classification rates it is preferable to include the effect of buildings size on the estimated weights of resources, materials and energy issues which are affected by it, and then change the estimated weights of other issues, so the final classification remains uniform.

Table 2 Some different aspects between some versions of LEED which lead to the difficulty of comparing their assessment results [16,17].

Some LEED aspects	Some versions of LEED		
	Multi-residential 2005	Multi-residential-2009	Multi-residential-2011
Evaluation areas and points can be obtained	Sustainable Sites (SS) (14) Water Efficiency (WE) (5) Energy & Atmosphere (EA) (17) Materials & Resources (MR) (13) Indoor Environmental Quality (EQ) (15) Innovation & Design Process (ID) (5)	Sustainable Sites (SS) (26) Water Efficiency (WE) (10) Energy & Atmosphere (EA) (35) Materials & Resources (MR) (14) Indoor Environmental Quality (EQ) (15) Innovation & Design Process (ID) (6) Regional Priority (RP) (4)	Innovation & Design Process (11) Location & Linkages (LL) (10) Sustainable Sites (SS) (22) Water Efficiency (WE) (15) Energy & Atmosphere (EA) (38) Materials and Resources (MR) (16) Indoor Environmental Quality (EQ) (21) Awareness & Education (AE) (3)
Classifications and related grades	Certified (26–32 point) Silver (33–38 point) Gold (39–51 point) Platinum (52–69 point)	Certified (40–49 point) Silver (50–59 point) Gold (60–79 point) Platinum (89–110 point)	Certified (45–59 point) Silver (60–74 point) Gold (75–89 point) Platinum (90–136 point)

Challenges with environmental assessment of buildings hosting major sports events

Countries hosting major sports events vary; therefore the environmental assessment of buildings hosting such events must be adapted to the spatial variable characteristics of each country. Assessment of buildings dedicated to hosting events according to an American request cannot be the same for buildings dedicated to hosting those events in Egypt for example. Major sports events are held at distant time periods which are enough for the emergence of technological developments or the change of the interests in different environmental issues, therefore assessing the environmental performance of buildings in 2010 cannot be used for 2014, meaning that environmental assessment of buildings hosting sports events must be adapted with time variables too. Thereby, the importance of getting a flexible method for assessing the environmental performance of buildings can be inferred to be able to change and evolve according to spatial and time variables to ensure the fairness of the evaluation results.

Spatial characteristics vary significantly between countries hosting sports events, even between regions in the same country. Natural spatial variables affecting environmental assessment of buildings include climatic, hydrological, geological and ecological characteristics. There are also spatial humanity variables, such as the prevalent practice, culture, prevailing laws, the cost of resources and materials as well as the population density. Different site conditions change the attention to sustainability issues, for example, assessing the efficiency of water consumption in a rainy country differs from those in dry ones. Drought in Australia for example, leads to a rise in the importance of rationalizing the local water, unlike the United Kingdom, where the heavy rain and high population density raise the attention of land use and ecology [6]. Climatic characteristics control the material construction types and determine the used techniques of operating and maintaining buildings [18]. Urban characteristics control the appropriate means of transport and urban spaces. Environmental assessment of buildings is also influenced by the urban and historical characteristics of the country [16].

Other variables connected to time appear when organizing sport events, especially the change of global environmental issues interest priorities over time, including the issue of global warming, scarcity of fresh water resources, degradation of biodiversity and others. There are also variables associated with the degree of technological development, which is connected to the different elements and components used in buildings. New materials or inventions may appear, importance of some resources may be discovered and other forms of transformation in events and ideas may arise, resulting from researches or studies leading to change in vision of many assessment items. Since the World Cup is held every four years and the Olympic Games are organized currently every 2 years with alternating summer and winter games, those time periods are sufficient for the emergence of time effect on the environmental assessment components of the buildings.

Current solutions of variables' impact on buildings assessment results

International versions of environmental assessment methods of buildings such as BREEAM and LEED known as BREEAM International and LEED International are adjustable versions by the green buildings' councils scattered around the world. They can be converted into a local method for each country, helping to form a locally recognized assessment tool, and keep the advantage of benefiting from the well-known methods experience [9,19]. The idea of international versions is unifying a set of constants with the original method and letting the region teams complete them. So the areas and essential assessment items are similar with the original method, while the weights of relative importance of the assessed fields and items and the number of items within the assessed fields as a whole are different. Changes made in these versions are required to be as minimum as possible [18,19]. However, some defects have emerged in the dealing of those versions with variables affecting the environmental assessment of buildings, and some of them can be displayed as follows:

- Amendment consumes a lot of time and effort because of its association with more than one aspect, besides the requirement of the approval of the original method's institution for the amendment requests made by the local authorities, in order to preserve the consistency and to protect the brand promotion of the original method [19].
- Standards used in assessment are not to be changed unless the substituted standards are equally strict or stricter than the existing standards, which cannot be achieved in many local codes around the world, wasting the chance of taking advantage of them [19].
- International versions are affected by the view and culture of the original producing country. They are also affected by their market's requirements and they continue to deal with the assessment items requirements in the same manner of the original methods [3], which can be noted clearly in the significant differences of assessed issues and weights between BREEAM Gulf and LEED Emirates which are designed for the same region [3,19].
- International versions depend on deleting the specialized items and keeping general ones, which are commensurate with all buildings and different places. However, that way leads to empty the method from experiences which were included in it. This may cause work duplication, waste of time and effort, and experiences conflict when putting items that existed previously [11].

Green Building Challenge (GBC) appeared in Canada to deal with variables affecting the environmental building assessment. It was under construction since 1996 through a variety of specialists and was handed to the International Initiative for a Sustainable Built Environment (iiSBE) in 2002. GBC was created to help countries producing their own assessment tools. In the Sustainable Building Conference 2002 (SB 2002) in Oslo, Norway; Green Building Tool (GBTool) was introduced as an assessment tool for GBC which was upgraded later to Sustainable Building Tool (SBTool) [14,20]. The idea of this method depends on developing general values that can be replaced with local values by local experts to determine the levels of appropriate performance [20]. GBC has no limits in the amount and type of changes which are to be made in it as long as they are necessary. The items' estimated weights are edited in the method by using a scale of 1–3 to express properties of items in terms of the extent, intensity and duration of potential effect of each assessed item. When analyzing the dealing of GBC with variables a number of defects could be displayed as follows:

- Variables' impacts are gathered in common and similar characteristics for all items, while instead of specifying certain properties to include the effects of different variables, it is preferable to study the effect of each variable according to its respective characteristics [20].
- The used technique does not allow distinguishing the effect of some variables from others for various items, as including the impact of variables through specific characteristics does not separate the effect of one variable from another variable for different items, so it is difficult to distinguish how much effect each one has when determining the value and weight of items [14,20].
- The maximum assessment level does not represent achieving the perfect sustainability for the item's requirements, which makes the same level to be used in expressing different levels of sustainability in different countries and over time, which detracts from the acquired feature achieved by using several levels to assess the achievement of items' requirements, ranging from negative practice (−2) to best practice (+5) [14,20].
- There is no total environmental performance results for assessed buildings that can be compared with other buildings' results, as the assessment process is divided into different stages without having an appropriate mechanism for combining different assessment results of these stages into one. This makes it difficult to compare the environmental performance of assessed buildings except for the same stage, especially for GBC method with the possibility of deleting some of the assessed main issues in some of those stages depending on variable effects for different countries [14,20].

Proposed solution of variables' impact on sports buildings' assessment results

Instead of giving the task of the environmental assessment of the buildings of major sports events to the countries applying to host these events, the formation of a competent organization for the environmental assessment of these buildings is preferred, which can be based in Switzerland, for example, like the other major organizations of those events. The proposed organization may include environmental assessment experts from all around the world, who are experts in this field and independent of other assessment organizations. Those experts configure different versions according to the local environmental conditions of the applicant countries for hosting, taking into consideration the time period to ensure the utmost justice, credibility and transparency of the assessment results, and to ensure a fair assessment and a consistent environmental building performance from the perspective of green architecture for all countries. The challenge in this case is to facilitate the work of experts by providing a flexible assessment method that can adapt with the impact of spatial and temporal variables.

Importance of including variables' effect on the assessment results of sports buildings

Due to the great diversity in the characteristics of countries hosting major sports events, there is a need to include the effect of spatial and temporal variables on the environmental assessment of buildings results to get them in the utmost justice and accuracy. This leads to the exclusion of relying on one of the most famous assessment methods such as LEED and BREEAM as a result of their local properties, besides excluding the use of international versions, as there are problems in using them as previously mentioned and also the use of SBTool to create different assessment methods for each country, as there are other shortcomings. The solution of having a local method for each applicant country to host sports events to be used for the environmental assessment of their buildings is not sufficient too, as it is noted that many countries are still without environmental assessment methods of their own and some countries rely on other countries' assessment methods. Even when assuming the existence of local environmental assessment methods for all the countries applying to host sports events, a problem in the credibility of comparing their results

appears due to the big differences between their components, weights, rating scales, and the degree of strictness in the used standards, laws and codes. Even when overlooking the previous differences, another problem appears that forces each country to put a specialized version for the major sports buildings, which leads to a loss of time and effort for the applicant countries which will not be accepted for hosting the event. It is also noted that the characteristics of these buildings are unique and cannot be applied to other buildings later on, which means that they also cannot be reused efficiently by time, as they have to be updated every time to keep up with the time variables affecting the evaluation.

Appling a proposed method for solving variables' effect on the buildings assessment results

It is suggested that a group of experts would identify spatial and temporal variables affecting the environmental building assessment using reliable electronic global sources, then linking them with the method's components and elements affected by them. Variables' properties can be determined by their impact on the environmental assessment of buildings included as follows:

- Experts responsible for determining the presence and the mandatory degree of items study the effect of different variables on each item to identify the variables that eliminate some items or increase their attention to the degree of compulsion.
- Experts responsible for changing the formulation of assessment items determine the impact of spatial and temporal variables on the requirements presented in the formulation of the assessment items. This may include numbers, ratios and required properties to be achieved, besides standards, codes, and laws to be followed. Experts would then change previous requirements with suitable ones according to the impact of variables.
- Initial weights are put into the different assessment fields and items either by distributing the overall percentage of 100% evenly on the assessment fields then on the items consisting of each detailed level, or by using initial default weights. Experts responsible for modifying weights of assessment fields and items study the impact of different variables in terms of their effect that may be raising or lowering the weight. They would also determine the degree of impact and the degree of variable importance in relation to other variables affecting the same item. Finally, they can use mathematical equations to obtain degrees that can be added or subtracted from the initial weight of each item to get its final degree after modification, noting that changing the weight of any item leads to a change of the weights of all other items that are in the same level, to get a total of 100% of the overall weight of the building.
- Modified weights are examined to ensure the possibility of the building to succeed according to the required limits of success –if found– after completing their modification. It is suggested that the success requirements should include a minimum level of achieving various environmental functions in the building.
- Experts responsible for determining the scoring levels of different items study the impact of different variables upon each item, allowing the identification of scoring levels that commensurate with each item's requirements contained therein. The minimum scoring level may represent a 0% and the maximum is always 100% expressing the ideal sustainability for achieving all items. Experts then determine grades corresponding to each previous level ranging from 0 to 1 and depending on the number of those levels.
- The assessment method appears finally in the form of a set of choices for each of the items, according to what the experts have determined for the scoring levels, depending on the reformulated requirements of each. Then the degree of chosen level during assessment is multiplied by the item's weight already determined by experts too.

Table 3 Simplified example of determining the presence and the mandatory number of items according to variables' effect.

Item no.	Presence	Mandatory
Item 1	Y	M
Item 2	Y	–
Item 3	Y	–
Item 4	Y	–

Illustrative example of including variables' effect on items in the proposed method

The following example will use one of the environmental assessment building issues to show the main concept of including the variables' effect on items way in the proposed method, hence, showing the possible flexibility through these items. The assessing issue (Energy in Use) is the one chosen to be used in the example. Some main items of this issue are:

Item 1: All buildings shall be designed to minimize carbon emissions and energy demand to achieve a minimum 15% improvement over Part L 2006.[1]

Item 2: Efficiency conversion and distribution of energy obtained through a Combined Cooling, Heating and Power (CCHP) system to provide a minimum 20% carbon reduction.

Item 3: Across the site as a whole, sufficient On-site renewable energy generation capacity shall be installed to meet at least 20% of the annual carbon emissions (reduction) of the venues, and other buildings to be retained within the site in the Legacy phase.

Item 4: Use reasonable endeavors and subject to obtain requisite consents, to seek achievement of a reduction in carbon emissions (against 2006 Building Regulation standards) for the built aspects of the Development of 50% by 2013 [21,22].

To change the previous items into flexible ones by including the variables' effect on them the following steps may be used:

First: Depending on the spatial and temporal characteristics of the project, those can be known from some reliable global websites, experts responsible for determining the presence and the mandatory degree of items decide if any of these items is neglected or mandatory. For example all of these items may be presented in an amended method, and (item 1) may be

[1] Part L is a building regulation standards used in the United Kingdom (the origin source of BREEAM) for efficient energy consumption [9].

Table 4 Simplified example of determining the weight of an item according to some variables that could affect it.

Item no.	Initial weight	Variables affecting the item's weight (e.g.)	Type of impact	Degree of impact (DI)[a]	Degree of variable importance (DVI)[b]	Final weight[c]
Item 1	2%	V1 (climate)	+	10	5	13.5% [d]
		V2 (surrounding urban)	–	4	6	
		V3 (historic fetchers)	–	3	2	
		V4 (population density)	+	4	1	

[a] (DI) is a number that experts put from 1 to 10 to express the amount of variable impact on the item's weight, number 1 expresses the lowest impact.

[b] (DVI) is a number that experts put from 1 to 10 to express the degree of variable importance in relation to other variables affecting the same item; number 1 expresses the highest importance.

[c] The mathematical equation used to get the final weight is: Final weight = Initial weight + ((DI for V1/DVI for V1) × type of impact × 3%) + ((DI for V2/DVI for V2) × type of impact × 3%) + ...etc. Noting that the figure 3% (proposed and not constant) used in the equation is expressing the even division of 100% (the overall score of the building) on the expected final overall items contained in the assessing method, this figure keep the changing in the item's weight in an appropriate range, So, for the previous proposed figures the final weight was calculated as follows: Final weight = 2% + {((10/5) * 3%) + (−(4/6) * 3%) + (−(3/2) * 3%) + ((4/1) * 3%)} = 2% + 6% − 2% − 4.5% + 12% = 13.5%.

[d] It should be noted that raising or lowering any item's weight will affect the weights of all other items that are in the same level, to get a total of 100% of the overall weight of the building, and it should be noted that the upper levels are calculated before the lower levels, so changing items weight and their initial weights are limited within the weights of the upper levels.

mandatory as it expresses the minimum level of achieving energy efficiency (Table 3).

Second: Depending on the spatial and temporal characteristics of the project; experts responsible for changing the formulation of the assessment items change the items requirements according to deferent and new conditions; the requirements of the previous items appear underlined, these underlined sections of the items are the ones which are changed in the formation of the items. In Egypt for example one of the previous items can be:

Item 1: All buildings shall be designed to minimize carbon emissions and energy demand to achieve a minimum 10% improvement over the Egyptian Code to improve the efficiency of energy consumption (if there is no Egyptian code for sport buildings it could be changed to a global one or another country's code that is near to the Egyptian characteristics).

Third: Initial weights are given for the previous items, for example they may all be assessed from 2% as initial weights (taking into account that the overall percentage of assessing the building is 100% including the other items for all other issues), then depending on the spatial and temporal characteristics of the project experts responsible for modifying weights change the initial weights according to these characteristics. For example one of the items weights could be changed according to different variables as follows: (Table 4)

Forth: Depending on the spatial and temporal characteristics of the project; experts responsible for modifying weights put required limits of the building success. The required limits to succeed could be a minimum level of achieving various environmental functions in the building, for example the minimum level of achieving all the environmental functions included in the assessing method (including the Energy in Use issue) may be 7.5%, so experts when modifying items weights they should be careful not to be less than 7.5% for the overall weight of each environmental functions and not more than (100% − (7.5% * no. of environmental functions)), therefore experts after modifying items weights make sure of the possibility of the building to succeed according to the modified weights.

Fifth: Depending on the spatial and temporal characteristics of the project; experts responsible for determining the scoring levels of different items change their scoring levels according to the type of these items and their requirements, and according to the variables affecting them, noting that the maximum scoring level should always reach the 100% of sustainability for each item, for example the first item can have a scoring level as follows: (Table 5)

Experts could also make a mix of scores when needed to express achieving levels of requirements in a way that are not previously stated, for example, in the previous item's requirements achieving 80% improvement over "A more strictness regulation than Part L 2006" leads to get a score of 1.8%, while achieving 15% improvement over Part L 2006 leads to get a score of 1.3%, so achieving 15% improvement over A more strictness regulation than Part L 2006 may lead to get a score of 1.5%.

Some comparison aspects between the proposed method and other current methods

The following shows some comparison aspects between the proposed method and other current methods, which were previously mentioned in the research paper and considered as the current solutions to include variables' effect on buildings assessment results, which is the main concern of the paper (Table 6).

Benefits of implementing the proposed method to buildings hosting sports events

Application of the proposed flexible method helps to achieve a set of objectives that can be summarized as follows:

Justice in comparing assessment results across time and place

A flexible method, due to its ability to adapt to changes affecting the assessment, helps to get an appropriate accuracy and

Table 5 Simplified example of determining the scoring levels of an item according to some variables that could affect it.

Item's requirement	Level of achievement	Score of achievement	Item's weight (%)	Final score (%)
All buildings shall be designed to benefit any carbon emissions	100%	1	2	2
All buildings shall be designed to block any carbon emissions	90–100%	0.95		1.9
All buildings shall be designed to minimize carbon emissions and energy demand to achieve a minimum *80%* improvement over ("*A more strictness regulation than Part L 2006*")	80–90%	0.9		1.8
All buildings shall be designed to minimize carbon emissions and energy demand to achieve a minimum *80%* improvement over (*Part L 2006*)	70–80%	0.85		1.7
All ... a minimum *65%* improvement over (*Part L 2006*)	60–70%	0.8		1.6
All ... a minimum *50%* improvement over (*Part L 2006*)	50–60%	0.75		1.5
All ... a minimum *35%* improvement over (*Part L 2006*)	40–50%	0.7		1.4
All ... a minimum *15%* improvement over (*Part L 2006*)	30–40%	0.65		1.3

Table 6 Some comparison aspects between the proposed method and other current methods.

Aspects	Assessment method	Comparisons
Flexibility in modifying the methods components	International versions (BREEAM International – LEED International)	Modification and changes in these methods are restricted with the lowest possible changes, to unify the main form of the method and the main elements all over the world with the original ones, which reduces their flexibility
	GBC (SBTool)	Modification can happen in all its components and elements as long as is necessary to match with the country conditions, but it also allows changing the main presence of the assessed main issues, which leads to a difficulty in comparing the resulting versions between the different countries
	Flexible method	Modification and changes are adjustable without the compliance with a final form; although it maintains the unification of the main assessment issues between all the countries to help comparing their results
Flexibility in modifying the assessing weights	International versions	Include a minimum degree of success in the different assessed issues beside a set of mandatory requirements, but those limits vary between the countries, and there are no minimum limits for them to prevent them being too low in some cases, and there is no relationship between those limits for the same building
	GBC	Does not include limits of success connected to the building
	Flexible method	Includes a minimum degree of success, such as a minimum degree to pass achieving the environmental functions included in the method, so changing the assessment items weights does not lead to overcoming these limits which are all connected with each other for the same building
Flexibility in dealing with different standards	International versions	There is a strict compliance with the stringent degree of the used standards regardless of its preference in dealing with the local characteristics of different countries
	GBC	Allows flexibility to deal with different standards but their stringent degree had no effect on the degree of evaluation
	Flexible method	Allows the flexibility to deal with different standards such as the country-specific standards or the global standards or a combination when needed, taking into account their stringent degree which is itself a variable affecting raising or lowering the weights and score levels of assessment items that use those standards
Flexibility in modifying the rating scores	International versions	Allow changing the predefined rating scores in the original method without the possibility of having other evaluation levels or secondary ones, noticing that the maximum score for evaluating the items may be given to a degree of sustainability less than 100%
	GBC	Allow changing the rating scores of several evaluation levels, noticing that the maximum score for the items are given to a degree of sustainability less than 100%
	Flexible method	Allow flexibility of having several evaluation levels, taking into account that the maximum degree is always given when achieving a 100% sustainable level
Responsible party for forming the method	International versions	They lead for losing a lot of time and effort because of their association with more than one association working on the amendment of the methods
	GBC	Each country can configure their local assessment method on their own without putting a unified level of experts' experience formatting these methods
	Flexible method	Depends on a specific and competent organization which includes experts from all over the world according to an appropriate level of experience, it may also engage local experts when needed to avoid the effect of a certain view or culture on the produced method

fairness for the results to assess the environmental performance of buildings among different conditions and country characteristics hosting the sports events and among various time periods.

Providing a global design standard for sports projects

A designer can use versions of the flexible method to make sure of the environmental performance of his building, as buildings hosting such events have unique properties. Thus, the existence of environmental assessment certificates from a specialized authority helps putting global environmental standards to assess the design of these buildings and to meet the environmental requirements that must be taken into account for projects that receive major sports events commensurate, with different characteristics of countries and time periods.

Ability to add different extra items to assess the distinction of sports buildings

The proposed flexible method helps including a range of items that assess the distinction of sports buildings according to the variables associated with each country, where it can assess the social benefits, upgrading of the historical places, elevation of the environmental awareness, as well as the emotional interaction in the sports buildings. It is noted that all of these requirements may vary among different countries.

Limitations of implementing the proposed method

Applications of the proposed flexible method include some limitations that can be summarized as follows:

- Needs an unknown period of time to be examined and edited before competing with other international methods.
- Faces some challenges in marketing its publications on the contrary of other international methods due to the strength of their global institutions.
- Includes several steps to ensure fair comparison of assessed results, which are reflected on both the experts responsible for the method formation and the assessors responsible for the building assessment results, so it is theoretically more difficult to be dealt with than the previous ones and more time-consuming.
- Needs a formation of a unified competent organization for the environmental assessment of buildings to create the different versions of the method in study, while the formation of such an organization needs an unknown period of time, beside the difficulty of gathering appropriate experts from different countries around the world within an appropriate time.

However, previous problems can be resolved. To achieve rapid and accurate versions from the flexible method an automated tool would be recommended and used, as it will facilitate the work of experts and assessors. The tool could be linked with several internet websites, which will help in its marketing and in competing with other international methods, besides helping in the communication with appropriate experts across the network until the formation of a unified organization.

Results

- Environmental assessment of buildings holding major sports events contributes to the choice of the hosting city for these events according to global environmental standards and bases, creating a competition among them and encourages the achievement of the environmental dimension in buildings that attract millions of people.
- There is a range of spatial variables between applicant countries to host sports events and temporal variables between periods of their occurrence. That must be taken into account when assessing buildings prepared for these events environmentally to ensure fairness of the evaluation results.
- Differences between methods put limits to compare the results of environmental assessment of buildings in a fair and accurate manner among different countries.
- Some current solutions of issuing environmental assessment methods internationally can be used to transmit methods all over the world, as using the international versions of some well-known methods (LEED-BREEAM) or using the SBTool. But despite them dealing with some problems associated with comparing assessment results across places, they possess deficiencies in their way of implying the impact of variables which causes a reduction of the accuracy and fairness of comparable results.
- The high experience of a limited number of countries in the field of environmental assessment of buildings raises their opportunity to assess the hosting sports events buildings. But since these countries also host most of those events, this reduces the chances of other countries to host such events when taking the environmental assessment into consideration.
- It is a difficult request to depend on the applicant countries hosting sports events to do their own environmental assessment for their buildings, especially when taking into account the time and effort to produce specialized versions of their local methods to assess such buildings, which may not be utilized at all or later, besides the lack of credibility in comparing the outcoming results.
- A flexible environmental assessment method of buildings can be used to include the impact of spatial and temporal variables by determining the effect of different variables on each item and then studying their impact on the formulation of those items, weights and evaluation scoring levels.
- The application of the proposed flexible approach to assess the buildings hosting major sports events helps to ensure the fairness of comparing the assessment results across place and time and provides global standards for designing sports projects, as well as the ability of adding various additional items to distinguish those buildings.

Recommendations

- The competent authorities of organizing and managing major sport events are recommended to configure a neutral subsidiary to issue certificates for environmental assessment of buildings for those events, to evaluate the submitted projects of hosting from different countries and for different time periods.
- The proposed authority for environmental assessment of buildings hosting sport events is recommended to use a

standardized assessment method, which should be flexible enough to accommodate to changes in time and place.

- Green councils and competent authorities are recommended to develop and propose a flexible method of assessing the premises of major sports events.
- Green Building Council in Egypt is recommended to gather the Egyptian different variables to study their reflection on their own method or on the produced versions from the flexible method in the future for any suggested place to host a sports event.

Conflict of interest

None declared.

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