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Applicability of LEED Certification system in Palestine

Mustafa Abedmousa and Dr Abdul Naser Arafat
Birzeit University- Palestine

Abstract,
Due to the increasing of environmental concerns, there has been a growing interest towards building healthier communities and structures. Governmental bodies as wells environmental protection agencies have developed many regulations towards protecting the environment through reducing the use of energy and saving our natural resources. Recently having green buildings is an indicator to having successful projects.
Several evaluation methods for development and neighborhoods have been established, Leadership in Energy and Environmental Design (LEED) is one of these rating-systems that is used in the USA to evaluate to buildings, spaces, and neighborhoods in the context of their surroundings. The United States Green Building Council (USGBC) devises a rating system to evaluate the environmental performance of a building and to get a sustainable design in USA. Under the provisions of this system the projects undergoes a series of prerequisites and can earn points from environmentally friendly actions taken during construction and use of a building. Based on the number of points achieved, a project then receives one of four LEED rating levels: Certified, Silver, Gold and Platinum.
According to the USGBC criteria, there are few projects that can be certified in Palestine. One of these projects that has it certification in progress is the Palestinian Museum in Birzeit – Palestine.. In this article, the possibility of applying LEED requirements for new construction is investigated. The study tests how far LEED credits are viable in the Palestine how relevant data can be collected or obtained. The results of this study Points to the differences in urban context that makes it difficult to apply LEED locally. Furthermore, the study should contribute to a better understating of the concept of LEED and green building rating systems and their implementation in Palestine. Finally, the study will make recommendations on how LEED can be modified to be more applicable in Palestine.

1. Introduction:

Having green buildings means healthier more prolific places, encouraging energy and resource-efficient buildings, increasing the value of the building and decreasing the utility costs. Experts in the U.S. argue that such buildings can reduce up to 50% of the energy use, 39% of the CO_2 emission, 40% of the water use and 70% of solid waste (Turner and Frankel (2008), Kats (2009) and GSA Public Building service (2008)). Moreover, what is responsible for a large proportion of greenhouse gas emissions is urban growth. According to US Census Bureau in 2011, the world population is expected to increase by 2 billion by the end of year 2050. Therefore having a green building becomes a vital issue to meet our current needs without sacrificing natural resources needed for future generations. Green building term could be defined as designing and building healthy facilities in a resource- efficient manner using cost-effectively based principles (Kibert, 2013). Governmental bodies as well as environmental protection agencies have developed many regulations towards protecting the environment through reducing the use of energy and saving our natural resources. Recently having a green building is an indicator to having a successful project.
According to Jabareen (2006), although there is an agreement about the definition of sustainable development concepts; there is no concern on the definition of the sustainable development and evaluation process of sustainability. Several evaluation methods for development and neighborhoods scales have been established. But there is no particular

method that can be used as an assessment tool to provide an objective evaluation (Garde, 2009). Some of the green building assessment indicators are discussed in the following paragraphs.

1.1. Living Building Challenge which is created by Cascadia Green Building Council (a chapter of both the US Green Building Council and Canada Green Building Council, and their requirements are higher than LEED. (Kibert, 2013).

1.2. Building Research Establishment Environmental Assessment Method (BREEAM), this was established in the UK as an assessment tool for the sustainability for new constructions. This assessment indicator which was first launched in 1990 is used in more than fifty countries and considered the leading and first environmental accreditation system for buildings. It serves as foundation for many assessments systems like The LEED. Over 250,000 buildings have been certified by BREEAM since 1990.

1.3. Haute Qualité Environnementale (High Quality Environmental Standard), this system was established in 1992 in France. This assessment indicator tries to integrate the choice of construction method and materials. The relation between buildings and their immediate environment is also considered. (HQE (2017)).

1.4. Comprehensive Assessment System for Built Environment Efficiency (CASBEE) is a Japanese rating system for buildings. This system defines the environmental efficiency as maximizing the ratio of the quality of the building to the environmental loadings. (Comprehensive Assessment System for Built Environment Efficiency (CASBEE)(2017)).

1.5. Green star which is developed in 2002 by the green building council of Australia, it was adopted as platform for national green building assessment systems in South Africa and New Zealand. (Green building council of Australia (2017))

1.6. The German sustainable building council (DGNB Deutsche Gesellshaft für Nachhaltiges Bauen) is an assessment system for construction for government buildings, commercial and nonresidential buildings. (The German sustainable building council (2017)).

1.7. Leadership in Energy and Environmental Design (LEED) is a rating-system that is used in the USA to evaluate to buildings, spaces, and neighborhoods in the context of their surroundings. The United States Green Building Council (USGBC) devises a rating system to evaluate the environmental performance of a building and to get a sustainable design in USA. Under the provisions of this system the projects undergoes a series of prerequisites and can earn points from environmentally friendly actions taken during construction and use of a building. Based on the number of points achieved, a project then receives one of four LEED rating levels: Certified, Silver, Gold and Platinum. (LEED v4 (2016)).

2. Background on LEED

In 1993 the US Green Building Council (USGBC) was founded as a nonprofit organization. The aim of this council is to promote green buildings in order to achieve a more sustainable environment. Different products of LEED were issued since it was established till now. The first LEED product was issued in 1998 for beta testing and the

newest version is LEED4.0. The aim of LEED is to address the complete life cycle for the buildings. Some of the LEED systems are

- Building Design and Construction and Major Renovations (BD+C)
- Existing Building Operations and Maintenance (O+M)
- Interior Design and Construction (ID+C)
- Core and Shell Development Projects (CS)
- Homes (H)
- Neighborhood Development (ND)

In this article, the applicability of LEED system regarding Building design and Construction and Major renovations (BD+C) in Palestine will be studied.

3. Building Design and Construction and Major Renovations (BD+C)

This rating system focuses on the development of commercial and institutional projects. Despite the fact that the main focus of this system is the commercial spaces, it also provides additional guidelines and scoring systems for other building types like schools, retail, healthcare and warehouse and distribution centers.

As mentioned earlier, under the provisions of this system the projects undergo a series of prerequisites and can earn points from environmentally friendly actions taken during construction and use of a building. Under this rating system there are 26 possible points for sustainable site, 10 possible points for water efficiency, 35 possible points for Energy and Atmosphere, 14 possible points for Materials and Resources, 15 possible points for Indoor Environmental Quality, 6 possible points for Innovation in Design and 4 possible points for Regional Priority. Based on the number of points achieved a project then receives one of four LEED rating levels: Certified, Silver, Gold and Platinum. (LEED v4 (2016)).

4. How applicable LEED is

Experts have different opinions about LEED. Some of them argue that LEED is "the triple bottom line in action, benefiting people, plant and profit". Other authors claim that, LEED is for US not other places since many credit points are not relevant to other places outside the US. The other objection for the use of LEED is that the idea of the high cost of the green building in comparison with the conventional building. According to Abo Neama (2012), LEED is based only on collecting some points and achieving some prerequisites but sustainability cannot really achieved by this way. He also pointed out whether sustainability achieved by these collecting points or not, the point collection is the only concern of some consultants. Others like Humbert (2007) made a suggestion for modified scoring system for LEED credits since the existing weights or possible points on each of the five environmental categories which are sustainable site, water efficiency, Energy and Atmosphere, Materials and Resources and Indoor Environmental Quality evaluated in LEED are not reflecting the environmental benefits. Moreover, Gifford (2008) states that the whole process of evaluation used in LEED rating system are more business driven than environmentally driven.

According to the USGBC criteria, there are few projects that can be certified in Palestine. One of these projects that have its certification in progress is the Palestinian Museum in Birzeit – Palestine. According to Higgawi (2016), Palestinian museum is the first energy –efficient green building in Palestine. Moreover, there is a plan to apply for other two under construction projects to be LEED certified. These projects are AQABA School and Abdulmusen Qattan's foundation. The two main problems of having LEED certified projects in Palestine are the cost and occupation. According to Higgawi (2016) the cost of green

building is 15-20% more than traditional building and there are scarcities of lands that can fit the LEED requirements.

In this article, the possibility of applying LEED requirements for new construction is investigated. The study tests how far LEED credits are viable in the Palestine how relevant data can be collected or obtained. The results of this study Points to the differences in urban context that makes it difficult to apply LEED locally. Furthermore, the study should contribute to a better understating of the concept of LEED and green building rating systems and their implementation in Palestine. Finally, the study will make recommendations on how LEED can be modified to be more applicable in Palestine.

5. Pillars of green buildings sustainability

The idea of having green building is to meet our current needs without sacrificing natural resources needed for future generations. Furthermore, it can be argued that, in order to have a sustainable development a balance between the three pillars which are environmental protection, social equity, and economic development should be stroked. Table 1 below provides the principles of green buildings as summarized by Hussein et al (2013)

Table 1: Pillars of green building (developed from http://www.iaesjournal.com)

A. Environment aspect	1. Increase material efficiency by reducing the material demand of non-renewable goods 2. Reduce the material intensity via substitution technologies. 3. Enhance material recyclability. 4. Reduce and control the use and dispersion of toxic materials. 5. Reduce the energy required for transforming goods and supplying services. 6. Support the instruments of international conventions and agreements. 7. Maximize the sustainable use of biological and renewable resources. 8. Consider the impact of planned projects on air, soil, water, flora, and fauna.
B. Economic aspect	1. Consider life-cycle costs. 2. Internalize external costs. 3. Consider alternative financing mechanisms. 4. Develop appropriate economic instruments to promote sustainable consumption. 5. Consider the economic impact on local structures.
C. Social Aspect	1. Enhance a participatory approach by involving stakeholders. 2. Promote public participation. 3. Promote the development of appropriate institutional frameworks. 4. Consider the influence on the existing social framework. **5.** Assess the impact on health and the quality of life.

From table above, it can be stated that, green buildings have a lot of benefits from more one side and examples for those benefits could be environmental like reducing wastage of water and improving the quality of air and water, economical like reducing operating cost and creating market for green products and Social like improving the quality of life and minimizing strain on local infrastructure.

6. Methodology

In this paper, the likelihood of applying LEED requirements in Palestine for new construction will be investigated. Thus, the LEED rating system checklist (prerequisites and credits) and its relevant data will be analyzed and tested and see how far LEED prerequisites and credits are viable in Palestine. The credits and prerequisites will be fall in one of four categories in terms of their applicability. These types are either easily achieved, project based, rarely achieved; high cost and cannot be achieved prerequisites and credits.

In order to conduct our evaluations to draw the results and conclusion, data sources and availability will be checked. Based on these evaluations, the prerequisites and credits will be classified under one of the following categories easily achieved; project based, rarely achieved; high cost and cannot be achieved prerequisites and credits.

Moreover, in order to know the idea of the people about green building and the barriers of having green buildings in Palestine a questionnaire survey will be distributed to a random sample of experts in construction field. Then the data will be analyzed using Statistical Package for Social Sciences SPSS. Using SPSS, what turns people away from the ideas of having green buildings, what drives people in their support for green building and what is the accepted price difference between green and traditional building will be analyzed.

7. Analysis of LEED v4 for Building design and construction in Palestine

I. Sustainable sites (26 points)

A. Prerequisite: construction activity pollution prevention :

a) To prevent loss of soil during construction by storm water runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse.
b) To prevent sedimentation of storm sewers or receiving streams.
c) To prevent pollution of the air with dust and particulate matter.

B. Credits

a. Site selection (1 point)

The preference should be given to sites that do not include sensitive elements or restrictive land types. Select a suitable building location and design the building with a minimal footprint to minimize disruption of the environmentally sensitive areas. The data and software needed are: master plan for the city or the village, topographic map, Arial photograph, soil tests, EIA for the projects and GIS to select the best location.

b. Development Density and Community Connectivity (5 points)

The preference should be given to urban sites with pedestrian access to a variety of services. To channel development to urban areas with existing infrastructure, protect Greenfields, and preserve habitat and natural resources.

c. Brownfield Redevelopment (1 point).
d. Alternative Transportation—Public Transportation Access (6 points): The sources of data are Ministry of public transportation and Municipality master plans.
e. Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles (3 points).
f. Alternative Transportation—Parking Capacity (2 points): Minimize parking lot/garage size. Sharing parking facilities with adjacent buildings should be considered.
g. Site Development—Protect or Restore Habitat and Maximize Open Space (2 point): A site survey to identify site elements is required and the master plans for developing the projects sites should be adopted.
h. Storm water Design—Quantity Control (1 point): Design the project site to maintain natural storm water flows by promoting infiltration. Reusing of storm water for non-potable uses should be considered.

i. Heat Island Effect—Non-roof (1 point): Employ strategies, materials and landscaping techniques that reduce the heat absorption of exterior materials. Use shade (calculated on June 21, noon solar time) from native or adapted trees and large shrubs, vegetated trellises or other exterior structures supporting vegetation. Using new coatings and integral colorants for asphalt to achieve light-colored surfaces instead of blacktop should be considered. Consider replacing constructed surfaces (e.g., roof, roads, sidewalks, etc.) with vegetated surfaces.

j. Heat Island Effect—roof (1 point): Installing vegetated roofs to reduce heat absorption should be considered.

k. Light Pollution Reduction (1 point): Adopt site lighting criteria to maintain safe light levels while avoiding off-site lighting and night sky pollution. Minimize site lighting where possible, and use computer software to model the site lighting.

II. Water Efficiency (10 points)

A. Prerequisites- Water Use Reduction

a) Potential Technologies & Strategies Water sense-certified fixtures and fixture fittings should be used where available. To reduce potable water demand, it is required to use high-efficiency fixtures (e.g., water closets and urinals) and dry fixtures, such as toilets attached to composting systems. Consider using alternative on-site sources of water (e.g., rainwater, storm water, and air conditioner condensate) and graywater for non-potable applications such as custodial uses and toilet and urinal flushing.

B. Credits

a) Water efficient landscaping (2-4 points): To limit or eliminate the use of potable water or other natural surface or subsurface water resources available on or near the project site for landscape irrigation. Perform a soil/climate analysis to determine appropriate plant material and design the landscape with native or adapted plants to reduce or eliminate irrigation requirements.

b) Innovative wastewater technologies (2 Points): To reduce wastewater generation and potable water demand while increasing the local aquifer recharge. Specify high-efficiency fixtures and dry fixtures (e.g., composting toilet systems, nonwater-using urinals) to reduce wastewater volumes. Consider reusing stormwater or graywater for sewage conveyance or on-site mechanical and/ or natural wastewater treatment systems.

c) Water use reduction (2-4 points): Use Water sense-certified fixtures and fixture fittings where available. Use high-efficiency fixtures (e.g., water closets and urinals) and dry fixtures, such as toilets attached to composting systems, to reduce the potable water demand. Consider using alternative on-site sources of water (e.g., rainwater, stormwater, and air conditioner condensate, graywater) for non-potable applications (e.g., toilet and urinal flushing, custodial uses).

III. Energy and atmosphere (35 points)

A. Prerequisites:

1.1. Fundamental Commissioning of Building Energy Systems: Extra cost, conceptual design should include the required systems based on owner requirements

1.2. Minimum energy performance: Design the building envelope and systems to meet baseline requirements. Use a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures. Quantify energy performance compared with a baseline building

1.3. Fundamental Refrigerant Management: For new buildings, specify new HVAC equipment in the base building that uses no CFC-based refrigerants.

B. Credits:

a) Optimize energy performance (1-19 points): Design the building envelope and systems to maximize energy performance. Use a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures. Quantify energy performance compared with a baseline building.

b) On-site renewable Energy (1-7 points): Assess the project for nonpolluting and renewable energy potential including solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies.

c) Enhanced Refrigerant Management (2 points): Design and operate the facility without mechanical cooling and refrigeration equipment. Where mechanical cooling is used, utilize base building HVAC&R systems for the refrigeration cycle that minimizes direct impact on ozone depletion and global climate change. Use fire suppression systems that do not contain HCFCs or halons.

d) Measurements and verification (3 points): Develop an M&V plan to evaluate building and/or energy system performance. Characterize the building and/or energy systems through energy simulation or engineering analysis. Install the necessary metering equipment to measure energy use. Track performance by comparing predicted performance to actual performance, broken down by component or system as appropriate.

e) Green power (2 points): All purchases of green power shall be based on the quantity of energy consumed, not the cost. Determine the energy needs of the building and investigate opportunities to engage in a green power contract.

IV. Materials and resources (14 points)

A. Prerequisite- Storage and Collection of Recyclables: Designate an area for recyclable collection and storage that is appropriately sized and located in a convenient area. Identify local waste handlers and buyers for glass, plastic, metals, office paper, newspaper, cardboard and organic wastes.

B. Credits:

a) Building reuse - Maintain Existing Walls, Floors and Roof (1-3 points): consider reusing existing, previously-occupied building structures, envelopes and elements. Remove elements that pose a contamination risk to building occupants and upgrade components that would improve energy and water efficiency such as windows, mechanical systems and plumbing fixtures

b) Construction waste management (1-2 points).

c) Materials reuse (1-2 points): Identify opportunities to incorporate salvaged materials into the building design, and research potential material suppliers.

d) Recycled Content (1-2 points): Consider a range of environmental, economic and performance attributes when selecting products and materials.

e) Regional Materials (1-2 points): Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within a specified distance of the project site for a minimum of 10% or 20%, based on cost, of the total materials value.

f) Rapidly Renewable Materials (1 point): During construction, ensure that the specified renewable materials are installed

g) Certified wood (1 point).

V. Indoor environmental quality (15 points)

A. Prerequisites:

a. Minimum Indoor Air Quality Performance: Design ventilation systems to meet or exceed the minimum outdoor air ventilation rates as described in the ASHRAE

standard. Balance the impacts of ventilation rates on energy use and indoor air quality to optimize for energy efficiency and occupant comfort. You may need documents for the sources of pollution, a study about air quality in that area if applicable. Mechanical drawings for both Air Intake Points and Exhaust Air Discharge Points spread sheet to calculate the ventilation rate for all indoor spaces are needed.

b. Environmental Tobacco Smoke (ETS): Control Prohibit smoking in commercial buildings or effectively control the ventilation air in smoking rooms. For residential buildings, prohibit smoking in common areas and design building envelope and systems to minimize ETS transfer among dwelling units.

B. Credits:

a) Outdoor Air Delivery Monitoring (1 point): Install CO_2 and airflow measurement equipment and feed the information to the heating, ventilating and air conditioning (HVAC) system and/or building automation system (BAS) to trigger corrective action, if applicable.

b) Increased Ventilation (1 point): Dynamic Simulation Modeling is needed to calculate the CO2 levels and Historic weather data is also needed.

c) Construction Indoor Air Quality Management Plan—During Construction (1 point): Adopt an IAQ management plan to protect the heating, ventilating and air conditioning (HVAC) system during construction, control pollutant sources and interrupt contamination pathways. Sequence the installation of materials to avoid contamination of absorptive materials, such as insulation, carpeting, ceiling tile and gypsum wallboard. If possible, avoid using permanently installed air handlers for temporary heating/cooling during construction

d) Construction Indoor Air Quality Management Plan—Before Occupancy (1 point): Prior to occupancy, perform a building flush-out or test the air contaminant levels in the building. Testing the quality of the air using a certified equipment and repeat the test after 5 years.

e) Low-Emitting Materials—Adhesives and Sealants (1 point): Review product cut sheets, material safety data (MSD) sheets, signed attestations or other official literature from the manufacturer clearly identifying the VOC contents or compliance with referenced standards.

f) Low-Emitting Materials—Paints and Coatings (1 point): Specify low-VOC paints and coatings in construction documents. Track the VOC content of all interior paints and coatings during construction.

g) Low-Emitting Materials—Flooring Systems (1 point): Clearly specify requirements for product testing and/or certification in the construction documents. Select products that are either certified under the Green Label Plus program or for which testing has been done by qualified independent laboratories in accordance with the appropriate requirements.

h) Low-Emitting Materials—Composite Wood and Agri-fiber Products (1 point): Specify wood and agri-fiber products that contain no added urea-formaldehyde resins.

i) Indoor Chemical and Pollutant Source Control (1 point): Design facility cleaning and maintenance areas with isolated exhaust systems for contaminants.

j) Controllability of Systems—lighting (1 point): Design the building with occupant controls for lighting.

k) Controllability of Systems—Thermal Comfort (1 point): Design the building and systems with comfort controls to allow adjustments to suit individual needs or those of groups in shared spaces.

l) Thermal Comfort—Design (1 point): Evaluate air temperature, radiant temperature, air speed and relative humidity in an integrated fashion, and coordinate these criteria with IEQ Prerequisite 1: Minimum IAQ Performance, IEQ Credit 1: Outdoor Air Delivery Monitoring, and IEQ Credit 2: Increased Ventilation.

m) Thermal Comfort—Verification (1 point): Establishing thermal comfort criteria and documenting and validating building performance to the criteria.

n) Daylight and Views—Daylight (1 point): Design the building to maximize interior day-lighting. Strategies to consider include building orientation, shallow floor plates, and increased building perimeter. Predict daylight factors via manual calculations or model day lighting strategies with a physical or computer model to assess foot candle (lux) levels and daylight factors achieved.

VI. Daylight and Views—Views (1 point): Design the space to maximize day-lighting and view opportunities.

VII. Innovation in Design (6 points)

A. Credits:

a) Innovation in Design (1-5 points). Substantially exceed a LEED 2009 for New Construction and Major Renovations performance credit such as energy performance or water efficiency. Apply strategies or measures that demonstrate a comprehensive approach and quantifiable environment and/or health benefits.

b) LEED Accredited Professional (1 point): At least 1 principal participant of the project team shall be a LEED Accredited Professional.

VIII. Regional Priority (4 Points)

A. Credits:

a) Regional Priority (1-4 points): It cannot be applied in Palestine

8. Data Sources

Table 2 provides the List of data needed and its sources in order to check the applicability to apply LEED prerequisites as it is in Palestine. Also, it gives the category of each prerequisite for the five environmental aspects of LEED. The categories are

- Easily Achieved (EA)
- Project dependent (PD)
- High capital cost (HC)
- Not applicable (NA)

Table 2: Data needed and Sources for LEED for building design and construction Prerequisites

Environmental aspect		**Data needed**	**Data sources**	**Category**
Type	**Name**			
Sustainable sites	Prerequisite: construction activity pollution prevention	• Master plan for the city or the village • Topographic map • Arial photograph • Soil tests (Geotechnical tests) • EIA for the projects	• Municipalities • Department of surveying • Owners for the projects	**HC**
Water Efficiency	Prerequisites-Water Use Reduction	• The mechanical design for the buildings • Types of water and	• Owners and consultants of the projects • The suppliers	**HC**

		wastewater fitting used in Palestine	for water and wastewater fittings	
Energy and atmosphere	Prerequisites-Fundamental Commissioning of Building Energy Systems	• Concept design • Systems available	• Owners and consultants of the projects	**HC**
	Prerequisites-Minimum energy performance	• Concept design for energy • Computer models • Software • Energy efficiency measuring tool	• Owners and consultants of the projects • Electricity companies	**HC**
	Prerequisites-Fundamental Refrigerant Management	• Available HVAC units • Mechanical design	• Owners and consultants of the projects	**HC**
Materials and resources	Prerequisite-Storage and Collection of Recyclables	• Waste management plan • Topographic map • Water table and soil reports	• Municipalities • Department of surveying	**HC**
Indoor environmental quality	Prerequisite-Minimum Indoor Air Quality Performance	• HVAC design • Study of air quality • Mechanical drawings for both Air Intake Points and Exhaust Air Discharge Points • spread sheet to calculate the ventilation rate for all indoor spaces	• Owners and consultants of the projects • Ministry of environment	**HC**
	Prerequisite-Environmental Tobacco Smoke	• Mechanical Drawings	• Owners and consultants of the projects	**EA**

Table 3 provides the List of data needed and its sources in order to check the applicability to apply LEED credits as it is in Palestine. Also, it gives the category of each credit for the five environmental aspects of LEED, Innovation in Design and Regional Priority. The categories are

- Easily Achieved (EA)
- Project dependent (PD)
- High capital cost (HC)
- Not applicable (NA)

Table 3: Data needed and Sources for Applying LEED for building design and construction credits

Credit		Data Needed	Data source	Points can be achieved under each category			
Type	Name			EA	PD	HC	NA
S.S.	Site selection	A. master plan for the city or the village B. topographic map C. Arial photograph D. Soil tests (Geotechnical tests) E. EIA for the projects F. GIS Software	• Municipalities • Department of surveying • Owners for the projects • Department of Geography –Birzeit university			1p.	
	Development Density and Community Connectivity	A. topographic map B. Arial photograph C. GIS Software	• Municipalities • Department of surveying • Owners for the projects • Department of Geography –Birzeit university			5Ps	
	Brownfield Redevelopment	A. topographic map B. master plan for the city or the village	• Municipalities • Department of surveying		1p		
	Alternative Transportation—Public Transportation Access	A. master plan for the city or the village B. capacity of roads C. main roads D. transit services in the city	• Municipalities • Ministry of public transportation			6ps	
	Alternative Transportation—Bicycle Storage and Changing Rooms						1p
	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles						3 ps
	Alternative Transportation—Parking Capacity	A. topographic map B. Arial photograph	• Municipalities • Department of surveying • Department of Geography –Birzeit university			2Ps	
	Site	A. topographic	• Municipalities	1 P			

	Development—Protect or Restore Habitat	map	• Department of Geography –Birzeit university				
	Site Development—Maximize Open Space	A. master plan for the city or the village B. capacity of roads C. main roads	• Municipalities • Department of Geography –Birzeit university			1 P	
	Storm water Design	A. Rainfall charts	• Ministry of water		1 p		
	Heat Island Effect—Nonroof	A. Drawings for the project	• Consultant of the project		1p		
	Heat Island Effect—roof	A. Drawings for the project	• Consultant of the project		1p		
	Light Pollution Reduction						1 p
W.E.	Landscaping	A. soil/climate analysis B. Irrigation systems	• Department of Geography –Birzeit university			2ps	
	Innovative wastewater technologies						2 ps
	Water use reduction	A. Water consumption B. Water meter	• Water companies			4 ps	
E&A	Optimize energy performance	A. Computer models B. Software C. Energy efficiency measuring tool	• Owners and consultants of the projects • Electricity companies			9PS	
	On-site renewable Energy				1-7		
	Enhanced commissioning						2Ps
	Enhanced Refrigerant Management						2PS
	Measurements and verification	A. Electricity meter B. Data about energy consumptions	• Electricity companies			3ps	
	Green power						2ps
M&R	Building reuse				1-3		
	Maintain Interior Nonstructural Elements				1		
	Construction Waste Management	A. Waste management plan	• Owners and consultants of the projects			1-2	
	Materials reuse				1-2		
	Recycled Content				1-2		

	Regional Materials	A. topographic map B. Arial photograph	• Municipalities • Department of surveying • Department of Geography –Birzeit university	1-2			
	Rapidly Renewable Materials	A. Arial photograph	• Agricultural ministry • Department of Geography –Birzeit university		1p		
	Certified wood	A. Requirements of wood	• Suppliers of wood			1 p	
EIQ	Outdoor Air Delivery Monitoring	A. Mechanical drawings	• Owners and consultants of the projects			1ps	
	Increased Ventilation	A. Historic Weather Data B. Software	• Palestinian Meteorological depa rtment			1 p	
	Construction Indoor Air Quality Management Plan—During Construction					1p	
	Construction Indoor Air Quality Management Plan—Before Occupancy					1p	
	Low-Emitting Materials—Adhesives and Sealants				1p		
	Low-Emitting Materials—Paints and Coatings				1p		
	Low-Emitting Materials—Flooring Systems					1 p	
	Low-Emitting Materials—Composite Wood and Agrifiber Products						1 p
	Indoor Chemical and Pollutant Source Control						1p
	Controllability of Systems—lighting	A. Electrical design B. Electrical material	• Owners and consultants of the projects			1p	
	Controllability of Systems—Thermal Comfort					1p	
	Thermal Comfort—Design					1 p	

	Daylight and Views—Daylight	A. building orientation	• Department of architecture		1p		
	Daylight and Views—Views	B. interior design	• Owners and consultants of the projects		1p		
ID	Innovation in Design					1-5	
	LEED Accredited Professional					1	
RP	Regional Priority						4P

9. Statistical analysis

In order to test the applicability of green building in Palestine, a survey was conduct. The questionnaire focused on the incentives that could encourage the experts and people to purchase or renovate green building, defining and finding what features drive people in their support for green building and are the main factors that turn people away from the ideas that make up green building initiative. This questionnaire investigates the level of awareness of the green building concept amongst the various categories within the key stakeholders in the construction industry in Palestine. The survey was sent to 100 people including surveyors, architect, sustainability consultant, property consultant, and building service engineers. A total of 66 replies were received for a response rate of 66%. All of the responded questionnaires are valid. Then the Statistical Package for Social Sciences SPSS will be used to analyze the questionnaires and to draw the results and conclusion.

10. Results and Discussion

Based on SPSS Analysis for questionnaires, the survey respondents are classified into six groups, G1 to G6. Table 4 provides the respondent distribution in each category. Only 18% of the sample has awareness in green building against 6% of respondents whom are not aware about green buildings. An overwhelming 62 percent of respondents cannot consider themselves as experts in green building field but they have some knowledge about it.

Table 4: Distribution of survey respondents

Category	Description	Frequency	Percent
G1	Surveyors	1	1.5
G2	Sustainability consultant	8	12.1
G3	Architect	10	15.2
G4	Property consultant	6	9.1
G5	Building services engineer	40	60.6
G6	Other	1	1.5

Respondents were also asked to identify their gender and their age in one of four categories. Due to zero responses in one categories, the ultimately age was measured in one of three categories; 22-30, 31-40 and those over 40 as given in table 5. According to table 5, 52 percent of respondents are between 22-30 years.

Table 5: Distribution of respondents' age group and gender

Age Group	Frequency Gender		Percent Gender		Total percent
	Female	Male	Female	Male	
22-30	10	24	15.2	36.4	51.6
31-40	1	16	1.5	24.2	25.7
Above 40	0	15	0	22.7	22.7

Based on frequency analysis, it is found that 77% of respondents argue that green buildings are more desirable than traditional buildings and 83% thinks that green buildings present a more desirable investment than traditional one, i.e. it is more attractive to them to invest in green buildings. 61% of respondents agreed that retrofitting a building with Low to Zero Carbon Technology makes it more attractive to investors, residents and purchasers.

On the other hand, 55% of respondents agreed that higher investment cost makes the investor to be less supportive to green building ideas. 62% of respondents pointed that; the growth of green building will be very slow because of the financial barriers of such buildings. Additionally, 87% and 73% of survey respondents argued that having green buildings will make significant increases in both the capital and rental costs of buildings.
It is worth to mention that, the questionnaire investigates and ranks the incentives would encourage respondents to purchase or renovate green building. Having Low utility bills were among top ranked and emissions reduction was least preferable incentive. The gender of respondents and the age groups proved to be significance in term of support of some incentives. The crammer's V for weakness or strength of whole-life cycle cost saving incentive was found to be 0.194 for females and 0.207 for males, i.e. there is a moderate strength between gender and age group. Despite the fact that, both males and females who agreed for the top ranked incentive for having green building, their responses for the least important factors are different. Males' respondents put emissions reduction as least important factor and females had chosen increased property values for the building. Table six gives the percent based on gender and the total percent for the most interested answers for each incentive.

This questionnaire investigated the green building features that the stakeholders interested in. The features studied are indoor environmental quality, water conservation, energy efficiency and renewable energy, waste reduction, the use of recycled material in construction and operations, design buildings which will reduce greenhouse effect and global warming and environmental preferable building materials and other resources. All investigated features were examined against the age groups. Only the indoor environment quality had a Cramer's value of 0.334 which means a strong relation between this incentive and the age categories. The other incentives had Cramer's value range between (0.1-0.29), i.e. moderate strength with the age groups.

From table 7, it can be recognized that most of the respondents were highly supportive for indoor environmental quality, water efficiency, energy efficiency and waste reduction. In addition, it is noted that the indoor environmental quality are the dominant focus on green building concept. On the other hand, it can be argued that they are not aware about global warming, environmental resources and the use of recycled materials. Moreover, it can be noted that respondents aged 40 and over were less supportive to green building ideas in comparison with other age groups.

Table 6: Ranking for the incentives encourage respondents to purchase or renovate green building

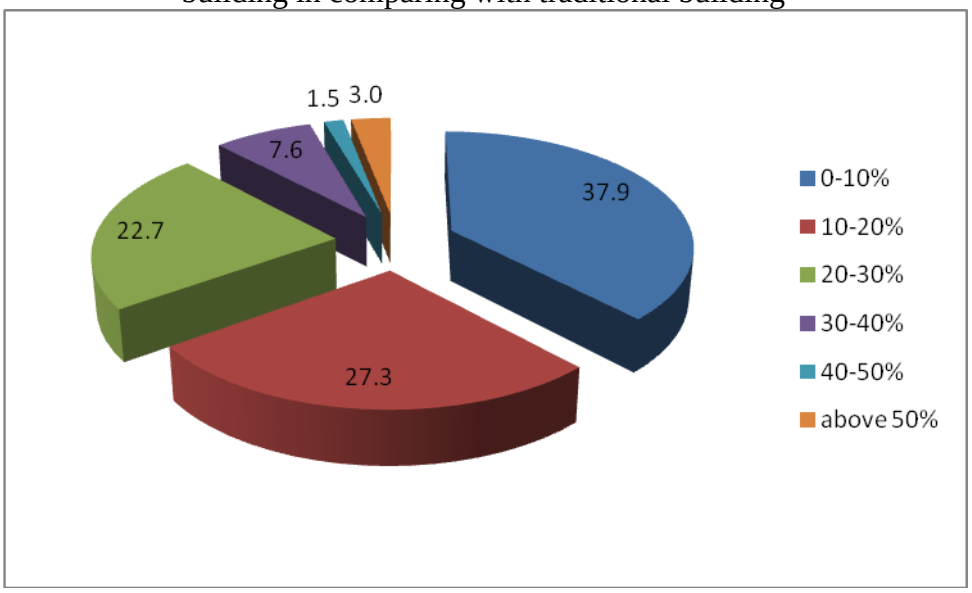
Incentive	Percent based on Gender		Total percent of most interested
	Female	Male	
Low utility bills	100	72.7	**77.3**
Improved health and productivity	72.7	56.4	**59.1**
Whole-life cycle cost saving	72.7	50.4	**54.5**
Increased property values	27.3	41.8	**39.4**
Emissions reduction	72.7	30.9	**37.8**

Table 7: Ranking of features of green buildings according to their importance

Feature	Percent based on age group			Total percent of most interested
	22-30	31-40	Above 40	
Indoor environmental quality	34.8	18.2	13.6	66.7
Water conservation	34.8	13.6	16.7	65.2
Energy efficiency and renewable energy	28.8	18.2	15.2	62.2
Waste reduction	34.8	15.2	12.1	62.1
The use of recycled material in construction and operations	22.7	18.2	6.1	47
Design buildings which will reduce greenhouse effect and global warming	21.2	13.6	10.6	45.5
Environmental preferable building materials and other resources	18.2	15.2	10.6	43.9

As expected the financial barrier is the most dominate factor against green building concept. Figure 1 shows that if the price differences for initiating a green building in comparison with traditional one increased, the respondents will be not supportive for the concept of green building. Also, it can be shown that, around 40 % of the sample agrees to pay a price difference not more than 10% and to have a green building. Interestingly enough, those most willing to pay for having green buildings are among those with age group 22-30 years. As the age increased, the percent of respondents willing to pay becomes smaller.

Figure 1: The percentage price differences accepted to be paid in order to have a green building in comparing with traditional building



According to the respondents, it can be recognized the following challenges facing green building in the construction industry in Palestine:

1. Higher construction cost
2. Lack of skilled contractors
3. The location of these buildings
4. The value of such buildings

11. Conclusions and Recommendations

Through the analysis of the prerequisites and credits of LEED v4 for Building design and construction, it can be noticed that none of the prerequisites are directly target the economic development and very few credits are connected to a sustainable economy. The main concern of LEED is technical aspect of environmental performance with less emphasis on economic side of green building concept. Additionally, the major critique of this rating system is its lack of social sustainability prerequisites and credits. Thus, LEED rating system concerns environmental aspects and less related to the economic and social dimensions of green building concept. For example none of the LEED v4 prerequisites and credits concern about alternative financing mechanisms, the economic impact on the local structure, life-cycle costs, promoting public participation and promoting the development of appropriate institutional frameworks. Therefore, it can be concluded that LEED v4 is a tool used to measure the daily environmental performance.

The analysis carried out using SPSS recognized that the barriers of implementing the green building concepts and LEED rating system are financial, capacity, steering and culture constraints. Higher capital cost and higher cost needed to implement LEED could be considered as examples for financial barriers. The scarcity of experts in this field and lack of technology could be considered as capacity barriers. Under steering barriers lack of regulations and codes could be considered. Finally the lack of awareness of public is an example of culture constraints.

The main problem for applying LEED V4 is the availability of data and its limited sources in Palestine. Another problem is the highly expected cost of implementing such rating system in Palestine since the nature of projects in Palestine does not have the requirements of LEEDv4 prerequisites and credits. All of these barriers could tend to cost overrun and time extension problems from projects willing to apply LEED v4 rating system.

Based on the above conclusions, the following recommendations should be considered:

- LEED V4 rating system should be modified to fit with the nature of projects in Palestine. This scoring system should concern economical and social aspects of green building as well as environmental ones. In this rating system, it is recommended to modify the existing scoring system for LEED credits since the existing weights or possible points on each of the five environmental categories which are sustainable site, water efficiency, Energy and Atmosphere, Materials and Resources and Indoor Environmental Quality evaluated in LEED are not reflecting the environmental benefits in Palestine. The adopted scoring system should also consider the needs and regional considerations including culture, social and economical aspects.
- There is a great need to have green building codes and regulation in Palestine.
- It is recommended to provide some incentives methods by the government to designers and contractor who implement the requirements of green building
- Universities should start offering courses and researches in the green building field

12. References

- Abo Neama, W. A., Protect the Planet through Sustainability Rating Systems with Local Environmental Criteria - LEED in the Middle East, Asia Pacific International Conference on Environment-Behavior Studies (pp. 752–766). Cairo: Proceeding - Social and Behavioral Sciences, Volume 68, 2012.
- BREEAM Communities. (2012). Technical Manual: SD202. BRE Global Limited. Retrieved from http://www.breeam.org/communitiesmanual/
- Comprehensive Assessment System for Built Environment Efficiency (CASBEE). (2017). CASBEE Certification system. Retrieved from http://www.ibec.or.jp/CASBEE/english/certificationE.htm
- The German sustainable building council. (2017).Assessment System for Sustainable Building Retrieved from http://www.nachhaltigesbauen.de/sustainable-building-english-speaking-information/assessment-system-for-sustainable-building.html
- Green building council of Australia. (2017). Rating system. Retrieved from http://new.gbca.org.au/green-star/rating-system/
- GSA public building service (2008). Assessing green building performance. A post occupancy evaluation of 12 GSA buildings.
- Higgawi, M. (2016) Museum News Retrieved from http://www.palmuseum.org/news-1/newsletter/museum-news-august-2016
- HQE GBC France. (2017). Plan action 2017 retrieved from http://www.hqegbc.org/publications/

- Hussin, J., Md, Abdul Rahman and Memon (2013) 'The Way Forward in Sustainable Construction: Issues and Challenges', International Journal of Advances in Applied Sciences (IJAAS), 2(1), pp. 31- 42.

- Jabareen, R. (2006). Sustainable urban forms: Their typologies, models, and concepts. Journal of Planning Education and Research, 26(1), 38–52.

- Kats, G. (2003). The cost and financial benefits of green building: Areport to California sustainable building task force

- Kibert, C. J. (2013) “Sustainable Construction: Green Building Design and Delivery”, 3rd Edition, New York: John Wiley & Sons, Inc.

- LEED v4 for BUILDING DESIGN AND CONSTRUCTION (2016). The U.S. Green Building Council (USGBC). Retrieved from http://www.usgbc.org

- Turner, C and Frankel, M (2008) Energy performance of Leed for new construction building: final report