BUILDING CERTIFICATION METHODS APPLIED IN AZERBAIJAN

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Abstract. Rapid environmental and economic changes occurring at the international and regional levels have necessitated the creation of a mechanism to provide an expert evaluation of the building's sustainability. In this regard, building certification methods have been developed to assess their energy efficiency and environmental friendliness. Building certification is one of the tools for sustainable state development. In Azerbaijan, the significant amount of natural resources causes mainly the voluntariness of the building certification process and the passivity of the government and public authorities. The article explores the experience of using the building certification methods BREEAM, LEED, Green Zoom Azeri in Azerbaijan. Technical characteristics of the certified buildings were considered. The benefits and drawbacks of the certification methods used were outlined, along with reasons for boosting the attractiveness of certified buildings. Based on the comparative analysis, the existing issues were classified as people-oriented, technology-oriented, and process-oriented. Expert recommendations on overcoming obstacles and eliminating issues are given. The outcomes of this research will contribute to the development of a roadmap for the sustainability of the building industry, and help a wide range of international and local experts to better understand the emerging green building market in Azerbaijan.

Key words: BREEAM, LEED, GZ Azeri, expert recommendations, technical characteristics of certified buildings.

1. Introduction

The building industry is one of the most influential sectors of the economy and largely determines the state of the environment (Doan *et al.,* 2023). According to the report of the United Nations Program for 2022, buildings during their life cycle spend approximately 37% of final energy, 17% of drinking water, they account for 25% of solid waste and 30% of global greenhouse gas emissions. To achieve carbon neutrality by 2050, it is necessary to reduce building emissions by 6 percent yearly (http://www.unep.org/resources/emissions-gap-report-2022). In addition that, for any country, the availability of sufficient energy reserves and natural

resources is one of the major driving forces of its sustainable development (Giannetti *et al.,* 2018). Although Azerbaijan today does not depend on external energy sources, it should focus on the energy efficiency of buildings, because they consume the most amount of energy and all the above indicators are worse. 47% of the country's final energy is consumed by buildings, 31%- by transport, 14%- by industry and construction, and 8%- by other sectors of the economy. Buildings account for more than 34% of greenhouse gas emissions. Out of 10 million people in the country, almost half of the population lives in the capital city -Baku, which, unfortunately, is one of the most polluted cities in the world (https://www.stat.gov.az/source/balance_fuel/-2022). All of these highlight the energy-saving potential of buildings and the need for a higher degree of building sustainability in Azerbaijan.

The fulfillment of the principles of sustainable development is a worldwide tendency in the modern building industry, focused on meeting the current needs of society without compromising the needs of future generations (Hamedani and Huber, 2012; Sandanayake *et al.,* 2018). Rapid changes in the environmental and economic spheres at the global and regional levels have necessitated the creation of a mechanism that provides expertise in the sustainability of the building industry (Darko *et al.,* 2017). In this regard, building certification methods in accordance with energy efficiency and environmental friendliness of buildings were created (Kocabas and Bademcioglu, 2017).

Today, there are more than 110 building certification methods in the world (Milovanovich and Bagarich, 2020). The most widespread among the international ones are BREEAM- Environmental Assessment Method of the Research Institute of Buildings (UK), LEED- Leadership in Energy and Environmental Design (USA), DGNB- German Sustainable Building Council (Germany). There are also national ones- Green Zoom Azeri (GZ Azeri), Green Construction (Russia), Green Homes (Romania), VERDE (Spain), HQE (France), SBTool (Canada), Green Star, NABERS (Australia), CASBEE (Japan), 3-Star (China), LOTUS (Vietnam), Green Mark (Singapore) and others (Doan *et al.,* 2017; Awadh, 2017). All of them evaluate the compliance of the technical characteristics of the building with the required standards based on the accepted certification method using a set of qualitative and quantitative criteria and their corresponding scores for a certain stage of the building life cycle (Qiu *et al.,* 2017; Wang *et al.*, 2012).

The goal of this research is to explore the experience of Azerbaijan in the implementation of building certification methods such as BREEAM, LEED, and GZ Azeri, to analyze the differences and similarities between them, to indicate factors for increasing the attractiveness of certified buildings, to identify the advantages and downsides of applied certification methods in the country, and to classify existing problems, obstacles and provide expert advice on how to overcome or eliminate them. The outcomes of this research will promote the development of a roadmap for the sustainability of the building industry in Azerbaijan.

2. Materials and methods

In this paper, the following research methods were used: descriptive review, comparative analysis, systematization, structuring, and generalization of

available information that was obtained from various sources, such as the expertise of the authors of the article, research reports, legal and technical standards, official documents of non-governmental and governmental organizations, press publications, interviews with representatives of the construction industry, assessments of other experts, as well as materials on building certification in Azerbaijan.

The considered sources of information made it possible to compare two international and one national methods of building certification, analyze their characteristics, identify problems, barriers and formulate recommendations.

Using the results of a qualitative and quantitative analysis comparing BREEAM and LEED, this study then aims to clarify the possibility of using GZ Azeri to certify local buildings according to international requirements. For further development of GZ Azeri, it is necessary to use the international version of the BREEAM and LEED operating system. Currently, local certified energy auditors continue to improve the first national building certification method GZ Azeri.

3. Analysis of international and national certification methods

Today, the building certification process is gaining popularity as the environmental impact of certified buildings is becoming more apparent and the use of certification methods is being encouraged due to their clear benefits in energy efficiency, resource efficiency, and environmental friendliness (Miller *et al.,* 2015).

Although significant efforts have been made in Azerbaijan over the past ten years to certify some buildings, studies show that green construction is not widely practiced here, and the certification process is voluntary and still in its infancy. Despite the well-known advantages of building certification methods, today there are only three certified buildings in Azerbaijan, two of them according to BREEAM and one according to GZ Azeri. Two more buildings are under construction and are undergoing LEED certification. All buildings are public. Table 1 summarizes the main features of the BREEAM, LEED, and GZ Azeri methods. Each certification method has its own characteristics and certification scheme, which mainly depends on the purpose of the certified building (Doan *et al.,* 2016).

4. Technical characteristics of the certified buildings in Azerbaijan

4.1 BREEAM certification method

Office Building in White City of Baku (Fig. 1, https://www.bakuwhitecity.com/en/buildings/1-baku-white-city-office-bulding) is the first building in Azerbaijan that was certified in 2014 by BREEAM International New Construction with a GOOD rating, Certificate No 0057-2834 with a score of 48.5% (https://esgfactor.pro/bakuwc).

The building has:

- Total area- 40437 m^2;
- Specific annual energy consumption for ventilation, heating, air conditioning, refrigeration and hot water supply- 115.6 (kWh)/m^2;
- Annual carbon footprint- 44 kg/m^2.

In addition to optimal architectural and design solutions, environmental principles for organizing construction processes were also implemented here (https://www.bakuwhitecity.com/en/newsd/85-baku-white-city-office-building-becomes-the-first-green-certified-asset-in-azerbaijan).

Table 1. Comparison of the main features of BREEAM, LEED, GZ Azeri (https://bregroup.com/breeam-technical-standards; https://www.usgbc.org/leed/v41; https://greenzoom.ru).

Certification method	BREEAM	LEED	GZ Azeri
Certified buildings in Azerbaijan by 2022	2	-	1
Logo & website	BREEAM, www.breeam.org	, www.usgbc.org	AZERI GREEN ZOOM, www.azstand.gov.az
Developed by organization	Building Research Establishment (BRE) Global company, non-governmental organization	Green Building Council, non-governmental organization	State Committee for Standardization, Green Building Council in Azerbaijan- non-governmental organization
Priority of the assessment criteria	Environmental friendliness, Energy efficiency	Energy efficiency, Water consumption efficiency	Energy efficiency, Water consumption efficiency, Environmental friendliness
Started off	1990	1998	2014
Goals	Establish detailed standards for environmental performance of the building and the best measures for a sustainable building life cycle	Operate as a tool for assessing all stages of green building life cycle	minimize energy consumption while maximizing the environmental friendliness of the building
Maximum / minimum scores	100% / 30%	110 / 40	90 / 35
Certification scores Rating system	Outstanding ≥ 85 Excellent ≥ 70 Very Good ≥ 55 Good ≥ 45 Pass ≥ 30	Platinum ≥ 80 Gold ≥ 60 Silver ≥ 50 Certified ≥ 40	Platinum ≥ 70 Gold ≥ 55 Silver ≥ 45 Bronze ≥ 35
What design and construction methods are based on?	European standards - EN 15804:2012-04 International standards- ISO 15392:2008, ISO 21931-1:2010 UK standards It is possible to use local standards in agreement with BRE	Only American standards: ASHRAE, ANSI, FEMA, SMAQMA, IGCC, EPA ASTME 2432 – 11	Local standards European standards Russian standards
What is the certification level?	The total scores for all criteria		
Certification types	New Construction, International New Construction, In-use, Refurbishment and fit-out, Communities	New Construction, Existing Building (Operations& Maintenance), Commercial Interiors Project, Core, and Shell Project, Homes, Health Care	New Construction In-use and integrated sustainable development of neighborhoods
Review process	Based on the documentation, on-site reviews, visits to buildings		
Documents submission	In English or the investor's native language	Only in English	In the investor's native language

Fig. 1. Office Building in White City of Baku, BREEAM.

The innovative technical features of the building are (http://zvt.abok.ru/upload/pdf_articles/266.pdf):

- Building energy consumption is 19% less than the base model;
- Reducing the specific energy consumption for heating, ventilation, and air conditioning (HVAC) systems relative to the baseline is 41% due to the usage of energy-efficient equipment and optimization of operation modes;
- U-value of the façade is 1.1 W/(m$^{2.0}$C), which provides efficient thermal insulation;
- Thermal conductivity coefficient of external glazing is 1.8 W/(m^{0}C), while for ordinary buildings- 2.8 W/(m^{0}C);
- Although the area of external glazing is 70% of the total surface of the building, it provides effective sound insulation
- Heating system works with duplex burners;
- Air conditioning is with VRV (Variable Refrigerant Volume) fourth generation;
- All occupants have 100% outdoor visibility;
- To ensure a healthy microclimate the facing and finishing materials used do not contain VOC (volatile organic compounds);
- Due to the usage of LED (Light-Emitting Diode) lighting, it was possible to achieve visual comfort for employees and visitors;
- Zoned automated lighting control promotes significant energy savings;
- The energy-saving measures include applying heat meters to renters and using sensory plumbing fixtures;
- The use of humidity sensors allows saving water during capillary irrigation of vegetation;
- To prevent night light pollution, an optimal scheme of outdoor lighting with energy-saving lamps was used;
- The proximity of public transport stops ensures the accessibility of the building for pedestrians;
- For the safety of pedestrians, the crossings located on the path of their movement are raised above ground level on the nearby territory of the building;
- There is infrastructure for disabled people;
- The presence of special paving stones helps to reduce the speed of passing vehicles;
- There are bike racks and charging stations for electric vehicles;
- The noise and light impact of neighboring buildings is minimized due to the optimal location of the building and the good sound insulation of its glass façade;
- The biodiversity of the local landscape makes the building fascinating.

In 2016, the *administrative building of the State Oil Fund* of Azerbaijan passed the BREEAM certification (Fig. 2, https://www.oilfund.az/en/fund/about/new-building) and received a GOOD assessment at the “building in-use” stage. The requirements defined by BREEAM were considered during the construction phase.

The total height of the building is about 209 m, it is the third tallest building in Azerbaijan. It has 24 ground floors and a two-story underground parking. The interior combines images of drawings from 9 national schools of carpet weaving.

Fig. 2. Building of the State Oil Fund of Azerbaijan, BREEAM.

The major building technical features are as follows (https://www.oilfund.az/en/fund/about/new-building):

- Mechanical ventilation with heat recovery saves 24% of the annual energy balance of HVAC;
- Ozone-friendly refrigerant is used for HVAC;
- For the hot water supply system solar flat panels are used;
- All engineering systems are environmentally certified;
- The use of intelligent technologies based on the concept of integrated engineering systems provides automated management of the building infrastructure;
- Management of all communication networks is carried out from a single center;
- Heat supply is carried out by a system of heat pumps with an automated control unit;
- 54% of used building materials and structures are eco-friendly;
- 25% of building materials are manufactured locally and have ISO certification;
- All insulating materials, finishing materials, coatings, and paints are made from natural raw materials;
- 10% of waste (concrete, glass, brick, mortar, metals, wood) was recycled and reused;
- Automatic lighting control with motion sensor is provided;
- Transport accessibility of the building is 280 m;
- Collection and purification of stormwater is used;
- Drainage water from the ventilation system is used for irrigation of nearby landscaping;
- An automated landscape irrigation system with storm-water storage is provided for irrigation of the adjacent territory;
- The fertilizers used for landscaping are environmentally friendly and ISO 9001 certified.

4.2. LEED certification method

The *main building of the ADA University in Baku* (Fig. 3, https://www.ada.edu.az/en/about/campus/337-buildings) was commissioned in 2014 according to the LEED certification criteria, but it was not finally certified due to applying for certification so late- at the construction stage but not at the design stage, which is a strict requirement.

The following advanced technologies are applied here (https://www.ada.edu.az/en/about/campus#block-337):

- Geothermal energy is used to heat and cool the building by applying heat pumps on 290 vertical wells 130 m deep;

Fig. 3. The main building of ADA University complies with LEED requirements.

- Low-potential thermal energy collection installation, circulation pumps, and other equipment have environmental certifications;
- The building has a central air conditioning system with plate-type heat recovery that saves about 30% of energy consumption for HVAC;
- Green roof is used;
- The sensory plumbing fixtures have aerators with a water flow rate of 2–5 l/min, which is 2-3 times less than for conventional ones;
- There is zonal LED lighting, which saves electricity by about 2.5 times and improves IAQ (indoor air quality);
- The layout of the premises provides all learning areas with natural daylight;
- There is a separate area for four groups of garbage;
- The use of water coolers reduces the number of plastic bottles.

4.3. GZ Azeri certification method

Fairmont Hotel in Baku (Fig. 4, https://www.pinterest.com/pin/760263980826579765) of the high-rise complex Flame Towers is the first building in Azerbaijan certified by the national building eco-standard GZ Azeri in 2017 at the beginning of the operation stage as New Construction. It was awarded the Platinum Certificate, with a score of 70% out of 90%.

The Azerbaijani certification method is based on the international LEED and the Russian Green Zoom assessment systems (Fig. 5). The authors of this work participated at all stages of the certification process.

Fig. 4. Fairmont Hotel in Baku, GZ Azeri.

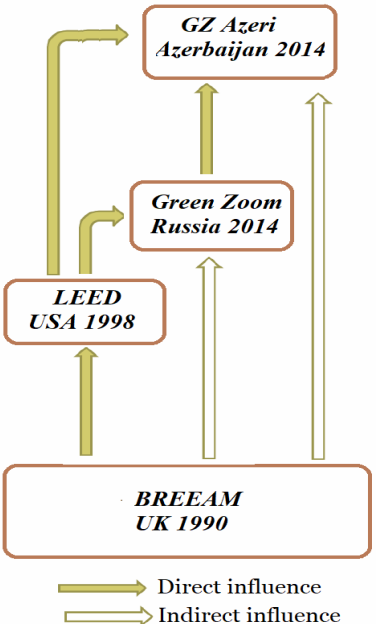

Fig. 5. Influence of international certification methods on national GZ Azeri.

The assessment of the object was carried out according to 46 indicators by the methods of visual, instrumental, and documentary control and corresponding calculations (https://greenzoom.ru/objects/full/172). Confirmation of the compliance of the building indicators with the requirements was recorded by both local and international experts by photo fixations and instrumental methods directly on the building and with the help of relevant documents. Each score made by the experts had a documentary justification.

More than half of the assessed indicators had parametric values, which excluded the subjectivity of assessment and evaluation (Leskinen *et al.,* 2020) The energy-efficient solutions allowed to reduce the hotel's annual operating costs by more than 2 times, heat consumption was reduced by 13%, and overall energy consumption was reduced by 23% compared to the base building according to the ASHRAE standard (https://www.ashrae.org/technical-resources/standards-and-guidelines).

5. Comparison of BREEAM, LEED and GZ Azeri

A comparative analysis of the three certification methods shows that, despite the differences in the assessment systems, the priority assessment criteria is Energy section, and all three methods have approximately the same sections: Energy efficiency, Water efficiency, Materials and resources, Indoor environmental quality, Site ecology, Innovations, and Regional features (Chethana *et al.,* 2017; Lopez *et al.,* 2019). The second-highest priority in BREEAM is the well-being and health of people, followed by the Indoor environmental quality, which means that this system has a greater social focus than LEED (Awadh, 2017) and GZ Azeri (Fig. 6).

BREEAM is more focused on the environmental criteria for evaluating a building- location, transport accessibility and reducing the impact of transport on the environment. In both BREEAM and LEED, procedural performance takes priority over performance. For LEED, after Energy efficiency Materials and resources criterion is important, so LEED is more suitable for public buildings (Illankoon et al., 2017; Dong and Ng, 2015).

The local certification method is more suitable for multifunctional buildings, including housing, but unfortunately, there are no certified residential buildings in Azerbaijan yet.

For all three methods, the assessment of the thermal and acoustic characteristics of building envelopes is identical (Agyekum et al., 2019; Asdrubali et al., 2015).

Fig. 7 shows a comparison of rating points for each certification system. LEED is the most stringent certification method, followed by GZ Azeri and BREEAM. However, the highest rating scores for BREEAM (Outstanding) are more difficult to obtain than for other certification methods (Platinum for GZ Azeri and LEED). In general, GZ Azeri uses a simpler scoring system than the other two.

6. Attractiveness of certified buildings

According to the authors' many years of experience in the field of energy auditing and building certification, although the cost of construction and operation of certified buildings is approximately 11-16% higher than for conventional buildings, the main factors contributing

to increasing their attractiveness for investors and long-term tenants are:

- High quality of the building as a construction structure as a whole;
- High level of occupants` comfort;
- The international image of the building;
- Reduction of operating cost by 25-30%;
- Saving resources and minimizing emissions and waste;
- Increase in rent for premises by 2-16%;
- Improved risk management;
- Increase in the cost of sales by 8-35%;
- Recoupment of construction- 7-10 years.

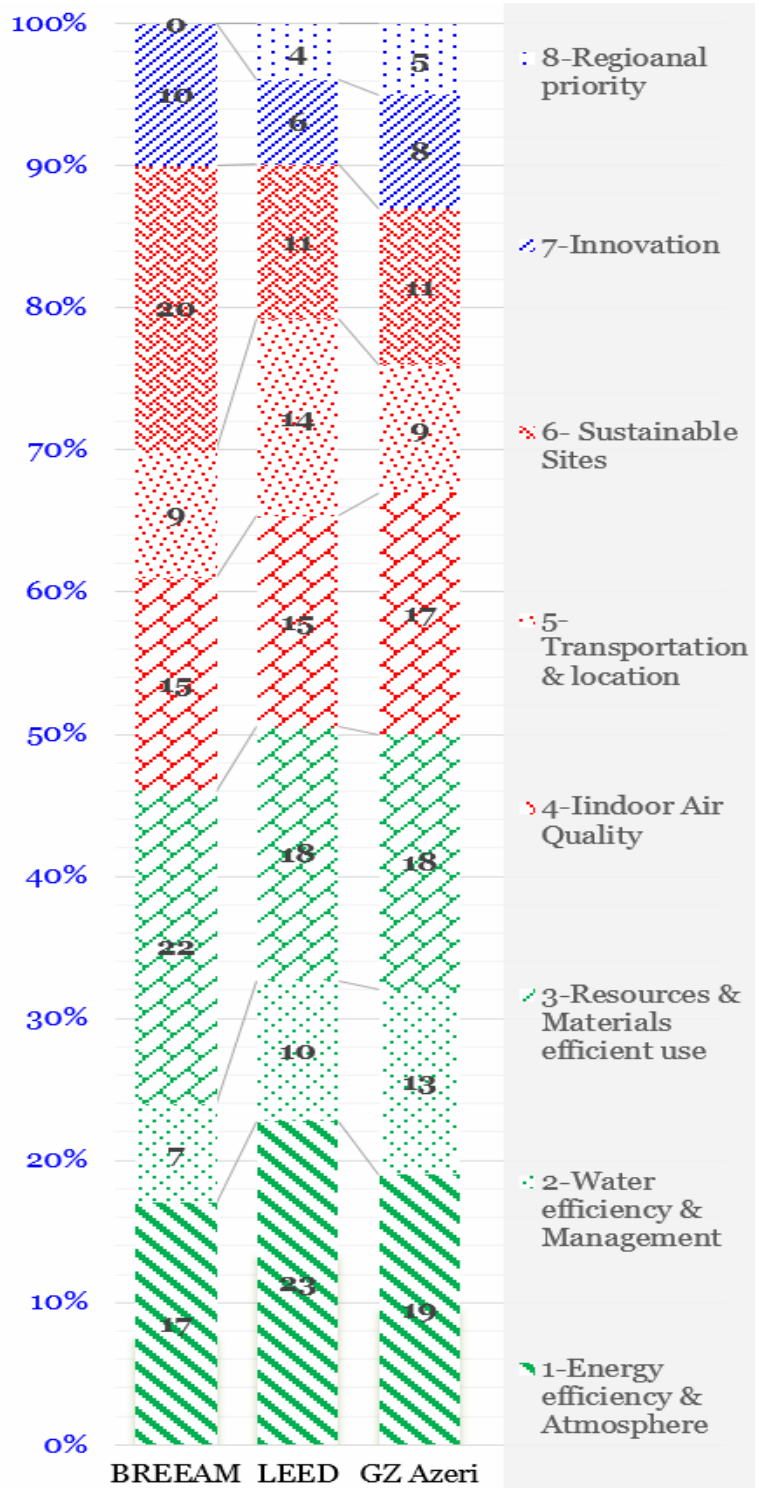

Fig. 6. Assessment criteria and weights for BREEAM, LEED and GZ Azeri.

Fig. 7. Comparison between the rating scores for BREEAM, LEED, and GZ Azeri.

Also, the expediency of certification is dictated by the fact that the owners of buildings, fulfilling corporate goals, seek to attract additional attention to their property (Chan et al., 2018). For the state, building certification is the solution of national tasks for decarbonization, improvement of the quality of life and health of the population, and integrated development of territories (Thilakaratne and Lew, 2011).

7. Existing problems, obstacles, and their classification

The main obstacles to the implementation of building certification methods in Azerbaijan are:

- For LEED certification, the documents are accepted only in English with imperial units of measurement and with the mandatory use of American standards like ASHRAE and others, but BREEAM can work with national building codes and standards (Table 1). For LEED, applying for the certification process is possible only at the initial stage of project development. After the start of construction, the application for LEED certification is not considered (case of ADA University, Baku);
- According to BREEAM, when creating a computer building model in an accredited calculation program of energy consumption, comparing the real energy consumption of a building with acceptable baseline values and indicators should be provided by experienced specialists, unfortunately, the experience of local specialists is insufficient;
- To use only certified building materials and engineering equipment is necessary and information on their environmental impact during production, use, recycling, and disposal is obligatory. Local manufacturers do not have this data, but LEED strictly follows this rule;
- Certification is a costly process, not only from an organizational point of view but also from a financial one. At present, the cost of certification in Azerbaijan is high and determined separately for each project. But it is obvious that as experience is gained in this area, this process will become more affordable.

Qualitative research was applied to assess all the factors and challenges that mainly influence the development and adoption of the building certification process in Azerbaijan. All of them were grouped into three main categories: people-focused issues, technology-focused issues, process-focused issues as shown in Table 2.

8. Conclusion and recommendations

The study and analysis of the main issues associated with the building certification methods used in Azerbaijan led to the following conclusion.

Building certification as an effective tool for reducing human impact on the environment and promoting innovative energy and resource-saving technologies is relevant today (Zhao *et al*., 2023). The completed complex of general and special research, the analysis of materials on the referent topic, and the experience of the authors as certified energy auditors show that:

- The presence of a significant amount of natural resources determines the voluntariness of the building certification process and the passivity of officials and state organizations;
- Cases of LEED and BREEAM application in Azerbaijan are due to their relative flexibility and adaptability to local building codes and practices;
- The experience of applying international certification methods in Azerbaijan is gradually changing the attitude of project customers toward the organization and implementation of the construction process and stimulating further development;

Table 2. Categories of issues affecting building certification (Skoro, 2011; Seinre *et al.,* 2014).

Categories of issues	Factors	Challenges
People-focused	Government & public officials	- lack of proper construction codes and regulatory processes - lack of incentives
	Developers	- unawareness of the benefits and advantages - risks of unforeseen costs compared to traditional buildings
	Skilled personnel	- the absence of an integrated design team: project owner, project manager, building contractor, architect, services engineer, structural engineer, environmental engineer, civil engineer, cost planner, building surveyor, and acoustic expert - insufficient number of local experts, professionals
Technology-focused	Green-oriented construction materials and products	- lack of biodegradable certified local materials with zero emissions and toxicity - no easily accessible records, information, or catalogs on green products and associated technical standards
	Integrated design process	- lack of access to information about the best software products and tools
	Engineering systems	- lack of advanced technologies for heating, ventilation, air conditioning, refrigeration, water supply, etc.
Process-focused	Cost barrier	- fear of high-cost investments in comparison to conventional buildings - risks of unexpected costs
	Mechanisms for project implementation	- models of cooperation and networking, models of communication, roles of different actors, decision-making and management processes, and the scheduling of tasks
	Tendering processes and procurement	- barriers to implementing the sustainable supply chain

- The existing experience in building certification in Azerbaijan matters of great socio-economic importance, but indicates an insufficient level of development of the real estate market in terms of compliance with international requirements;
- An adequate strategy and methodology for the implementation of international and local certification methods has not yet been developed;
- Further application of the national certification method GZ Azeri will be more successful and effective only with the support and facilitation of the state.

Although some building owners in Azerbaijan are applying for certification, no building has been definitively certified in the last seven years. Only two buildings under construction are undergoing the process of LEED certification, and the authors are members of the expert working group.

To accelerate the building certification process in Azerbaijan and for further improvement of GZ Azeri, it is necessary to purposefully form the appropriate prerequisites:

- Develop a specialized training course for local professionals depending on their skill level (Skoro, 2011) and establish an appropriate training center in collaboration with international experts;
- Create a consultation center and provide consultancy services to answer questions about building certification;
- Develop a green building roadmap for Azerbaijan according to modern international requirements (Subhash and Palaniappan, 2019).
- Introduce a specialized authority to monitor buildings' compliance with the requirements of green construction and energy efficiency of buildings;
- Develop the legislative system related to green construction in general and introduce the legislative and economic incentives from the state through subsidizing, introducing a simplified taxation system, and paying part of the costs of certification.

This research will help a wide range of international and local experts to better understand the emerging green building market in Azerbaijan and expand engagement with parties concerned both inside and outside of the country. The developers and owners can clarify and evaluate the goals, criteria, and standards of the three certification methods to better realize the factors influencing the choice of one or another certification method for a given building. The continuing relevance of the underlying principles and trends allows the article to claim to attract the attention of international experts for a comprehensive solution to the issue of accelerating the building certification process in Azerbaijan. Future research will focus on further improving the methodological foundations of the national certification method to involve more buildings in this process.

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