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Action Plan for Integrating Sustainability and Future Studies Highlighting the Construction Market's Obstacles in Egypt

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Abstract This paper presents an Implementation Schedule for integrating technology into buildings to balance human needs with natural and cultural environments. It addresses challenges in implementing sustainable assessment systems in Egypt, including financial, economic, policy, and regulatory hurdles. It recommends policy reforms, financial incentives, educational programs, and infrastructure adjustments to promote environmental design and energy efficiency. Future studies highlight Egypt's construction market challenges for sustainable transformation, suggesting expanding the database, managing passive design potentials, and developing detailed plans to reduce energy consumption.

The paper work plan outlines recommendations for enhancing life quality through green buildings. It recommends specialized research on the benefits of green buildings, evaluating their economic impact on society, and conducting feasibility studies on sustainable design. It also suggests establishing an Interagency Green Building Council to coordinate government efforts in sustainable architecture. The plan also calls for the creation of local and federal regulations for sustainable practices in the construction industry. The plan also suggests setting up pilot project schemes to study the effects of green buildings, providing valuable insights for future endeavors.

Keywords: *Implementation Schedule, Construction market, Egypt, Future studies, Implementation challenges, Integrating technology, LEED, Sustainable assessment systems*

Introduction

The paper is an Implementation Schedule for integrating technology into buildings and explains the difficulties Egypt is having putting in place sustainable assessment mechanisms; Future studies highlight Egypt's construction market challenges for sustainable transformation. Paper suggests promoting sustainable architecture in Egypt by integrating technology into buildings that balance human needs with natural and cultural environments. It recommends specialized research, evaluating the economic impact of green buildings, establishing an Interagency Green Building Council, creating regulations, and setting up pilot projects. It also emphasizes raising awareness, developing rating systems, and introducing new subjects in architecture and urban schools (AbdelAzim, A. I., 2017).

The Sustainable Sites Implementation Schedule aims to prevent pollution, improve site selection, and redevelop contaminated sites in Egypt. It emphasizes monitoring water, soil, and air, promoting low emission vehicles, habitat preservation, and energy efficiency. The plan also highlights the need for recycling, renewable materials, and reusing construction materials, while addressing challenges in acquiring recycling content and monitoring environmental tobacco smoke impact. The text emphasizes the importance of monitoring indoor air quality, increasing ventilation, and developing a proper management plan for construction indoor air quality. Strategies include ensuring ventilation system capacity, installing mechanics, and monitoring air-conditioning systems. Low-emitting materials, thermal relief, and hybrid systems can improve indoor environmental quality (El-Dorghamy, A., 2021).

The implementation of sustainable assessment systems in Egypt faces challenges such as financial constraints, socio-cultural factors, and technical and expertise issues. These include higher upfront costs for sustainable technologies and green building practices, lack of comprehensive guidelines, public awareness, technical and

expertise gaps, and infrastructure limitations. To address these, policy reforms, financial incentives, educational programs, and infrastructural adjustments are needed. Local energy efficiency codes, environmental design ideas, and training are crucial for reducing energy demands and promoting sustainability in public buildings. Government intervention and financial incentives can help make costs affordable (Elkholy, A. 2024).

The research highlights Egypt's construction market's challenges in sustainable transformation, suggesting future studies expand the database, require an independent third party for sustainable materials quality monitoring, promote energy simulation, and establish an environmental test database, and require government intervention. Egypt's sustainable urban development strategy involves a multi-tiered approach, including innovative financing, community engagement, technical innovation, private sector investment, policy enhancements, education programs, and cultural values (Pahl-Weber, E., 2013).

1. The objectives of this paper are:

1. The Implementation Schedule focuses on integrating technology into buildings to balance human needs with natural and cultural environments, recommending research, establishing an Interagency Green Building Council, regulations, and pilot projects.
2. Challenges in implementing sustainable assessment systems in Egypt Including Financial and economic barriers, Policy and regulatory hurdles, Socio-cultural factors, Technical and expertise challenges and Infrastructure and urban planning limitations.
3. Conclusions & Recommendations for practicing architects, organizations, and government to face challenges that require policy reforms, financial incentives, educational programs, and infrastructure adjustments, as well as promoting environmental design, energy efficiency, and government intervention.
4. Future Studies That highlights Egypt's construction market challenges for sustainable transformation, suggesting expanding the database, managing passive design potentials, and developing detailed plans to upgrade and reduce energy consumption Through Sustainable Materials Quality Monitoring And Energy Simulation and Commissioning.

2. Implementation Schedule

These suggestions are the result of the paper work plan:

1. Conduct in-depth study on the benefits that green buildings provide in terms of raising the standard of living. This study aims to elucidate the genuine possibilities and importance of green buildings for improving indoor and outdoor environments, enhancing human well-being, and advancing social and cultural values.
2. Experts in finance and real estate conduct feasibility assessments for sustainable design, examining its impact on initial outlay, funding, insurance premiums, building life cycle costs, budgets, marketing, and profitability, demonstrating the community's overall impact on sustainable development.
3. Form an Interagency Green Building Council to help government initiatives in sustainable building be coordinated and focused.
4. Establishment of national and municipal laws governing the use of sustainable practices in the building sector.
5. It is possible to do more empirical research on the effects of green building by establishing pilot project schemes. In these schemes, the impact of many aspects may be examined in order to provide designers with invaluable knowledge and invaluable data for their future projects (1). The scope, goals, methods, and suggested implementation schedule for LEED credits are detailed in the following table.

Points **NC**	**Credit**	**Target**	**Techniques & Strategies Scope**	**Proposed Implementation Schedule**
Sustainable Sites (SS) [14 points]				
Obligatory SS Pre-requisite 1	*Reducing pollution during the construction procedure*	Pollution caused by construction work can be significantly mitigated. For this purpose, the water, soil and air must be continually monitored for pollutants.	Ø Putting a specific plan for erosion and sedimentation monitoring during project planned design process. Ø Project planning must include study of seeding techniques to account for sedimentation and erosion.	This Prerequisite is easy to achieve; but the difficulty appears in keeping up &documentation through photos and maintaining measures during construction activates, moreover doing a frequent inspections on location.
1 SS Credit 1	*Site selection*	Project sites must be carefully considered for the impact of the project on the local environment that is projected and sites with significant impact ought to be avoided.	Ø Giving priority to site with no sensitive site element selection and sensitive land kind. Ø Choose a good location with a minimum footprint to reduce the site environmentally sensitive areas.	This credit can be achieved easily when choosing a suitable site that meets all the relevant requirements laid down in the LEED guide.
1 SS Credit 2	*Community linkage and denseness of development*	Development should be focused on urban backgrounds with pre-existing infrastructure and every possible effort should be made to preserve and protect the rural landscape and natural habitats.	Ø Urban locations with developed infrastructure and well managed systems already in place are prioritized in the selection of sites.	This varies according to project location; and it's relation to existing services. The problem here lies in documenting the services availability and pedestrian access for them.

1 SS Credit 3	*Redevelopment of brownfields*	Sites which have already been contaminated should be cleaned up and redeveloped into new projects in order to preserve nature at undeveloped locations.	Ø Brownfield sites are preferable during site selection process. Ø Determine the tax incentives and savings in costs. Ø Matching the development site with processing activity plans, as appropriate.	Project site is the main factor for this credit whatever if it is contaminated location that need to be remediation, in this case it will cost a lot. There for a Greenfield site is the ultimate solution.
Sustainable Sites (SS) [14 points]				
1 SS Credit 1	*Access to public transport as Alternative means of Transportation*	Adoption of public transport can mitigate vehicular pollution and also reduce the development burden for roads.	Ø Specific implementation of transportation requirements and needs for users in the future. Ø Choosing suitable site beside public transportation to achieve mass transit easily.	This credit depends on the site location 1/2 mile of an existing transportation, moreover if there isn't any public transportation around then owner provides bus to the nearest bus stops.
1 SS Credit 2	*Alternative Means of Transportation; Bicycle Storage & Changing Rooms*	Emphasizing the use of bicycling can help mitigate automotive pollution and reduce the development burden to support increasing automotive traffic.	Ø Buildings should provide necessary amenities to encourage residents to take up bicycling such as bicycle racks and changing / locker rooms and showers.	According to the number of users and how much the owner initiates a sustainable policy. It costs few money and very easy to be achieved in projects with low density users.
1				

SS Credit 3	*Advanced transportation methods: fuel efficient and low emption vehicles*	Emphasis on hybrid vehicles or small fuel efficient cars can reduce automotive pollution.	Ø Emphasizing cost reduction through reliance on carpooling, hybrid and small vehicle usage, etc.	This can be achieved by developing policies to encourage the use of efficient, hybrid or small cars. As an example, better parking slots can be reserved for the owners of such cars.
1				
SS Credit 4	*Parking Capacity for alternative transportation*	Mitigate the pollution caused by single occupancy automotive use.	Ø limiting single occupancy vehicles spacing. Ø Reduce the size of the space allocated for vehicle parking. Ø Choosing alternative means in place of vehicle occupancy.	Very easy to achieve as this credit has several ways to be achieved but, difficulty here are in specifying a preferred parking and sharing parking facilities.
Sustainable Sites (SS) [14 points]				
1				

SS Credit 1	*Site Development Protection and Restoration of Habitat*	Any development in rural areas should be carefully considered to preserve natural habitat and biodiversity. Restoration of damaged areas should be prioritized as well.	Ø Perform site survey on Greenfield sites to determine the elements of the site and putting a comprehensive plan for project site development. Ø Considering the disruption of current ecosystems to design building to reduce its presence. Ø Clearly defines construction limitations to minimize unrest of the current site. Ø Prohibition of plant material as contained invasive species and noxious weeds. Ø Using native species are required to minimal or no irrigation, these species requires less maintenance which may be damaging to the environment such as pesticides.	The whole idea depends on area of the site and planning and who it will be planned during construction, this credit is not easy to achieve because of contractors agreement for suitable construction plan suitable with LEED specifications.
1				
SS Credit 2	*Site Development Maximization of Open Spaces*	Preservation of open spaces for supporting biodiversity.	Ø Carefully study the proposed sites and analyze in terms of impact on biodiversity. Ø Good site location is a must to minimize footprint to extent the site inconvenience /crashes. Ø Filling in architectural program to share facilities with maximizing open spaces on the site.	It varies according to owner and projects requirements that can be applicable in several options in the reference guide.
1				

SS Credit 6.1	*Storm water Design Quantity Monitoring*	Control the project's impact on the site hydrology and minimize its effects on the local water by controlling contaminants, introducing on the site filtration, controlling the pollution caused by rain water runoff.	Ø Preserve the natural flow of rainwater during project site designing by raising leakage. Ø Consider using sky gardens and other forms of vegetation on the roof, making proper drainage arrangements for the collection of rainwater to be filtered and reused. Ø Re-using rain/storm water for applications such as toilets, cooling and heating systems, watering plants, etc.	This is not important locally as storm water happened occasionally in Egypt and credit needs is expensive.
Sustainable Sites (SS) [14 points]				
1				
SS Credit 6.1	*Storm water Design Quality Monitoring*	Proper processing of rainwater to prevent contamination of the natural water.	Ø Utilize of another technologies like sky gardens and non-structural technologies (such as rainwater reusing) to minimize harmful pollutants. Ø designing with sustainable strategies for systems which allow collection and integrated treatment of storm water runoff.	This credit is not important locally as storm water happened occasionally in Egypt and credit needs is expensive.
1				

SS Credit 6.1	*URBAN Heat Island Effect (Non-Roof)*	Reduction in the thermal difference of an urban area and its surrounding rural areas in order to conserve on energy, reduce micro-climactic effects on life.	Ø Shade surfaces on sites with landscape features to take advantage of high-reflectance materials uses. Ø Taking matter by replaced surfaces on site (such as roads and sidewalks, etc.) with planted surfaces and vegetated cover for open grid paving and specified materials to reduce heat absorption.	It is easy to be applicable in the case studies giving three examples of materials that have been chosen for use in car parks and undergone trials by the Housing and Building Research Center (HBRC).
1				
SS Credit 6.2	*URBAN Heat Island Effect (Roof)*	Reduction in the thermal difference of an urban area and its surrounding rural areas in order to conserve on energy, reduce micro-climactic effects on life.	Ø Preferring high vegetated roofs more in order to minimize heat absorption. Ø Moreover using high ceilings treatments to reduce heat gaining.	Credit is achievable by testing material in HBRC but second and third options most likely to be difficult to achieve as green roofing is not familiar in Egypt.
Sustainable Sites (SS) [14 points]				
1				
SS Credit 8	*Light Pollution Reduction*	Minimizing night glare by improving nighttime visibility for nocturnal prevention.	Develop certain strategies for lighting at site to make the lighting levels safer. Moreover take advantage of the maximum illumination through a computer model for lighting calculations during implementation.	It varies according to the project nature and needs.
Water Efficiency (WE) [5 points]				
1				

WE Credit 1	*Conservation of water*	Clean potable water is a precious resource which must be conserved to mitigate shortages of water.	Minimize the demand for toilet systems by using composting toilet systems and the use of urinals--- processing and use of rainwater and grey water for requirements where potable water is not needed (toilet, flushing, and custodial uses)	Using smart water supplies like sensor taps and urinals that can save in the amount of water consumed. Credit is very easy to achieve only when using appropriate water fixtures when owner raise the initial cost with high cost.
1 WE Credit 1	*Conservation of Water in Landscaping*	Usage of potable water for landscaping purposes should be banned. Instead, landscaping can focus on other forms such as rock gardens or the use of reprocessed water.	Ø Landscaping should use local plant varieties or those varieties which require minimal irrigation. Ø If irrigation cannot be avoided, then good quality equipment that efficiently uses water ought to be used.	Specific landscaping professional is needed to achieve this credit easily but it is difficult to perform landscape calculations.
Water Efficiency (WE) [5 points]				
1 WE Credit 2	*Innovative Wastewater Technologies*	Reduce the demand for potable water while maximizing the efficiency of reuse of reprocessed waste water as well as rain water.	On site waste water – reuse of rain water after processing, gray water for sewage conveyance ’	Need special and complex site water treatment
Energy and Atmosphere [16 points]				
Obligatory				

EA Prerequisite 1	*Building Energy Systems Commissioning*	The objective is to ensure that the energy systems in the building are operating as per specifications to limit the wastage of energy.	Ø Installation should be done by professionals who are well qualified and have significant experience of prior work in the commissioning and operating of energy systems as well as an understanding of such system's maintenance, performance, testing and trouble shooting.	Using smart application in buildings that help minimize the consumption of energy and optimize energy flows like for example with Proper LEED commissioner with high skills (fundamental or enhanced) for more involvement and tasks
1				
EA Credit 5	*Measurement & Verification*	Monitoring the energy consumption for timely identification of problems.	The initial design should incorporate energy monitoring provisions, determining the building's optimal performance through simulations and analysis. A monitoring plan should be in place, involving energy meters for monitoring consumption. The actual energy performance should be compared to the projected optimal performance to identify issues.	Operating costs monitoring systems in order to comply with design and energy saving in spite of size of building regulations
Energy and Atmosphere (EA) [16 points]				
Obligatory				

EA Prerequisite 2	*Lower Bound on the acceptable energy performance*	A lower bound on the energy efficiency of the project must be determined to serve as a benchmark for performance comparison.	Ø The building must be designed from an energy perspective to minimize consumption of energy for lighting, ventilation and cooling systems through appropriate passive measures.	This prerequisite require professionals expert in simulating such project designs. However, although Egyptian professionals are increasingly becoming familiar with simulation technologies, they have yet to develop the kind of expertise needed.
Obligatory				
EA Prerequisite 3	*Fundamental Refrigerant Management*	The key objective is to counteract the depleting ozone layer.	Ø Where legacy HVAC equipment based on chlorofluorocarbons (CFC) is being used, it should be properly maintained and periodically checked for leakages as CFCs are very destructive to the ozone layer. In case of new structures where new HVAC is to be purchased, equipment based on alternative refrigerants should be preferred.	This is a prerequisite requires high cost in the beginning of the project. The cost, as for the use of split units that can be used as non cfc based refrigerant, which are exported from abroad, as they are not available in Egypt.
3-Jan				

EA Credit 2	*Energy Generation through Renewable Sources On-Site*	Onsite energy generation using clean sources of energy such as solar, wind, etc will significantly reduce the building's utility supply bill as well as decrease its carbon footprint.	ØA proper study and investigation into the feasibility of various renewable energy sources such as wind, solar, geothermal, etc. is required.	This credit is very difficult to achieve in the Egyptian market as of yet because there are very strong concerns regarding a perceived high price of equipment and maintenance. There is a need to change peoples attitudes towards renewable energy to make such steps possible.
Energy and Atmosphere (EA) [16 points]				
1				
EA Credit 6	*Green Power*	To foster the growth of renewable energy sources to power the grid with little resulting pollution.	This would require assessment of the building's own power requirements and an agreement with the company operating the grid for the sale of any surplus energy generated. Renewable energy may be generated through green sources such as wind, solar, biomass, geothermal, and low impact hydropower generation.	Attainment of this credit is difficult because there is presently no policy in place to encourage the grid to buy energy from renewable sources.
Materials and Resources (MR) [13 points]				
Obligatory				
uisite 1	*Recyclable Materials Collection and Storage*	Encouraging recycling will allow the reduction of waste making	Ø Within the building, areas must be dedicated for recycling materials. These must be	This credit is easy, only in condition of regular monitoring for

		its way to landfills and polluting the environment.	designed in accordance with the projected amount of recyclable waste generated. Ø Conservation and efficient utilization of precious space can be achieved by having an in-house cardboard baling and can crushing system within the building. Furthermore, the building may have many recycling bins and chutes installed at short distances to encourage residents.	recycling companies regularly to check that wastes are handled in a sustainable way.
1 MR Credit 1	*Use of Local Materials*	Emphasis has to be laid on the use of building materials sourced locally. This not only reduces the carbon footprint associated with the transportation of materials but will also support the local economy.	Ø It is necessary to set out objectives for the use of local materials and identification of key suppliers who can provide local material as per standards required Ø Emphasis should be placed on local materials, and if some material is not available locally, a suitable local alternative may be used. Ø The materials used in the project must be considered from all perspectives including performance, durability, economic and environmental perspectives.	Performing a material survey to sort out existing Egyptian construction materials and materials 'suppliers. This credit can be achieved very easily in locations where much construction materials are produced locally. However it may be difficult in very remote locations.
Materials and Resources (MR) [13 points]				
1	*Reuse of Building*	In the interest of resource conservation and waste	Ø The concept of reusing buildings should begin with the buildings that	In the Egyptian building market, this has never been done

MR Credit 1		reduction, it is necessary to increase building life and to reuse the structure or its components after the building's life cycle is complete.	already exist and not only new projects designed specifically for the purpose. Ø It is possible to upgrade such buildings by replacing harmful contaminating materials. Also the fixtures for energy and water supply may be upgraded to increase efficiency and conservation. Ø put a figure on the degree to which reuse is possible.	previously. For new projects, this area often seeks LEED certification.
1 MR Credit 1	*Reusing Construction Materials*	Recycling of construction materials helps to reduce the consumption of fresh materials and also cuts down on waste generated. This can have significant environmental impact.	Ø identifying suitable opportunities for the integration of salvaged materials in the design of the building and the search for potential material suppliers. Ø use of such materials, e.g. bridges, columns, fittings, fixtures, woodwork, panels, cabinets, furniture, etc.	Performing a material survey to sort out existing Egyptian construction materials and materials 'suppliers. Apart from new buildings, this approach can also be very useful for existing buildings undergoing refurbishment. There is a need to change people's attitudes however as many investors tend to opt for new materials.
1				

MR Credit 1	*Recycled Content*	Maximizing the use of recycled materials will minimize the environmental impact associated with the production of new unused materials.	Ø Decide on which materials will be employed after recycling and choose people who can supply the requisite recycled materials.Ø Make sure that the materials used are actually recycled. Ø Take both performance and environment into consideration along with economics in deciding on materials to use.	In the Egyptian context, there is difficulty achieving this particular credit as it is difficult to acquire recycled materials here.
Materials and Resources (MR) [13 points]				
1				
MR Credit 6	*Rapidly Renewable Materials*	Emphasis has to be placed on renewable resources which can quickly renew or replenish themselves instead of those which are slowly renewed.	The development of a future venture to employ renewable resources and discover resources and their dealers who will help achieve this objective.	Realization of this credit is hard in the Egyptian context because there are a limited number of materials available for construction work and import of resources is financially infeasible.
Quality of Indoor Environment [15 points]				
Obligatory				
EQ Prerequisite 1	*Minimum IAQ Perform-ance*	Set down required standards for the quality of air in the building interior to provide a minimum standard of life.	The plans of air conditioning systems does not fall below the least amount of air flow outdoor Ø achieve a balance between rate of ventilation and the quality of the indoor air for optimal energy consumption, and well-being of the users.	This prerequisite is achievable easily especially locally because mechanical engineers in Egypt operate in accordance with ASHRAE standard. Documentation of this credit may be a little difficult and an online form has to be filled in.

Obligatory EQ Prerequisite 2	*Monitoring of Environmental Tobacco Smoke (ETS)*	Reduce the impact of smoke to the building population as well as interior surfaces and materials.	Ø ban smoking in commercial buildings and monitoring ventilated smoking rooms. Ø ban smoking in public areas in residential buildings and design exterior facades that limits air pollution transfer between the residential units.	The building management is primarily responsible for ensuring that smoking occurs exclusively in the designated area, even though this requirement is very simple to meet.
Quality of Indoor Environment [15 points]				
1 EQ Credit 1	*Monitoring of Outdoor Air Delivery*	Ensure that the capacity of the system for ventilation is sufficient to provide a comfortable indoor environment regardless of weather conditions.	Installation of mechanics for measuring air and carbon percentage to the information in the HVAC database systems. Using the appropriate measurement equipment alarms to improve the environmental indoor air quality of the building.	It is too had to be done due to the expensive nature of carbon dioxide measurements needed in a high density populated area.
1 EQ Credit 2	*Increased Ventilation*	Ensure a substantial flow of fresh air from outside for better indoor environment quality.	Ø Heat recovery usage in mechanical ventilation, wherever possible, can help reduce the consumed energy for ventilation purpose.	It varies according to the project kind and occupancy average. It is expensive only if the rate is fully occupied.
1	*Management Plan for Construction IAQ*	Quality problems associated with indoor air can be mitigated if a proper management plan is in place. This will protect the environment and the health of	Ø adoption of strategy to look after the air-conditioning systems, monitoring pollution sources and reduce them to the minimum. Ø organize material composition in a particular order to avoid contamination of absorbing substances such as	Only if LEED contractor is continuously checking all procedures standards done on site.

EQ Credit 1		construction workers.	insulating materials, carpets and gypsum board.	

Indoors Environmental Quality [15 points]				
Points **NC**	**Credit**	**Target**	**Techniques & Strategies Scope**	**Proposed Implementation Schedule**
1	*Low-Emitting Materials*	Reduce the amount of pollutants in closed places, since those pollutants are odorless and reduce	Ø Identifying appropriate materials during the construction process carefully for each item of special materials specifications. Choose the material that has been previously tested in independent laboratories and match the desired	·Difficult to achieve using LEED building local materials because local contractors may need a knowledge for LEED special materials that is compatible with the environment.· It is also expensive depending on different kind of material types purchased.

EQ Credit 1		the comfort of users.	requirements in the interior environment of the building. Determine which products do not contain added urea-formaldehyde resins.	
1	*Monitoring of indoor Pollutants and chemicals*	Protect residents of the building from harmful substances.	Ø Design of buildings that have private zone for cleaning and maintenance to isolate the contaminants system. Ensure that any area infected by a contamination can be isolated to prevent further contamination. Installation of isolating system to	Credit is not difficult however in some projects it is difficult to use a 1 meter floor mat in entrance; it must be already pre-designed in project design.

EQ Credit 5			prevent pollutants. Installing filtration systems to purify the air at the entrances and exits.	

Table 01- *Targets, approaches, plans, and scope for water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and indoor environmental quality are all included in the proposed Implementation Schedule (Khanam, Z., 2023).*

The proposed Implementation Schedule aims to prevent pollution in construction, site selection, community connectivity, and density of development. It emphasizes monitoring water, soil, and air, implementing erosion plans, and studying seeding techniques. It recommends redeveloping contaminated sites, promoting public transport, minimizing open spaces, and reducing light pollution. Strategies include water conservation, landscaping, innovative wastewater technologies, building energy systems, and renewable energy generation. The plan also emphasizes recycling, locally sourced materials, indoor air quality monitoring, low-emitting materials, and energy efficiency.

3. The difficulties Egypt has in putting in place sustainable evaluation systems

Financial and economic limitations, sociocultural issues, and other elements that have a big influence on the direction of urban growth are only a few of the challenges that sustainable development must overcome (Hassan, A. M., 2015).

1- Persistent Awareness and Instruction

Raising sustainable awareness and education is crucial for key construction market players, including architects, consultants, contractors, and manufacturers. Architecture education should focus on sustainable architecture, developing rating systems for other trends like zero energy or zero carbon buildings. Introducing new subjects and programs, conducting seminars, and promoting sustainability in urban schools can help minimize long-term energy, water, and material consumption (Mlecnik, E., 2024).

A research organization on the subject of green and sustainable architecture is required. Government support and direction are necessary, but business sector cooperation and the utilization of university talent are also important (OECD, 2024).

2- Teamwork culture

The project faces issues of lack of coordination among various stakeholders, including owners, architects, MEPs, and civil engineers. The use of software programs as drafting tools and lack of documentation tools hinders coordination. To address these issues, a sustainability chart should be checked twice a month, and a person appointed to handle coordination and documentation should be appointed (Pritchard, C. , 2013).

3- Energy systems

Energy modeling simulation is cost-effective, reducing building system testing and commissioning. Renewable energy offers environmental benefits and a payback period, while minimizing environmental requirements for minimal building system testing and commissioning (Ahmed, A., 2022).

4- Construction products and construction waste management

Construction waste management concept lacks concept, product information is poor, and locally manufactured products are poor. Waste sorting with recycling companies and minimal environmental testing recommended by HBRC [1]. (Daoud, A.,2021)

5- Financial and economic obstacles

Sustainable technologies and green building practices often have higher upfront costs, especially in developing economies. There's a lack of financial incentives, and more government-led initiatives like grants, subsidies, or tax reductions are needed to encourage adoption (Chen, L., 2024).

6- Policy and regulatory hurdles:

Because current frameworks lack clear norms and standards, the implementation of green construction techniques may be hampered and sustainable development may not be supported. Time-consuming and discouraging to stakeholders are the bureaucratic procedures involved in obtaining approvals (Van Tulder, R., 2018).

7- Sociocultural aspects

1 Originally founded in 1945, the Housing and Building National Research Center is headquartered in Cairo and is overseen by the Minister of Housing and Urban Communities. It was renamed in 2005.

Due to misunderstandings or false information, public perception and knowledge of sustainable living are difficult to achieve. Raising awareness and educating the public is essential to breaking old behaviors, and it's also critical to involve the community and provide real advantages (Corner, A., & Clarke, J. 2016).

8- Technical and expertise challenges

The use of sophisticated sustainable technologies is being hampered by limited access to them and skill deficits in sustainable urban planning and green building. To close these skills gaps and provide local professionals the tools they need, training and capacity-building programs are essential (Chan, A. P., 2017).

9- Infrastructure and urban planning limitations

Urban infrastructure faces challenges in integrating sustainable solutions due to complexity and cost. Urban sprawl complicates sustainable strategies implementation. Addressing these barriers requires policy reforms, financial incentives, educational programs, and infrastructural adjustments. This aims to facilitate a smooth transition to sustainable urban living (Hegazy, I.R., 2024).

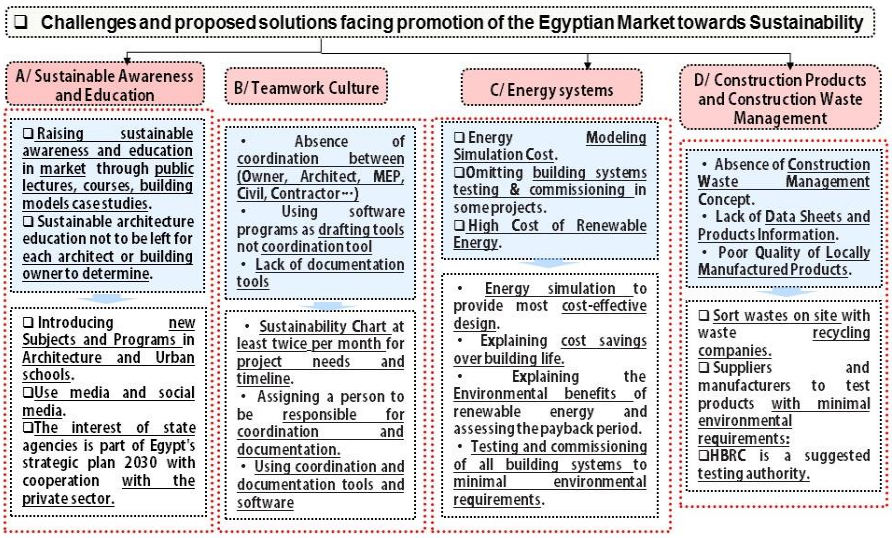


Fig 01- ***Discusses the challenges and proposed solutions for promoting sustainability in the Egyptian market (Hegazy, I.R., 2024).***

4. Conclusions & Recommendations

5.1 For practicing architects:

- Buildings significantly contribute to national energy consumption, requiring energy efficiency consideration in all design and use stages, with early decisions influencing building usage and environmental impact.
- Glazing type significantly impacts envelope design and space energy requirements, especially with higher than 20% WWR. It reduces energy demands and attenuates other envelope key factors.
- The project aims to minimize embodied energy by using local materials, relying on simple skills, avoiding toxic materials, and consuming non-renewable materials in limited quantities if they cannot be replaced with renewable alternatives.
- Using smart application in buildings that help minimize the consumption of energy and optimize energy flows like for example.
- Making use of water-saving smart water sources, such as sensor taps and urinals.
- The recycling of gray water for beneficial uses such as irrigation.
- Certified rating systems aid designers in assessing environmental impact, reducing energy consumption and ensuring positive environmental effects during building design, construction, and operation.

- Building design should prioritize natural ventilation by avoiding spaces that are not accessible to fresh air, such as basements, and design English courts for better ventilation.
- It is occasionally advised to employ courts in wide span structures to ventilate the interior regions that aren't exposed to natural air (Ehab, T., 2024).

5.2 Regarding establishments:

- Implementing local energy efficiency codes should be supported by progressive information, environmental design ideas, strategies, and training, promoting environmental benefits, energy conservation, and cost savings.
- Accessible and sufficient data, including meteorological information, should be provided by governmental organizations to support environmental design.
- When designing, it is important to consider the environment and provide appropriate design tools that should be broadly and gradually implemented.
- The research recommends reviewing and accrediting design tools by authorized organizations for credibility and adoption by supporting organizations to optimize implementation and identify gaps (Leal Filho, W., 2024).

5.3 Governmental various measurements

Furthermore, it is imperative that the government takes action by implementing sustainable practices and amending local regulations that are required, at least in public buildings.

- • Since most public buildings use a lot of energy, all government buildings should be environmentally friendly and sustainable.
- • In order to monitor projects and address sustainable challenges in Egypt, building owners should certify their structures using the Green Pyramid Rating System and establish the Egyptian Green Building Council.
- • The establishment of financial incentives is correlated with expenses that become competitive with those related to sustainable development and conventional energy sources and that are also affordable for consumers.
- • It must be shown that energy conservation may result in large cost savings in a comparatively short payback period without compromising the quality of indoor settings in order to propel it to the top of the national policy agenda.
- • Form, function, and cost should all be considered in building design.
- • Using renewable resources, the government should endeavor to lower the demand for energy.
- • A considerable portion of the natural environment's deterioration may be attributed to modern design techniques. Self-sustaining buildings are the best option for the future since they may use natural solutions to lower energy consumption and environmental harm (Bampou, P., 2017).

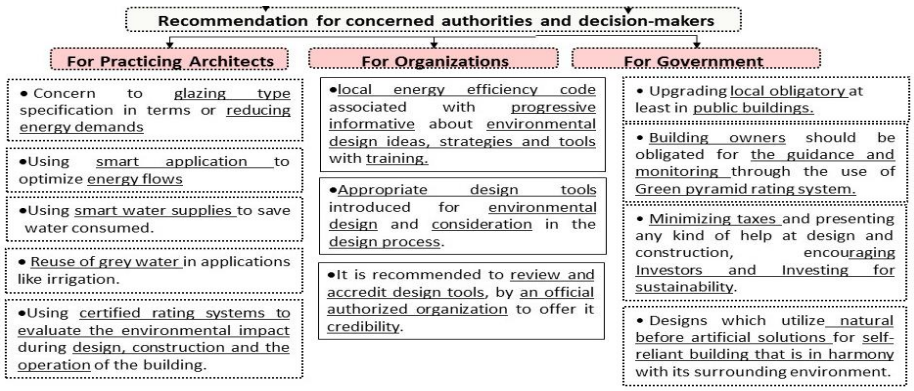


Fig 02- Provides suggestions for architects, organizations, and the government regarding architectural practices (Juffle, N.A.H., 2024).

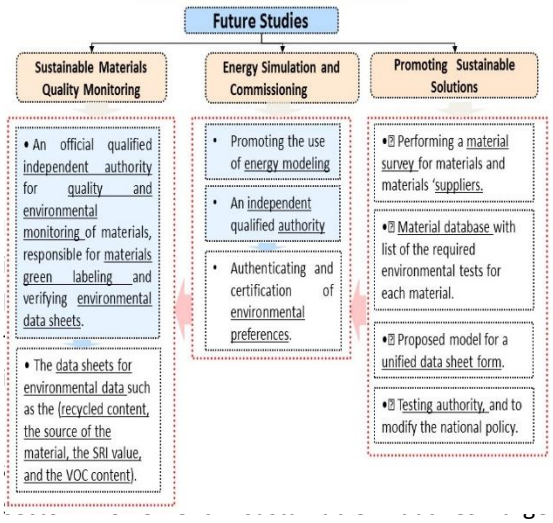
5. Future Studies

Fig 03- *Future research will concentrate on energy modeling, operation, quality control of sustainable materials, and the promotion of sustainable solutions (Oguntona, O.A., 2024).*

This research highlights the challenges in Egypt's construction market for sustainable transformation. It provides valuable insights for analyzing and planning for upgrading the market. The limitations of the study suggest expanding the database to include other spaces and climatic regions. Additionally, managing passive design potentials in thermal relief can indirectly improve energy consumption by adjusting set point temperatures and adjusting thermal relief range (Salah, S.I., 2022).

5.1 Sustainable material quality control

Official quality and environmental monitoring of locally made building materials must be carried out by an impartial third party to ensure the procurement of certified sustainable materials and prevent environmental deception. The third party bears the responsibility of certifying the environmental data sheets of locally sourced products and applying the green label to materials. Information on the environment, such as recycled content, material source, SRI value [1], and VOC content [2] should be included in the data sheets (Thakur, A., 2024).



scale projects may be funded with the help of green finance options like sustainability-linked loans or green bonds, which support sustainable urban development.

5.2 Energy simulation and operation

Promoting the use of energy modelling software is very important for achieving energy efficiency in the built environment. The same applies to the operation of building systems, where a qualified third party is responsible for certifying and issuing certificates to qualified third party commissioners who will ensure that energy efficient building systems are built in accordance with environmental preferences (Chong, A., 2021).

5.3 Promoting Sustainable Construction Materials

In order to encourage the use of sustainable construction materials in the Egyptian market, the researcher suggests a number of actions, such as surveying the market for materials, compiling a database of materials specifications and environmental testing, and suggesting a single data sheet model for all building products. Additionally, he recommends that the government step in to change national policy about environmental requirements and designate an outside testing authority (Oguntona, O.A., 2024).

2- Strengthening governance and policies: Promoting sustainable projects and expediting approval procedures are essential for advancing sustainable development, which can be done at a considerably faster rate. Policies that support sustainable urban development practices should be put into place.

3. Creative finance and investment: With the help of partnerships and incentives, the private sector must invest in sustainable initiatives. Green finance solutions that support sustainable urban development include green bonds and sustainability-linked loans, which supply the funds required for major projects.

1 Solar reflectance index (SRI) values various colors of metal roofing products, which can potentially decrease energy consumption and heat island effect.

2 The VOC content are Low-emitting materials improving indoor air quality in buildings, but US Green Building Council doesn't require "LEED compliance" attestation; manufacturers can provide documentation.

4. Stimulating efforts and expediting approval procedures are essential for advancing sustainable development, which may be greatly accelerated. Policies that support sustainable urban development practices must be put into effect.

5. Community and Cultural Integration: To promote sustainability, increase public knowledge, and build community acceptance, comprehensive education and awareness initiatives are essential. In order to ensure that sustainability is not pushed from the top down but rather is firmly ingrained in the cultural fabric of society, these programs should be in line with local cultural values.

6. Improving technical know-how and innovation: Egypt will change if funds are allocated to local research and development of sustainable technologies, and training courses on sustainability and green building are essential to producing a trained local labor force.

7. Modeling sustainable urban development: In Egypt, sustainable practices are used to assess whether sustainable urban development is feasible. The plan calls for creative funding, strengthened policies, community involvement, technical know-how, and experimental initiatives (Hegazy, I.R., 2024).

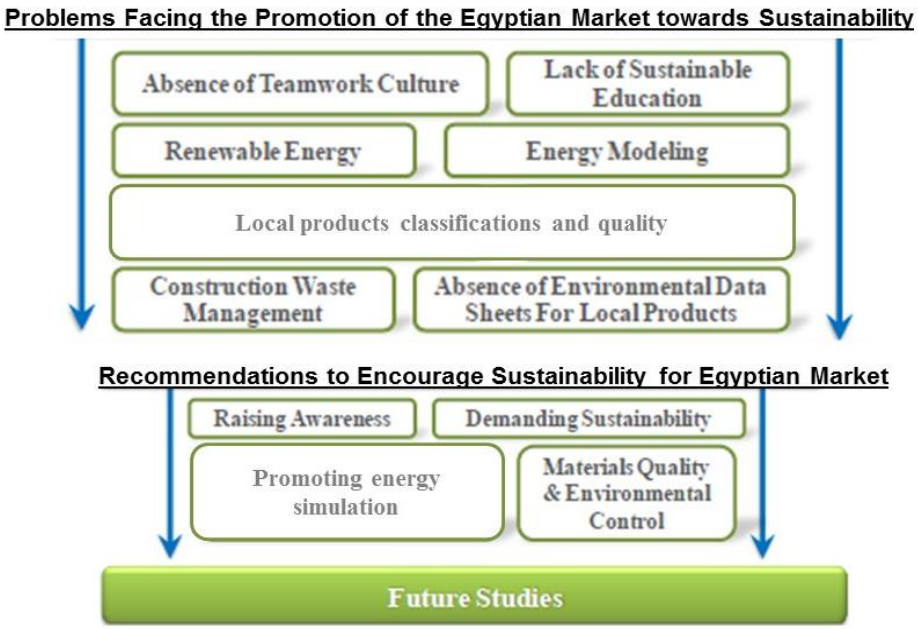


Fig 04- The article discusses the promotion of sustainability in the Egyptian market and offers suggestions for its improvement (Abulata, N.N., 2024).

Conclusions

The paper presents an Implementation Schedule for Egypt's integration of technology into buildings, focusing on sustainable architecture, monitoring, low-emission vehicles, habitat preservation, energy efficiency, recycling, renewable materials, and reusing construction materials. Challenges include financial constraints, socio-cultural factors, and technical issues. Egypt's green urban planning, using LEED, GPRS, and BREEAM, faces challenges in economic, policy, technology, and culture. Investments stimulate local economies and create jobs, but initial costs can be high. This paper presents an Implementation Schedule for integrating technology into buildings to balance human needs with natural and cultural environments, recommending research, establishing an Interagency Green Building Council, regulations, and pilot projects. It discusses challenges in implementing sustainable assessment systems in Egypt, including financial, economic, policy, socio-cultural, technical, and infrastructure limitations. It concludes with recommendations for policy reforms, financial incentives, educational programs, and infrastructure adjustments. Future studies highlight Egypt's construction market challenges for sustainable transformation. The

paper advocates for sustainable architecture in Egypt, integrating technology into buildings to balance human needs with natural and cultural environments. It recommends research, regulations, and pilot projects. Challenges include financial, economic, socio-cultural, and technical factors. Strategies include innovative financing, community engagement, and cultural values.

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