Expert Roundtable on
Green Building Challenges and AI Solutions
17th August 2022

(A confluence session of industry leaders, technologists, innovators, and researchers to understand the use cases, problems, challenges, and particularly AI-based solution possibilities pertaining to Green Buildings)

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1 Context

As per UN estimates[1] India's urban population is expected to add another 416 million people to its urban areas by 2050. This rapid pace of urbanization along with climate change can pose additional challenges with respect to demand proliferation, stress on natural resources, and management, operation, and expansion of critical infrastructure. This calls for immediate and better utilization of legacy as well as emerging technology solutions to meet India's urban challenges effectively and efficiently. A green or sustainable building is one, which because of its construction and features, can maintain / improve the quality of the environment in which it is located[2]. In this context, the Government of India has also emphasised on development of low-cost and user-friendly technologies for resolving varied urban challenges. Against this backdrop of emerging national priorities, the AGNIi Mission along with IIIT Hyderabad Smart City Living Lab organized an Expert Roundtable series 'Technology and Innovation for Sustainable and Resilient Cities'. It brought together a gamut of stakeholders to deliberate on how best emerging technologies and innovations, especially with respect to artificial intelligence (AI) can be leveraged by Indian cities for resolving their current urban challenges and for ensuring sustainable development.

The focus of the discussion was on the following segments:

1. Existing green buildings related challenges and identifying priority areas for green buildings with respect to sustainable site development, water saving, energy efficiency, material selection, and indoor environment quality specific to Indian cities for technology intervention
2. Best practices in green buildings through AI technology adoption and scaling to suit India's needs
3. Design technologies involved
4. Expertise to be developed at the city level for technology adoption

In this context, the current position paper summarises the key deliberations and the way forward.

2 Key deliberations

Discussion was initiated to understand the key challenges that are being faced with respect to green buildings.

2.1 Design process and operations complexities

Designing green buildings is a very complex process. It entails simultaneous optimization of myriad variables involved and hence poses a significant challenge. For example, maintaining an efficient temperature (heating/cooling) of buildings while keeping the carbon footprint in control. According to experts, the know-how needed to design an optimized green building may not be commonly understood among architects. Manual operation of the processes also causes a huge challenge in addition to the design process.

2.2 Analysing human behaviour to build green and healthy Cities

Buildings are for the ultimate use of human beings, however, at times not much attention is paid to human behaviour with respect to energy and water consumption while designing green buildings. Emerging technologies like AI should be utilised keeping in mind the long-term focus

[1] https://www.un.org/development/desa/publications/2018-revision-of-world-urbanization-prospects.html
[2] https://www.worldgbc.org/what-green-building

of green buildings i.e., human health. In this context, in September 2021, NITI Aayog has also introduced the concept of 'Healthy Cities' for 500 Indian cities[3].

2.3 Data availability, standard Models, processing, storage

An important prerequisite of AI-based solutions is data availability. In the context of green buildings there is paucity of data. There is a need to integrate micro and macro level databases pertaining to different parameters. Additionally, even with limited data availability there is at times lack of awareness regarding data integration and utilization. According to experts, in certain cases basic Building Management System (BMS) is also missing. Further, even if all buildings of a particular size have BMS or sensors installed, then it is a must that they generate data in a standardized format.

As the construction and development of green buildings gains traction, it is also important to note that some of the related systems will generate huge amounts of data. Hence, it is important to assess the existing software capabilities as well as human resource capacities to process the huge data sets generated and also if the associated systems are themselves green and sustainable.

There is also a need to undertake measurements of the total built up areas of cities to develop scalability of the green building concept. This also needs to be a dynamic system for updating pertinent information with time.

2.4 Lack of awareness – Gap in understanding of green building operations

According to experts, contractors and builders (largely) lack awareness about green buildings. There is need of formal training for these stakeholders so that they can be educated on green building technologies, techniques, material, methodologies, and data collection from buildings. At the time of designing a green building, some parameters are adhered to, however, builders may be unaware of the procedures if something goes amiss during operations especially if they are not guided by trained experts/green agencies. Similarly, homeowners of small buildings are not always trained in building/operating their green buildings. Looking at the huge built space existing in most urban areas of India, each green building individually might have a small impact but cumulatively the results can be significant. Hence, there is need to bridge this gap pertaining to green building design, construction, and operations.

2.5 Measurement errors in performance efficiency - Missing benchmarks

There do not exist many studies which do a comparative analysis of the projected energy consumption of green buildings and their actual energy consumption, especially post occupation. According to experts, there may also be a disparity between the projected energy efficiency of green buildings and the actual figures. This leads to measurement errors. Hence, there is a need to establish a mandatory benchmark system to assess the performance efficiency of green buildings. Therefore, it is also essential that energy consumption benchmarking and measurement is undertaken for both the construction and operation stage.

[3] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1755457#:~:text=Programmatic%20Intervention%20for%20Planning%20of,the%20states%20and%20local%20bodies.

3 Way forward

3.1 Creation of incentives

There is a need to understand how builders and owners can be incentivised to build, operate and maintain green buildings leveraging emerging technologies such as AI. Additionally, there is also a need to provide incentives to house/building owners for them to continue to maintain the green building. Experts also provided the example of what they referred to as 'guilt meters' or flow meters. These can be explored to help citizens track their water consumption and can play an instrumental role in reducing water consumption which is one of the key green building parameters. Additionally, best practices need to be identified, popularized, and replicated. Moreover, data can be analysed, and the savings measured from these best practices. Such initiatives are already implemented in countries like Singapore[4]. Further, gamification plans can be developed, where individual consumption is compared with locality consumption and suitable incentives are provided for better performance.

3.2 Make existing infrastructure more sustainable – Green retrofitting

Datasets can be collected for existing infrastructure, so that AI solutions can be designed in a more efficient manner to solve issues pertaining to different facets of existing buildings. In today's time, AI can integrate existing infrastructure into smart buildings by connecting different software seamlessly with various building components. With sensors and monitoring technology, performance may be continuously monitored for HVAC, air quality, temperature, energy use, occupancy, downtime hours, ventilation, and many other parameters. Hence, insights acquired through AI can facilitate retrofitting of existing buildings and improve their sustainability.

3.3 Holistically green

The 'green' aspects of buildings should not be confined to procurement of construction materials and the processes but need to have a 'human' perspective as well. It is important that human behaviour is considered while conceptualizing green buildings especially when applying on large scale urban areas.

As per experts, estimating an economic model based on data from individual homes might be be very noisy and not viable. It would rather be better to work on making infrastructure green - that is power grids, water grids, traffic grids, rail grids, wastewater & solid waste management grids - and present the outcome to citizens. Potential example of green infrastructure is use of emerging technologies to develop smart traffic systems. For instance, AI-driven cameras and sensors nowadays can enable constant monitoring of intersections leading to improved traffic management of the city that in turn leads to reduced vehicular emissions.

Furthermore, green building ratings should also include parameters pertaining to worker safety, usage of child labour, workers' health conditions, gender disparity etc.

3.4 Lifecycle maintenance

There is an emergent need to leverage emerging technologies to maintain green buildings during various stages of their lifecycle and not just during the design phase.

[4] https://www.researchgate.net/publication/324504364_Water_Governance_of_Singapore_in_Achieving_Sustainable_Water_Security

3.5 Micro to macro production

There is a need to start working on green buildings at a micro level. This can be done by educating builders and contractors about new technology features such as geothermal heating, storm water management amongst others; building one green building using the right parameters of design, technology and then emulating the same to build at a scale.

3.6 Short term energy projections -To meet the demands

The coming decades will be marked by a significant increase in population and urbanization. Hence, short term energy projections are the need of the hour. The future will witness an increase in the number of residential units. Additionally, along with regular energy consumption, new dimensions of energy consumption will emerge, for example, charging of electric vehicles in residences. These events will have implications for electricity demand and load. Hence, there is a need to be prepared for these kinds of energy demand proliferations and a possible way to do the same is short term energy projections. There is also a need to focus on implementing neighbourhood energy management systems along with home energy management systems. The peer-to-peer model of energy trading using such technologically advanced systems can also be explored to meet the growing demand of energy within the community.

4 Action points

The AGNIi Mission and IIIT Hyderabad will continue to work together on following action items:

- Understanding the specific problems related to green infrastructure through surveys, discussions etc.
- Collaborate on scouting indigenous technologies for the use cases identified
- Conduct workshops/technology showcases on algorithm-based systems, sensor research and datasets to demonstrate the solutions to relevant stakeholders
- Collaborate on developing emerging technology use cases for relevant government ministries

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