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Nanotechnologies Brooding Smart and Economic Green Architecture

Prof., of Constr. Eng. and Mng **Abd Al-Aziz S. Al-Sharkawy**
Faculty of Eng, Egyptian Russian University, Egypt
E-mail: el_sharkawy2012@yahoo.com

Abstract
More than six decades ago, surprising nanotechnologies with its so effective dynamic researches became the passage for approaching a dream of existing smart and economic tools with its so accuracy of synergy. Nanotechnologies, currently, cover a multinomial discipline including construction industry. However, an economic assessment , proved that nanotechnology has a significant impact for resulting smart and economic construction. However, architecture as a core field in construction industry became more sustainable with nanotechnologies and their applications through the use of nanomaterial brooding smart and economic buildings that are so friendly with the hoped healthy environment. This results in green architecture with high durability, performance, energy efficiency, and safety. That green architecture having smart components with their self-senses, self-repairing and self-cleaning resulting in friendly usage and optimum sustainability. This paper highlights on that surprising effectiveness of nanotechnologies as a brooding facility for smart and economic green architecture.

Keywords: Nanotechnologies; Smart; Economic Buildings; Green Architecture.

1. Introduction

• **Nanotechnology**, sometimes shortened to nanotech, is the manipulation of a matter on an atomic and molecular scale, One nanometer (nm) is 10^{-9}, of a meter. The concepts that seeded nanotechnology were first discussed in 1959 by renowned physicist Richard Feynman in his talk There's Plenty of Room at the Bottom, in which he described the possibility of synthesis via direct manipulation of atoms. The term; "nano-technology" was first used by Norio Taniguchi in 1974, though it was not widely known (Ganesh, 2012), (Al-Sharkawy, 2014).

• **green architecture**, indicating philosophy of architecture that advocates sustainable energy sources, the conservation of energy, the reuse and safety of building materials, and the siting of a building with consideration of its impact on the environment. However; In the early 21st century the building of shelter, in all its forms, consumed more than half of the world's resources, translating into 16% of the Earth's freshwater resources, range of 30 up to 40 % of global energy supplies, and 50% by weight of global raw materials withdrawn from Earth's surface. Architecture, in its traditional trends, was responsible for 40 up to 50% of waste deposits in landfills and 20 up to 30% building' gas emissions. At the turn of the 21st century, however, a building's environmental integrity, in the way of the conception of green design, building, zone and city for approaching how architecture to be so key factor in that hoped healthy environment while increasing their greening effect (Encyclopaepedia Britannica, 2022): *https://www.britannica.com/art/*green-architecture.

• **Nanotechnologies for green architecture,** nanotechnologies have an effectiveness on sustainability or green architecture through buildings and urbanism with high functional efficiency. However, Nano architecture increasingly directs for using Nano-materials, Nano products, and what may be called Nano shapes for accurate and long-run treatment of structures as well as construction. Also, nanotechnology as green technology is so promising for adopting Nano technological methods to treat the scarcity of natural resources and to reduce the environmental pollution. In addition, in conception of greening or environmental sustainability, the knowledge about sustainable development, preservation of nature, elimination of wastage and reusability, will be more possible in a successful manner (Rehan N.,2021; Rani K. and Sridevi V., 2017; Biswas et al., 2022).

• **Nanotechnologies for smart architecture,** nanotechnologies, strictly, affecting architecture' function through its focal columns; utility, durability and beauty. However, **n**anotechnologies' effectiveness on architecture, extremely, displays these surprising features as; aesthetic aspects of buildings, eco-efficiency of industrial processes and products.

These efficient products, as new and innovative materials, are having their unique properties of ultra-insulating, self-sensing, self-repairing and self-sending of reports. Nanotechnologies became having so positive impact on architectural design for brooding a recent generation of green buildings with their innovative materials having that so high ability for connecting needs of environmental aesthetic, electronic and communicative facilities. That high ability is resulting in smart architectural building, zones and cities (Mattia Federico Leone, 2012; Tok et al., 2022), (Figure 1).

Figure 1. Bletchley Park, as first smart community, 1938-1993 as museum, location; England-UK. http://www.constructionleadershipcouncil.co.uk./smart-construction-guide-and-case-studies

• **Nanotechnologies for economic green architecture**, these surprising technologies have so positive effectiveness on economic components of architecture and urbanism via achieving that longevous high safety, security, utility, durability and efficient architectural requirements. These requirements are approached through; reducing energy' consumption, conserving economic resources and minimizing pollution (Rehan N., 2017).

2. Materials and Methods

• Main frame of materials and methods of this present Research paper is structured as: Abstract 1. Introduction 2. Materials and Methods. 3. Smart Buildings. [3.1 Early smart buildings 3.2 Useful smart building' services 3.3 Smart power grid (SG)] 4. Smart construction 5. A smart city [5.1 History of Smart Cities 5.2 Why do we need them? 5.3 Are Smart Cities Sustainable? 5.4 Safety of Smart Cities 5.5 Examples of smart cities] 6. Economics of nanotechnologies in smart green architecture 7. Sustainable green architectural into Building and Eco village. [7.1 Nano House 7.2 Green building 7.3 Eco village] 8. Conclusions.

3. Smart Buildings

- **Early smart buildings** ever constructed were primitive shelters built with stones, sticks, animal skins and other natural and plantation materials. These primarily buildings to provide, relatively, a comfortable space for people inside. Over time, the components inside a building had been developed and improved, allowing recent building' owners to control lighting, security, heating, ventilation and air conditioning systems. Future' buildings approaching to connect numerous devices into an integrated, dynamic and functional way. These future' buildings to fulfill the mission for minimizing energy cost, supporting a robust electric grid and mitigating that negative environmental impact. (Danielle Crownover, 2019).
- **Useful smart building' services** making occupants with high level of illumination, thermal comfort, air quality, physical security, sanitation, and many more at the lowest cost and environmental impact over the building lifecycle. Achieving the vision requires adding intelligence or that smartness from the initial design phase to the end of the building's useful life. Smart buildings use information technology during operation to connect a variety of subsystems, operating independently, to enable these systems for sharing information to optimize total building performance. Smart buildings look beyond the building equipment within their four walls. These smart buildings are connected and responsive to a smart power grid, and they interact with building operators and occupants to empower them with new levels of visibility and actionable functional information. These

functional information for fulfilling; Connecting building systems, connecting people and technology, connecting to the global environment, Connecting to the smart power grid (Al-Sharkawy, 2022).

- Smart power grid (SG) Yonghong Ma. And Baixuam Li. (2020), Shiwani Goyall, Mrs. Shimi S. (2017) illustrated; Smart Grid (SG) also called smart power grid, smart electrical grid, intelligrid, intragrid, intergrid, intelligent grid or future grid however, there is no different from the traditional term but with certain enhancements that indicating the integration of information systems into the electrical energy distribution grid. In general, the traditional power grids are used to transfer power from a few and centralized power generation facilities to a large number of potential customers over a vast geographical area. The smart grid allows real time tracking and management of energy supply and demand thereby making the customer one of the essential roles in the whole power distribution system. In addition, smart buildings, are ready for Connecting to an intelligent future. However, Intelligent Future, will go far beyond saving energy but extend for contributing to the architectural sustainability goals. smart buildings, increasingly, extend capital equipment life and also impact security and safety of all resources both human and capital with a robust purification and economic future human 'life (Figure 2).

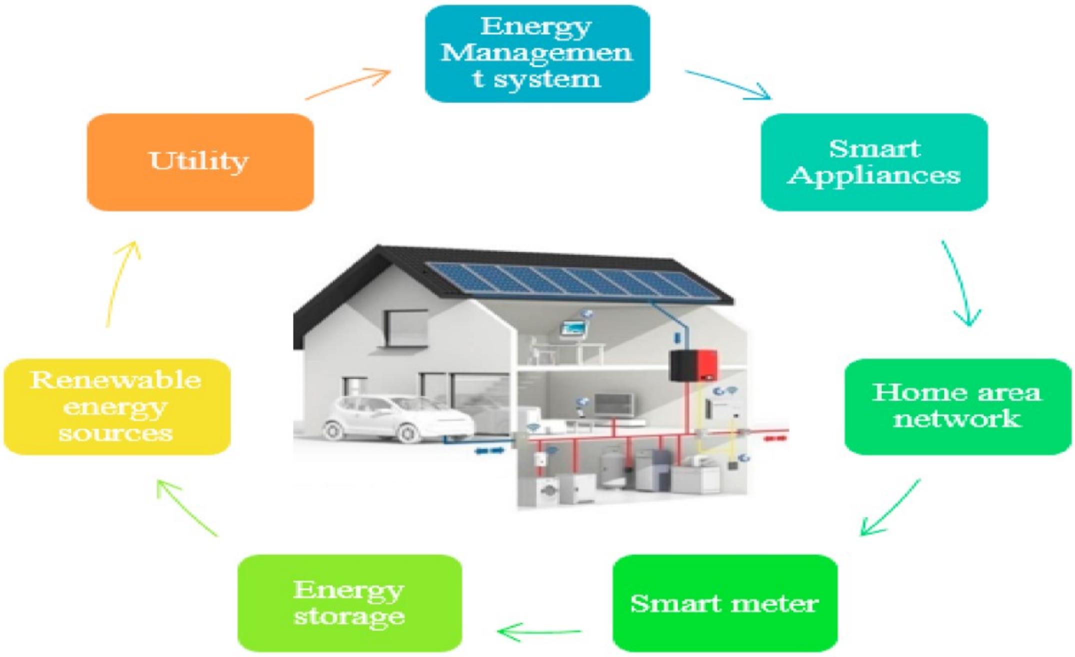

Figure 2. Home Energy Management System with smart Grid, (Yonghong Ma. And Baixuam Li., 2020).

4. Smart construction

Smart construction may be defined as; the design, construction and operation of assets achieved for fulfilling the full use of digital technologies and industrialized manufacturing techniques to improve productivity, minimize whole life costs, improve sustainability and maximize user benefits (Al-Sharkawy A. , 2019). UK HM-Government (2013) published; 'Construction 2025, setting out its long-term vision through proposal directing, by 2025, the industry should be 'smart'. The report proposes that there is a need to ensure UK construction for describing the conception of smart construction and digital design by: Working to remove barriers against innovation, Bringing forward more research and innovation, Improvement collaboration between industry, academia and research organizations. Capturing lessons learned from successful innovations. Improving access to innovation and R&D incentives. Investing in people and technology and making better use of existing technologies.

Delivering more sustainable buildings, more quickly and more efficiently, and Adopting off-site manufacturing, which has the potential to achieve greater precision and quality and reducing manufacture and assembly time, and using 25% less energy (Figure 3).

Figure 3. Lillis Business Complex; University of Oregon; The Lillis Business Complex, known for its environmentally friendly design, for having one of the largest solar installations in the Northwest, and for its innovative use of photovoltaic solar glass, on the campus of the University of Oregon in Eugene, Oregon, USA. https://www.britannica.com/art/green-architecture & https://en.wikipedia.org/wiki/Eugene,_Oregon

5. A smart city

A smart city, as a term, means a city that uses information and communication technology (ICT) for improvement operational efficiency, share information with the public, providing a better quality of public and private services and maximizing citizen welfare. The key goal of a smart city is achievement of city' functions and promotion of economic growth while enhancement quality of life for citizens. However, city' smartness contains; an infrastructure based on innovative technologies, environmental initiatives, effective and highly functional public transportation, well ability for people while living with work within the city, using its resources (TWI.UK., 2022). One of many smart cities, as illustrated in following article 5.5, is the Smart Columbus in Columbus, Ohio, USA, founded in 2016. (Andrew J. Ginther, Mayor, 2022)

5.1 History of Smart Cities

The concept of smart cities began as far back as the 1960s and 1970s when the US Community Analysis Bureau began using databases, aerial photography and cluster analysis to collect data, direct resources and issue reports in order to direct services, mitigate against disasters and reduce poverty. This led to the creation of the first generation of smart cities. The first generation of smart city was delivered by technology providers to understand the implications of technology on daily life. This led to the second generation of smart city, which looked at how smart technologies and other innovations could create joined-up municipal solutions. The third generation of smart city took the control away from technology providers and city leaders, instead creating a model that involved the public and enabled social inclusion and community engagement. This third-generation model was adopted allowing citizens to invest for affordable housing issues.

5.2 Why do We Need Them?

Smart cities should provide an urban environment that delivers a high quality of life to residents while also generating economic growth. This means delivering a suite of joined-up services to citizens with reduced infrastructure costs. This becomes increasingly important for the future population growth in urban areas, where more efficient use of infrastructure and assets will be required (Amen,2021). Smart city services and applications will allow these improvements which will lead to a higher quality of life for citizens. Smart city improvements also provide new value from existing infrastructure while creating new revenue streams and operational efficiencies to help save money for governments and citizens alike.

5.3 Are Smart Cities Sustainable?

The reply; Sustainability is an important aspect of smart cities as they seek to improve efficiencies in urban areas and improve citizen welfare. Cities offer many environmental advantages, such as smaller geographical footprints. However, smart technologies present the implementation of an electric transport system to reduce emissions. Such sustainable transport options should also cause in a reduction in the number of cars in urban areas. Creating such sustainable solutions could deliver environmental and societal benefits with so high economical level.

5.4 Safety of Smart Cities

Smart cities offer benefits for improvement citizen safety through intelligent roadways and public safety monitoring. However, core security objectives may be broken down into; Availability of Data in real time with reliable access in order to make sure it performs its function in monitoring the various parts of the smart city infrastructure, Integrity with availability, data not only be readily available, but it also be accurate. Confidentiality with Sensitive data being kept confidential and safe from unauthorized access. Accountability, however, system' users need to be accountable, in case problems, for their actions and interaction with sensitive data systems.

5.5 Examples of Smart Cities

These existing ones in; Barcelona, Spain, Columbus, Ohio, USA, Dubai, United Arab Emirates, Hong Kong, China, Kansas City, Missouri, USA, London, England, Melbourne, Australia, New York City, New York, USA, Reykjavik, Iceland, San Diego, California, USA, Singapore, Tokyo, Japan, Toronto, Canada, Vienna, Austria (Figure 4).
Safety of Smart Cities:

Figure 4. Smart Columbus in Columbus, Ohio. Smart Columbus was founded in 2016.
https://en.wikipedia.org/wiki/Smart_Columbus, - https://www.columbus.gov/smartcity/

6. Economics of nanotechnologies in smart green architecture

In studies of the long-term economic impacts of major technological accomplishment relating to nature, Philip Shapira and Jan Youtie, (2015), presented a review of multiple studies. These studies have examined the consequences of public R&D investments. These multiple studies illustrated the variety of channels through which economic and societal impacts are generated through growth in the stock of knowledge, human capital enhancement, new instruments and methods, networks and social interaction, problem solving, new firms, and social knowledge. However; green nanotechnologies have the potential to make significant contributions both to addressing green challenges and to fostering sustainable economic development. Through this sustainable economic development there is substantial promise, especially, in nano-enabled applications in solar cells, photovoltaics, batteries, fuel catalysts, and water filtration. Other nano-enabled applications have the potential to reduce operational energy required through offering comparable or better performance with less weight, more durability or greater efficiency.
While this economic contribution of green nanotechnologies with surprising nano-scale materials results in environmental, health, safety and broader societal values and comfortable considerations.

7. Sustainable green architectural into Building and Eco village

- Nano House in Sustainable green architectural with Building and Eco village, the term Nano house, was named to be the world's smallest sustainable house (Al-Sharkawy, 2022). The Nano Living System with its green pre-engineered concept for residential use presenting an innovative and sustainable architectural proposition. The design is based on creation of flexible spaces, through Nano Living Systems' suspending technology and use of renewable energy systems. This suggests an optimistic and environmental solution for the global housing issue of very small living spaces. As an example, model, the Nano House can be used by a family of three in an area consisting of 25 square metres (270 sq ft). This is made possible by the incorporation of the suspending technology, which nearly doubles the size of the living area within this space by transforming what is common living space by day into two separate bedrooms by night. The suspending technology can be used in new construction and can also be adapted to be used in existing structures, such as hotels, studios, dormitories and very small housing.

- Green building also known as green construction or sustainable building) refers to both a structure and the application of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle. However, that responsibility and efficiency beginng from planning to design, construction, operation, maintenance till renovation, and demolition. The Green Building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Leadership in Energy and Environmental Design (LEED) is a set of rating systems for the design, construction, operation, and maintenance of green buildings which was developed by the U.S. Green Building Council. Other certificate systems that confirm the sustainability of buildings are the British BREEAM (Building Research Establishment Environmental Assessment Method) for buildings and large-scale developments or the DGNB System (Deutsche Gesellschaft für Nachhaltiges Bauen e.V.) which benchmarks the sustainability performance of buildings, indoor environments and districts. Currently, the World Green Building Council is conducting research on the effects of green buildings on the health and productivity of their users and is working for promotion Green Buildings in Emerging Markets through EDGE (Excellence in Design for Greater Efficiencies) Market Transformation Program and certification. There are also other tools such as Green Star in Australia, Global Sustainability Assessment System (GSAS) used in the Middle East and the Green Building Index (GBI) predominantly used in Malaysia.

Building information modeling (BIM) is a process involving the generation and management of digital representations of physical and functional characteristics of places. Building information models (BIMs) are considered files to support decision-making regarding a building or other built asset. Although new technologies are constantly being developed to complement current practices in creating greener structures. while the common objective of green buildings is to reduce the overall impact of the built environment on human health and the natural environment by; Efficiently using energy, water, other resources, protecting occupant health and improving employee productivity, reducing waste, pollution, and environmental degradation.. (info. On; https://en.wikipedia.org/wiki/Green_building).

- Eco village as an example of it, is the village of Findhorn (Al-Sharkawy, 2019) as an experimental architectural community project based at The Park, in Moray, Scotland, near the village of Findhorn. The project's main aim is to demonstrate a sustainable development in environmental, social, and economic terms. Work began in the early 1980s under the auspices of the Findhorn Foundation but now includes a wide diversity of organizations and activities. Numerous different ecological techniques are in use, and the project has won a variety of awards, including the UN-Habitat Best Practice Designation in 1998.

An independent study concludes that the residents have the lowest ecological footprint of any community measured so far in the industrialized world and is also half of the UK average. Although the project has attracted some controversy, the growing profile of environmental issues such as climate change has led to a degree of mainstream acceptance of its ecological ethos. (Info., on: https://en.wikipedia.org/wiki/Findhorn_Ecovillage). (Figures 5., 6. and figure 7.).

Figure 5. A 3D-snapshot of the mkSolaire (or "Smart House"), a house design originally designed by Michelle Kaufmann, design is now owned by Blu Homes. See http://www.mkd-arc.com//homes/mksolaire/chicago_museum.php for the ecology behind its features.

Figure 6. A Barrel House, the first new dwelling to be created at Findhorn Ecovillage https://en.wikipedia.org/wiki/Green_building#/media/File:PA120016.JPG

Figure 7. An eco-house at Findhorn Ecovillage with a turf roof and solar panels. https://en.wikipedia.org/wiki/Green_building#/media/File:PA120016.JPG.

8. Conclusions

• **Architecture** as a core field in construction industry became more sustainable with nanotechnologies with their applications for approaching the hoped so friendly and healthy environment. • **Green architecture** indicating architectural philosophy motivating sustainable energy sources, conservation of energy, reuse and safety of building materials, and siting of a building with consideration of its impact on the environment. • **Nanotechnologies** have an effectiveness on sustainability or green architecture through buildings and urbanism with high functional efficiency into Nano architecture with using Nano-materials, Nano products and Nano shapes for accurate and long-run treatment of structures as well as construction. Nanotechnologies is brooding of; • **Smart building** with its surprising services making occupants with high level of illumination, thermal comfort, air quality, physical security, sanitation, and many more at the lowest cost and environmental impact over the building lifecycle, • S**mart construction** for fulfilling full use of digital technologies and industrialized manufacturing techniques for productivity improvement, minimizing whole life costs, improving sustainability and user benefits, • **Smart cities** providing an urban environment that delivers a high quality of life to residents while also generating economic growth, • **Sustainable green architectural into Building and Eco village, however,** green nanotechnologies have the potential making significant contributions for fostering sustainable economic development with so cost' reduction accomplished with so long-run of buildings' usage into their high smartness and sustainability. This summary proves that nanotechnologies brooding smart and economic green architecture.

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Conflict of Interests

The authors declare no conflict of interest.

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