

PAPER • OPEN ACCESS

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To cite this article: Hiyam Majeed Jaber Al-Bakry and Suha Mnati Abbas 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **518** 022030

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Towards a more relevance university campus with its biosphere based on LEED - Case study: Technology Institute campus/ Baghdad

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Abstract. "US LEED" is the most important for transformation towards sustainable building design and existing building. "LEED" is a voluntary, consensus-based green building standard, also is a rating system. After the United States, many countries adopted "LEED" standards, because of its popularity, where it has been developed and commensurate with its environment and capabilities. Here the problem of the research is represented, and can be formulated with the following question: Where is Iraq from the experience of the "LEED" rating system? And is it possible to approach the "LEED" system and our architectural reality with all its components compatible with its biosphere? The aim of the research is to introduce the "LEED" standard and to formulate a theoretical approach that can be applied using "LEED" standards to improve the efficiency of educational buildings in Iraq so that they become more sustainable and in harmony with their biosphere. The practical part of the research applied on one of the educational complexes in Baghdad, Baghdad Institute of Technology - and evaluated according to "LEED" system. The research follows the descriptive analytical method in its interlocutor. The research concludes with the conclusions and recommendations needed to raise the level of educational buildings.

1. Introduction

Sustainable development is important in creating a sustainable society and a viable environment that meets social, economic, urban and environmental requirements. The campus represents a small community with many and diverse activities and a large number of students and employees.

Achieving the elements of sustainability within this society will be the real nucleus of the larger society and more relevance with its biosphere. "The Leadership in Energy and Environmental Design (LEED) Green Building Rating System" is the U.S. standards for "the design, build, and operation of energy-efficient and green buildings", and "LEED" contributes to raising people's awareness of the dangers of human activities and environmental degradation.

With regard to the long period of construction of the buildings at the Technology Institute campus and the urban development taking place in the modern buildings, this encourages us to start the "LEED" evaluation process in a serious way to see the extent of the eligibility of these buildings to be suitable for higher education within quality requirements. This Study aims to upgrade the status of Technology Institute campus's buildings to suit the requirements of quality and academic accreditation.

Achieving the goal is done through the assessment of the problem leading to the identification of the gaps between the actual situation of the buildings and the requirements of academic accreditation and the quality of the building.



2. Sustainable concept

Humans have a powerful and often negative impact on the environment. The policy-makers and scientists tried to find solutions for the damage's that happened to the planet. Sustainability and sustainable development were the basic approaches to reach the solution. Sustainable development is "defined as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[1]. The foundation of sustainability "is commonly examined through three dimensions: the effect of a phenomenon or system of society (often referred to as social sustainability), its impact on the environment (often referred to as environmental sustainability), and its economic implications (often referred to as economic sustainability). This threefold depiction (Fig. 1) is called the triple bottom line (TBL) of sustainability"[2]; in 1994, Elkington was the first who introduced it and is used until now.

The TBL aims to the integration among the three dimensions, taking into account that each of them is equally important.



Figure 1. The triple bottom line (TBL) of sustainability [3].

3. Campus concept

Webster dictionary defines (campus) as "The grounds and buildings of a university, college, or school, or it is a university, college, or school viewed as an academic, social, or spiritual entity, or it is the area and buildings around a university, college, school, etc." [4]. And OXFORD dictionary defines (campus) as "the buildings of a university or college and the land around them" [5] or "The grounds and buildings of a university or college". The origin of (campus) word dates back to the Late 18th century (originally US): from Latin campus 'field' [6]

The functions of the university institution according to the UNESCO indicators include the following: teaching & learning, scientific research, life-long education, and to build the perfect human.

There are multiple definitions of campus, such as "The campus is not just leftover spaces between buildings. It is, in fact, a series of designing places that reflect the values of an institution's wish to known for. It is a culturally dynamic"[7], while it has been defined according to the ISCN Charter⁽¹⁾ as all the services and facilities of the foundation, including electrical equipment and installations, i.e. the site which includes all the buildings, buildings and sub-sections attached to those educational institutions affiliated with it.[8]

The study of Blaik Omar (2007) shows that Urban University Campus planning focuses not only on the planning of the campus but also on the urban design of the city and its fabric. It is important to

¹⁾ This "ISCN Charter" was prepared by participating tertiary institutions during the 2nd International Sustainable Campus Network Conference of April 23rd-April 25th 2008 in Zurich, Switzerland. The "ISCN Charter" commits institutions of higher education to abide sustainability principles regarding structural developments of their campuses.

achieve physical integration between the campus and the city.[9] This is confirmed by the "LEED" assessment in the site category.

4. Sustainable campus concept

Some institutions identified sustainability principles on campus as follows:[10]

- Planning of adjacent buildings and spaces: College sites must be interconnected with each other and with their surrounding external environment. Sustainability should also be taken into account in outdoor open spaces as an important part of the campus.
- Quality of design: Design must be of high quality.
- Participation: The university community should be involved in the development of sustainability on the campus.
- Education: Environmental awareness should be encouraged for campus users through learning and daily practical practices.
- Resource Management: Consumables used in construction must meet sustainability requirements.
- The cost of the building life cycle: It must be taken into consideration because it plays a role in all investments on campus.
- Treatment and maintenance: Establishing sustainability on campus requires efficiency in implementing appropriate measures.
- Climate change management: stakeholders must be involved in managing changes and working for sustainable development on campus.
- Control and monitoring: Results should be clarified and evaluated

The study (Sharp / 2002) dealt with the main sides of environmental determinism that disclose the nature of the future challenges facing the universities, namely: The first aspect: an effective solution to address environmental change in all operations on campus, and the second aspect: that these solutions are targeted towards a specific goal. Also the study pointed out that there are important indicators derived from the greening of universities, namely: a. "An effective approach to ensuring the survival and expansion of environmental initiatives on campus. b. To deepen the understanding of the nature of universities". Therefore, empirical knowledge should be used to explore new ways to overcome regulatory constraints and introduce new possibilities of systematic transformation towards environmental sustainability on the campus.[11]

5. "Rating systems"

"Rating systems" "for assessing the environmental impact of buildings are technical instruments that aim to evaluate the environmental impact of buildings and construction projects. In some cases, these rating systems can also cover urban-scale projects, community projects, and infrastructures. These schemes are designed to assist project managers in making the projects more sustainable by providing frameworks with precise criteria for assessing the various aspects of a building's environmental impact"[12].

There are six main rating systems available used to assess different types of buildings around the world: "the Building Research Establishment Environmental Assessment Methodology (BREEAM)", "the Comprehensive Assessment System for Built Environment Efficiency (CASBEE)", "the Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB)", "the Haute Qualité Environnementale (HQETM)", "the Leadership in Energy and Environmental Design (LEED)", and "the Sustainable Building Tool (SBTool)". This research is concerned with the "LEED" assessment.

"The Leadership in Energy and Environmental Design (LEED) Green Building Rating System" is the U.S. indicator for "the design", "build", and "operation of energy-efficient" and "green buildings". LEED projects are actually being done in more than forty countries. "The LEED Green Building Rating System" has been developed by the "US Green Building Council (USGBC)" and officially started in 1998 in the US.

"LEED certification" provides independent, third-party verification that a building project meets the highest green building and performance measures. The project that earns "LEED" certification,

will receive a "LEED" plaque, which is indicated to the healthy place to live and work. Earning "LEED" certification mainly has two benefits: environmental and financials[13].

"LEED certification" is "a certification process aimed at rewarding sustainable and environmentally friendly decisions that are part of your construction process. It is a way to demonstrate to you and your customers, that certain environmental goals have been achieved during the design and construction of the structure or facility that is being certified. To be certified, the building project needs to obtain certain points and meet green building standards that will, later on, be validated during the certification process"[14].

"LEED is a voluntary sustainability evaluation methodology and covers all types of buildings: Offices, retail, homes, residential high-rise, public buildings, commercial interiors, etc. Different customized adaptations of the scheme are available for various building types, as well as major renovations and minor refurbishments"[15].

5.1. "LEED" campus and multiple building certification

"Is available for multiple buildings on a single site and offers a number of options to help project owners determine the best, most cost effective way to reach their goals. In some cases, it's one single certification that applies to many buildings and in others it might be reviewing credits once to be utilized by a number of certifications. This process can be used with any of the "LEED" commercial rating systems. A campus can be any shared site; it doesn't have to be a traditional university or corporate campus. This path has been used by hospitals, universities, commercial property management and even a zoo".

Consider "LEED" campus certification if you:

- "Have two or more buildings located on a single site that are controlled by a single entity.
- Would benefit from projects being able to share "LEED" credits and strategies with one another.
- Are constructing multiple buildings that are very similar
- Manage projects that follow the same policies and plans or share the same vendors"[16]

5.2. The Available LEED Rating Systems

"The latest LEED rating system consists of 5 different areas addressing multiple projects:

- Building Design and Construction
- Interior Design and Construction
- Building Operations and Maintenance
- Neighborhood Development
- Homes

These 5 areas are then broken into smaller components where points are given and depending on a number of points received they can obtain one of the following categories:

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

It is very important to highlight that the rating system can be implemented in both, new construction and existing buildings".[17]

5.3. Minimum Requirements of "LEED Certification"

The minimum requirements that The "LEED certification" process needs to get it, are below:

- "Be in compliance with environmental regulations and standards.
- Must meet the threshold of floor area requirements.
- Meet a minimum of building occupancy in terms of number of users.
- Maintain a reasonable site boundary.
- Be a permanent building.
- Share energy and water usage data.

- Must have a minimum building to site area ratio". [18]

5.4. LEED Certification Credit Categories

In order to get credits that meet the above requirements, the project must achieve the criteria within the following categories: [19]

- "Sustainable sites": the project must be designed to minimize environmental pollution, by using ecosystems nearby and the natural resources.
- "Water efficiency": Reduce or reused resources of potable water, also minimizing needs of inside the building through the design of the building.
- "Energy and atmosphere": Promote great indoor air, environmental quality, and energy performance through the design of the building
- "Materials and Resources": The aim of this category is to use strategies to improve the use and conservation of materials and resources, to recycle them for reuse, and thus to reduce the production of new building materials in order to conserve resources and reduce the impact of environmental pollution resulting from the manufacture and transport of these materials.
- "Indoor environmental quality": Improve ventilation performance, in terms of air quality and purity, and try to use natural lighting as much as possible, and provide the best performance to control lighting, and seek to connect the internal environment abroad through natural lighting, and communication through the view of the external environment.
- "Innovation": Any thought, concept, and vision are not covered under "LEED" categories.

5.5. The Benefits of LEED Certification

Getting "LEED" certified has many benefits, they are:

- The building valuation will be increased.
- The liability will be reduces.
- The relationships between employees will be enhanced
- Usage of water and energy will be reduced.
- Indoor air quality will be enhanced.
- Maintenance and operation costs will be reduced.
- It will stir up innovation to improve the performance of the building.
- The construction waste will be reduced during the process.
- Sustainability goals will attract companies.
- The 'sick building' phenomenon will be reduced.
- The employee performance will be improved.
- The reuse of recycled materials will be enhanced.

5.6. "LEED Scheme"

LEED assesses covering the following 6 categories (Fig.2):[20]

- "Sustainable Sites"
- "Water Efficiency"
- "Energy & Atmosphere"
- "Materials & Resources"
- "Indoor Environmental Quality"
- "Innovation in Design"



Figure 2. LEED Credit Categories [21]

There are mandatory credits for any level of LEED certification.

"In LEED v4.1, the rating system is simplified. The scorecard and requirements are streamlined, and new methodologies for tracking and rating performance are integrated directly into the rating system, providing a clear framework for achieving LEED certification, not just for entire buildings, but for spaces within buildings as well. A stronger environmental performance leads to economic prosperity, better of quality of life and improved human health and well-being for all. LEED v4.1 for Building Operations and Maintenance (O+M) will support this goal by tracking performance in energy, water, waste, transportation, indoor air quality, toxin-free environment and occupant satisfaction." [22]

6. Case study

6.1. About Technology Institute

It is one of the oldest Iraqi institutes founded in 1969. It is one of the formations of the Institute of Technical Institutes. The Institute provides public and private sectors with staffs and youth energies that help rebuilding Iraq, committing themselves to develop the country. The campus is located in the south of Baghdad in Al-Zafaraniya city. It was formerly known as the University of Hekma or the American University, which Founded in 1956 by the Jesuit Fathers coming from the province of New England and completed work in 1959. In 1969 the university was dissolved by the Iraqi government, and merged its faculties at the University of Baghdad and transformed the American University buildings into a technology institute – Baghdad. Then the buildings of the American University became the Institute of Technology – Baghdad. Fig 3 shows the map (3D) of the Technical Institute-Baghdad.



Figure 3. Map of Technology institute – Baghdad[23]

6.2. Technology Institute Buildings' Assessment

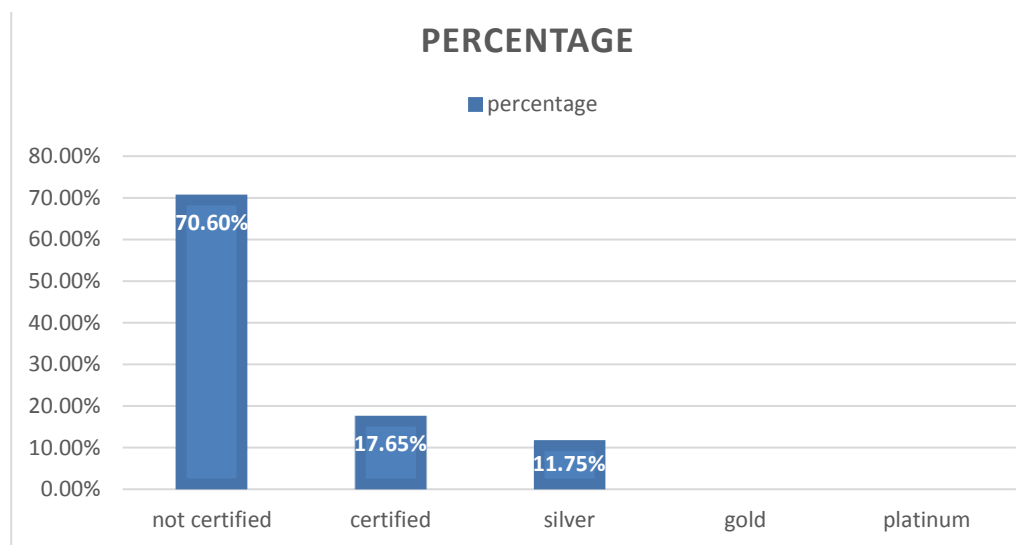
The Institute of Technology campus has 34 buildings, the researchers of this research assessed 50% of them. A total of 17 buildings were assessed. Scores of the chosen buildings are depicted in Table (1) while Table (2) represents the final assessment of Technology Institute Buildings (see Chart 1).

Table 1. The chosen buildings and their scores.

No.	Department	Construction date	Score	Assessment
1.	Deanship	1980s	49	Silver
2.	Department of Civil Techniques	1970s	35	Certifies
3.	Department of Electrical Techniques	1950s	27	Not-certified
4.	Department of Information Technology	1980s	30	Not-certified
5.	Department of Chemical Industries	1970s	38	certified
6.	Department of Electronic Technologies	2000s	49	silver
7.	Department of Water Resources Technologies	1970s	32	Not-certified
8.	Central Library - Computer Center	1950s	42	certified
9.	students Affairs	1950s	29	Not-certified
10.	Dormitories	2000s	30	Not-certified
11.	Student Club	1990s	26	Not-certified
12.	Laboratory maintenance	1980s	30	Not-certified
13.	Thermal Operating Laboratory	1960s	29	Not-certified
14.	Electrical Machinery Lab	1980s	33	Not-certified
15.	Plumbing Workshop	1960s	28	Not-certified
16.	Turning Workshop	1960s	26	Not-certified
17.	Welding workshop	1960s	26	Not-certified

Table 2. Assessment of technology Institute buildings

No.	Department	Not certified	certified	Silver	Gold	Platinum
1.	Deanship			✓		
2.	Department of Civil Techniques		✓			
3.	Department of Electrical Techniques	✓				
4.	Department of Information Technology	✓				
5.	Department of Chemical Industries		✓			
6.	Department of Electronic Technologies			✓		
7.	Department of Water Resources Technologies	✓				
8.	Central Library - Computer Center		✓			
9.	students Affairs	✓				
10.	Dormitories	✓				
11.	Student Club	✓				
12.	Laboratory maintenance	✓				
13.	Thermal Operating Laboratory	✓				
14.	Electrical Machinery Lab	✓				
15.	Plumbing Workshop	✓				
16.	Turning Workshop	✓				
17.	Welding workshop	✓				
	Total points	12	3	2	0	0
	Percentage	70.6%	17.65%	11.75%	0%	0%

**Chart 1.** Assessment of technology Institute buildings [23]

7. Conclusions

From all above, the research has found that most of the technology institute campus's buildings are NOT CERTIFIED (about 70%), while only 17.65% is considered CERTIFIED and 11.75% SILVER.

- The importance of sustainable campus as an educational institution that takes into account the requirements of sustainability in the organizational and educational processes.
- The current trends emphasize the importance of sustainable campus in terms of all the land, external spaces and buildings, and the relationship between them as well as the services and facilities that achieve sustainability in several dimensions and according to planning and

design considerations of the principles of sustainability and its requirements to serve institutions of higher education and academic, environmental and social, With contemporary global calls to create a sustainable society, environment and economy.

- The results of the application showed that the local campus built (Baghdad Technological Institute campus) lacks many of the design aspects of the sustainable campus, if the development and rehabilitation of buildings and services in accordance with the language of the age and the requirements of sustainability.

8. Recommendations

The following general recommendations are suggested to upgrade any campus, especially the buildings of technology institute campus.

- Short-term steps: All buildings to be constructed must comply with the American Gold Building Council's LEED Gold Standard.
- Medium-term steps: All existing buildings on campus must be renewed to meet the US LBC's Silver LEED standards.
- Long-term steps: Any planning and design of the campus should be carried out or rehabilitated according to the planning and design aspects of the campus.
- Adoption of sustainable transport.
- Install Indoor Plumbing Fixture and Fitting.
- Develop a building operating plan.
- Document the current sequence of operations systems for the building.
- Install Exhaust Systems, Tobacco Smoke (ETS) Control, and use of Green Cleaning products.
- Use local and Sustainable material in construction.
- Plan a Sustainable Purchasing Policy.
- Improve the storm water system of the buildings and install water measurement metering device for the building.
- Supply the buildings with suitable grey water treatment plant and use treated grey water for landscape irrigation OR reactivate the raw water system for irrigation.
- Install a drip irrigation system.
- Construct a renewable energy system for the buildings (solar energy & wind energy).
- Supply the building with IAQ measuring detectors for determining the degree of pollution and use the (e-windows, e-doors ... etc.) to improve IAQ quality.
- Stop making divisions to the interior spaces of the buildings.
- Installation of light sensors to reduce power consumption.
- Apply the policy of Green Cleaning.
- Apply thermal comfort monitoring.
- Preparing Emissions Reduction Reporting.
- Preserving the site of the campus and its old buildings.

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