T.C.
ISTANBUL GEDİK UNIVERSITY
INSTITUTE OF GRADUATE STUDIES

TECHNOLOGY MANAGEMENT FOR THE CONSTRUCTION OF SMART CITIES

MASTER'S THESIS

Huda Mohammedali Hashim AL- HABOOBI

Engineering Management Department

Engineering Management Master in English Program

JUNE 2022

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Thesis Advisor: Assist. Prof. Dr. Redvan GHASEMLOUNIA

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DEDICATION

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Thank you for everything.

DECLARATION

I, Huda Mohammedali Hashim AL- HABOOBI, do hereby declare that this thesis titled "Technology Management for The Construction of Smart Cities" is original work done by me for the award of the master's degree in the Faculty of Engineering Management. I also declare that this thesis or any part of it has not been submitted and presented for any other degree or research paper in any other university or institution. (…../…../2022)

Huda Mohammedali Hashim AL- HABOOBI

PREFACE

This thesis represents the moment of completion of the master's degree. It was a good adventure overall. However, many people stood by my side, even when they did not agree with my ideas. in my opinion. Thank you so much, all of you. First, I owe a lot to my supervisor, Assist. Prof. Dr. Redvan GHASEMLOUNIA, for his assistance and contribution to the data on this thesis. Since I was a university professor, everything I offered was valuable. Most importantly, I want to thank you for participating in this research, which has made it possible

June 2022 Huda Mohammedali Hashim ALHABOOBI

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ABBREVIATIONS

IB	**:** Intelligent Buildings
HVAC	**:** Heating, Ventilation and Air Conditioning
LEED	**:** Leadership in Energy and Environmental Design
LEED-NC	**:** LEED for New Construction
LEED-EB	**:** LEED for Existing Building
LEED-CS	**:** LEED for Core and Shell of Their Structure
LEED-CI	**:** LEED for Commercial Interiors
LEED-H	**:** Rate Homes
LEED-ND	**:** LEED of Neighborhood Developments
LEED-AP	**:** LEED Accredited Professional
CO2	**:** Carbon Dioxide
SLS	**:** Smart Lighting System
LED	**:** Light-Emitting Diode
EIFS	**:** Exterior Insulation and Finishing System
US	**:** United States
UAE	**:** United Arab Emirates
DSF'S	**:** Double-Skin Building Facades
UK	**:** United Kingdom
PVC	**:** Polyvinyl Chloride
R&D	**:** Research and Development
°F.	**:** Fahrenheit Degree
IPEG	**:** Innovation Policy Expert Group
ICT	**:** Information Communication Technology
$\bar{x}$	**:** Arithmetic Mean
N	**:** Sample
STD.	**:** Standard
%	**:** Percent
PH.D.	**:** Doctorate
Std. Dev	**:** Standard Deviation

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TECHNOLOGY MANAGEMENT FOR THE CONSTRUCTION OF SMART CITIE

ABSTRACT

The concept of smart homes and cities is one of the concepts that appeared recently in the developed world and which lacks application in the homes and cities of our Iraqi country, despite its possession of the qualifications that enable it to keep pace with the developed world. Therefore, the main objective of the current thesis is to provide a comprehensive review of the concept of smart homes and cities with their various applications in developed countries in the world, and its benefits for application in Iraqi homes and cities to transform them into smart cities by focusing on intelligence. Significant signs of progress have recently appeared in the design and construction of intelligent buildings (IB) that not only accommodates major developments in building technology but also provides better physical and environmental availability for residents and make the places where traditional services in building construction are more flexible, efficient, and sustainable. Therefore, with the increase in knowledge of environmental issues and the increasing concern about climate change, sustainable and green construction is gradually being proposed globally and its role in improving the environment. This method of data collection allows the study of different cases that depict the use of innovation in real life while giving clear indications of the importance of innovation in smart cities and the obstacles facing their implementation in Iraq. This thesis deals with various cases in studying the use of modern methods and materials in establishing modern construction in smart homes and cities. They include most technologies in homes like heating, ventilation and environmental design (HVAC) Systems, Smart lighting systems, Techniques in windows, Plug loads, and Security systems. On the other hand, it includes some study cases about technology techniques in smart cities in the prefabricated system, Technology management by Nano coating, skyscrapers, and technology in roads. In addition, it confirmed that engineering management is extremely essential to the success of a construction project and has an impact on every stage of a construction project. Therefore, it is concluded that the selection of engineering management should be made carefully with regard to experience, knowledge, strength, authority, and a good understanding of the type of project. The descriptive research methodology is used in this study by using a questionnaire to analyze the study's results on 60 samples of engineers of different disciplines. The results of the questionnaire used in the study indicate the utmost importance to refer to technological methods in the field of construction in developed countries that recognize the need for technology as a key to environmentally friendly, sustainable, and effective reform methods and their implementation in our country.

***Keywords**: IB, Innovation, Nanotechnology, Smart cities, skyscrapers, Technology management.*

AKILLI ŞEHIRLER INŞA ETMEK IÇIN TEKNOLOJI YÖNETIMI

ÖZET

Akıllı evler ve şehirler kavramı, gelişmiş dünyada son zamanlarda ortaya çıkan ve gelişmiş dünyaya ayak uydurabilecek niteliklere sahip olmalarına rağmen Irak ülkemizin evlerinde ve şehirlerinde uygulanmayan kavramlardan biridir.Bu nedenle, mevcut tezin temel amacı, dünyanın gelişmiş ülkelerindeki çeşitli uygulamaları ile akıllı evler ve şehirler kavramının kapsamlı bir incelemesini ve bunların Irak ev ve şehirlerinde uygulanmasına yönelik yararlarını akıllı hale dönüştürmek için kapsamlı bir şekilde sunmaktır. İstihbarata odaklanarak. Sadece bina teknolojisindeki büyük ilerlemelere uyum sağlamakla kalmayıp aynı zamanda bina sakinlerine daha iyi fiziksel ve çevresel kullanılabilirlik sağlayan ve bina inşaatında geleneksel hizmetlerin daha dayanıklı olduğu yerler yapan akıllı binaların (IB) tasarımı ve inşasında son zamanlarda önemli ilerleme işaretleri ortaya çıkmıştır. verimli ve sürdürülebilir. Bu nedenle, çevre sorunlarına ilişkin artan bilgi birikimi ve iklim değişikliğine ilişkin artan endişeyle birlikte, sürdürülebilir ve yeşil bina küresel olarak ve çevreyi iyileştirmedeki rolü giderek öneriliyor. Bu veri toplama yöntemi, akıllı şehirlerde yeniliğin önemine ve Irak'ta uygulanmasının önündeki engellere ilişkin net göstergeler vererek, gerçek hayatta yeniliğin kullanımını gösteren farklı vakaların incelenmesine olanak tanır. Bu tez, akıllı evlerde ve şehirlerde modern inşaatların yapımında modern yöntem ve malzemelerin kullanımının incelenmesindeki farklı durumları ele almaktadır. HVAC sistemleri, akıllı aydınlatma sistemleri, pencerelerdeki teknolojiler, bağlantı yükleri ve güvenlik sistemleri gibi evlerdeki çoğu teknolojiyi içerir. Öte yandan hazır sistemdeki akıllı şehirlerdeki teknolojik teknolojiler, nano kaplama ile teknoloji yönetimi, gökdelenler ve yollardaki teknoloji ile ilgili bazı vaka çalışmalarını içermektedir. Ayrıca, mühendislik yönetiminin bir inşaat projesinin başarısı için kesinlikle gerekli olduğunu ve bir inşaat projesinin her aşamasına etkisi olduğunu vurguladı. Bu nedenle mühendislik yönetimi seçiminin deneyim, bilgi, güç, yetki ve proje türünün iyi anlaşılması açısından dikkatle yapılması gerektiği sonucuna varılmıştır. Bu çalışmada, çeşitli disiplinlerden 60 mühendis örneği üzerinde çalışmanın sonuçlarını analiz etmek için bir anket kullanılarak betimsel araştırma yöntemi kullanılmıştır. Çalışmada kullanılan anketin sonuçları, teknoloji ihtiyacını çevre dostu, sürdürülebilir ve etkili onarım yöntemlerinin anahtarı olarak kabul eden gelişmiş ülkelerde inşaat alanındaki teknolojik yöntemlere başvurmanın ve ülkemizde uygulanmasının büyük önemini göstermektedir. bölge. ülke.

Anahtar Kelimeler: *Uluslararası Bakalorya, inovasyon, nanoteknoloji, akıllı şehirler, gökdelenler,teknolo.*

1.INTRODUCTION

1.1 Study Topic

Intelligent cities like a magnet for innovative workers and individuals and this encourages the circle creation that makes them more intelligent. As a consequence, intelligent cities have many chances to take advantage of their human capability and to encourage creative life (Partridge, 2004).

Where innovation, can be contributed as the chief reason for economic developments and making the economy more profitable, and such ideas seem to be more common with researchers and academics than with professionals from the building industry. However, when new products and technologies emerge, this problem appears to be more obvious as the difference between the available smart building technologies and the actual number of buildings (Hartkopf & Loftness, 1999).

The difference has many possible reasons. One of them is the lack of information and understanding between owners and developers of constructions in intelligent buildings and there are no stations for disseminating innovations in smart cities and encouraging its implementation. Therefore, the problem of research is majorly found in the concept of the smart house and city, its retard in launching utilization in Iraq. As well as, the lack of a clear urban policy to take advantage of smart cities technologies in modern planning. On other hand, the increasing number of smart city programs around the world has attracted and flourishing in the smart city movement a body of literature on its perceptions, policy approaches, desired outcomes, and myths (Angelidou, 2015; Anthopoulos, 2017; Mora, Bolici, & Deakin, 2017; Yigitcanlar et al., 2018).

These intellectual and practical efforts, reports and media discussions, the general interest of society, and the industry pursuit of an intelligent vision of

their cities all create a new buzzword for the smart cities. This buzzword has been spread in Smart building goals and Ambitions.

1.2 Purpose of Thesis

- The research seeks to achieve the basic goal of devising a strategy to transform Iraq's homes and cities into cities with technologies smart. It is achieved that by getting to know the latest technologies used in construction in the world with the aim of enhancing the awareness of the public and private sectors of the implications of the trends towards smart cities. Is achieved that by addressing some smart materials and methods in construction and their effective role in imparting the advantage of sustainability and intelligence to them because the application of smart city concepts is indispensable to ensure a distinctive standard of living for the world's population.
- There are not many studies dealings with smart, sustainable, green cities and homes to benefit from in the development of our countries. Smart city management is a complex work in the accelerated urban system. The research suggested that this topic is within the application of a development in the urban environment and its prospects in all areas of construction to be used in the development of homes and cities in Iraq.

1.3 Literature Review

The term technology management in smart houses and cities plays an important role in determining a given area's sustainable economic growth. They are seen as a key element for economically and socially increasing income, they are greener, safer, faster, on the other side to reduce energy consumption which is considered one of the important problems. Recent technological advancements have altered the stereotype of the architecture of buildings in all its different ways. It is known as smart building and smart cities that are developing and spreading across the world, especially in countries developed world, after architecture was developing based on the development of building materials and the emergence of various raw materials, it became, it relies on modern

technologies and information technology and its investment in construction and design in order to create buildings smart, environmentally friendly, helps individuals to enjoy comfort and luxury within these modern digital spaces. We can consider that sustainable development and smart buildings are becoming one of the construction industry's latest highlights (Volvačiovas, Turskis, Aviža, & Mikštienė, 2013).

On the other hand, as architects and engineers develop energy-saving HVAC modules, security, plug loads, smart lighting system, and techniques used in smart cities but there are no appropriate platforms for the dissemination of these new concepts to prospective users, and developers. At the same time, construction contractors are reluctant to take on these ideas in their goods, believing that this will make their work more challenging and raise project risks and costs (Yang & Peng, 2001).

One of the issues discussed in this research is the smart cities and one of the important technologies in it is pre-fabricated building due to their quick delivery and on-site convenience, prefabricated system structures have great potential for changing traditional construction methods at a quick rate. Prefabricated building modules able to be entire with services and architectural finishes in a quality regulated manufacturer environment. On the other hand, this technique has been suggested in highway renovations as it speeds up construction time. Also, the role of Nanotechnology and its capabilities for materials that give them contemporary concept architecture was discussed in the coating, being a water-repellent component and its many features in this field. On the other side, economic wealth, demand for functional living spaces to inhabit, and population growth have made one of the most sensational times to see huge size skyscrapers raising. In addition to being a man-made myth and their role in highlighting the advanced feature on the shape of the city in which they exist in it as a feature of contemporary urbanization, as it contains multiple technologies such as double-skin building facades, harnessing energy wind, revolving towers, windows, and curtain walls, the elevator spliced technology and sky gardens (Sexton & Barrett, 2003).

Also, discuss this thesis an overview of some innovative practices being trialed in the road construction sector. These include solar roads, smart roads glowing in dark in the Netherlands, plastic roads, energy harvesting piezoelectric, new design in the roads by using resting areas and paving tile for the guidance of blind persons. In addition to the role of engineering management in the success of building projects. On the other hand, the obstacles and critical points in Iraq that stand as an obstacle to the transformation of its cities into smart cities were clarified.

1.4 Hypotheses

- There is a relationship between spreading technology applications in homes and stimulating their application in them and thus transforming our homes into smart homes.
- There is a relationship between the transformation of Iraqi cities into smart cities and the lack of stations that demonstrate advanced technologies in developing countries.

2. LITERATURE REVIEW

2.1 Sustainable Construction Management

In a broad sense, sustainability is the ability to bear. It has become a wide-ranging term that can be applied to almost all facets of world life, from a local to a universal scale and over various periods of time. More than 70 different sustainability concepts exist (Holmberg & Sandbrook, 1992).

emphasized its importance and revealed the efforts of various scientific and disciplines of practice to identify and recognize its consequences to their fields. However, every definition agrees that it is fundamental to consider the future of the planet and find creative ways to conserve and improve the planet while satisfying different stakeholders' needs. There is now plenty of scientific proof that humanity lives unsustainably. This is apparent in the usage of Resources not renewable, land neglect, loss production, water pollution, and energy exhaustion for example (A. A. E. Othman, 2009) .

Returning human use of natural resources to sustainable limits will require a big collective effort. After the 1980s, sustainability included economic integration, social, and environmental spheres that meet existing demands without compromising future generations' ability to meet their own needs (Imperatives, 1987).

Efforts towards living more sustainably able to take many forms from reorganizing living conditions like eco-municipalities, ecovillages and sustainable cities, a reappraisal of Sectors economic like sustainable agriculture, green building or working practices such as sustainable architecture, the use of science for new technology such as green technologies, renewable energy to adjustments in individual lifestyles the challenge is about finding a balance between environmental considerations, economic constraints and social conditions (A. A. Othman, 2007).

The construction industry faces continual challenges and demands, because of coercion by governments and market conditions, for improvements in safety, in the avoidance of contractual disputes, and quality and cost control. To meet these challenges, construction firms need to constantly look for new ways and business models of building management (McGeorge & Zou, 2012).

On the other side, construction is one of the biggest end consumers of natural services, one of the biggest in the country, and the biggest polluters in Natural and man-made ecosystems. The improvement of the performance of buildings with regard to the environment will indeed promote greater environmental responsibility and place greater value on the welfare of future generations (Hill & Bowen, 1997).

One of the terminologies of construction technology is sustainable construction, the aim of sustainable construction, are:

- Improving quality of life and social fulfillment.
- Provide flexibility to accommodate future developments.
- Provide protection of the environment.
- Use resources completely.
- Build a safe, non-toxic ecosystem.
- Pursue quality in creating the built environment.

The sustainability of a new structure is based on a number of factors including water savings, selection of materials and energy efficiency. These factors are highly influenced by the architectural design of a building, the design of the site, and the assistance of civil infrastructure, and of course construction structures design (Rajendran, Seow, & Goh, 2012).

A common terminology that expresses technology and urbanization in construction sustainability address the social, environmental, and economic issues of a building in the context of its society. Sustainable building is applied during the whole life cycle of building, from pre-construction to the removal from the building. Such a building was designed to decrease the effect of the building effect on the environment by the preparation and operation of the project of construction compliance with the contract paper (Glavinich, 2008).

2.2 The Green Buildings Management

Buildings have an important and continuously growing effect on the environment as they are in charge of a big proportion of carbon emissions and use a big number of energy and resources. The green building motion emerged to relieve these impacts and to improve the process the building construction. This change should bring considerable environmental, economic, financial, and social benefits. However, in order to realize these efforts and benefits are needed not just in the appropriate selection technology, but also in the selection of appropriate materials (Jalaei & Jrade, 2015).

Where the term green building construction is part of the construction of sustainable (Kibert, 2016).

2.2.1 Green building design

Green building architecture may be more complex than expected from traditional construction considering that evaluate systems and alternative materials is commonly necessary by a team of designers. In traditional building projects, schematics designs that consist of at the beginning of the project process, the general and simplified concept of how constructions will be like is being used. While in green construction ventures, a systematic and streamlined concept approach is being utilized appropriately. The beginning of the green building project has several innovative architectural characteristics that are not usually present in the traditional construction and profound integration where the creation of the green construction characteristics is grouped in three-wide categories, including Indoor lights, construction, and layout materials. In a green building, the design of the lighting integrates low-energy lighting fixtures also environmentally. friendly building materials are used in green buildings to ensure that they are sustainable, such as recyclable bamboo flooring, toxic-free materials, such as non-toxic paints, and formaldehyde-free cabinets. Building design plays an important role in improving the energy efficiency of the building. Green buildings also take benefit from natural ventilation by the orientation of the building (J Yudelson, 2008).

In addition to traditional building procedures, projects of a green building must be implemented in a sustainable manner. One of the activities of sustainable green building is leadership in energy and environmental design (LEED) and one of them the waste treatment strategy is an indicator of these procedures to minimize the generation of waste building site a green building construction also have to adopt sustainable practices such as the use of timber from sustainable sources and using recycled aggregates for concrete work. In addition, the project manager and main contractor have to ensure that pollution from the construction is kept to the minimum by soil erosion control, airborne dust generation, and waterway sedimentation. in fact, the habitat of the natural should be protected by the prudent sitting of the building to reduce disruption to the environment. In traditional construction, these considerations are often ignored. We can consider that the building design and growth of the LEED rating may increase cost, but as well, it is increasing in future marketability to both tenants and investors, and, perhaps most importantly, the potential return on investment of constructing a green building. Unveiled in 2000, System for public use LEED green building rating (Jerry Yudelson, 2010).

That is the dominant tool used to scrutinize a broad range of a building or project's impact on water and energy use, use of transportation energy, resource conservation, ground use, municipal infrastructure, and indoor air quality. It can be classified LEED as follows:

- LEED for new construction (LEED-NC) for the system used for rating new construction.
- LEED for existing buildings (LEED-EB) is used to rate existing buildings.
- LEED for core and shell of their structure (LEED-CS) is used to rate speculative buildings in which the developer controls fewer than 50% of the final improvements.
- LEED for commercial interiors (LEED-CI) is used to rate commercial interiors for tenant improvements and remodeling.
- Rate homes (LEED-H) pilot systems are planned to rate homes.

- LEED of neighborhood developments (LEED-ND) to rate neighborhood developments.
- LEED accredited professional (LEED-AP) with third-party verification of the rating by a LEED accredited professional.

2.3 The Smart Homes Management

Management smart homes enabling future generations to fulfill their quality, the provision of user-friendly apartments, flexibility, durability, urban planning needs, improved conditions of living, the, increased flexibility of the entire buildings design and its elements, in line with the residents' current and future needs and provide electrical energy and reduce its consumption. Fig.2.1 shows some smart designs we can use in buildings. The benefits of smart buildings can be summarized as follows:

- Improving efficiency, increasing innovation.
- Achieving social goals such as affordable housing.
- Minimizing climate change and human health risks as a result of economic activities, that is:
  - ❖ Mitigating climate change by mitigating ambient carbon dioxide (CO2) pollution Because of construction energy consumption.
  - ❖ minimizing the chemical compounds emission causing ozone layer fluffy.
  - ❖ Taking care of the indoor environment in buildings by improving air quality, avoiding potentially harmful building materials (Mickaityte, Zavadskas, Kaklauskas, & Tupenaite, 2008).

It can summarization some techniques in a smart building as follows:

Figure 2.1: Element of Smart Buildings

Source: (King & Perry, 2017).

2.3.1 HVAC Systems

The process of air conditioning in all parts of the building requires a large amount of energy and it is not surprising that HVAC equipment in general, consumes at least 40 percent of the energy of commercial construction where HVAC systems of many buildings use even more energy than this (Misic, Gilani, & McArthur).

Smart HVAC Systems are capable of significantly minimize energy consumption when maintaining or even enhancing occupants' comfort. This technology can be used in hotels. Intelligent building software interprets information from a variety of HVAC sensor points, where engineers create algorithms in smart building software for the optimization of the database information control and monitoring of HVAC systems. These advanced controls can limit HVAC consumption in unoccupied building zones, minimize HVAC

use during the period of high energy demand, diagnose and detect faults. Where this technique can be implemented by using sensors. By senses, the amount of CO2 in occupied areas of the building can modify the amount of airflow in one area without starving or over ventilating another. This will save considerable energy in heating, Ventilation fan operation, and cooling. In addition to controlling HVAC operation based on CO2 levels, sensors are devices that sense a physical stimulus and transform it into a signal. The sensor transfers an electrical signal indicating this shift in static pressure allows the construction operators to use these static pressure readings heating, ventilation, and air conditioning systems (King & Perry, 2017).

This system for many years has been developed, manufactured, and put for the convenience of inhabitants (Ehlers & Beaudet, 2008).

This technology can be used in Iraq to save electrical energy consumption in hotels, government departments, and homes.

2.3.2 Smart lighting system (SLS)

In a smart building's settings, the term SLS refers to its being autonomous and effective, which is accomplished in different ways. The most popular modify sort that building owners conduct is lighting modify where buildings do not have energy-efficient lighting and retrofit lighting fixtures able outcome in a rise in the amount lighting level whilst reducing energy consuming up to 70%, making big cost saving. Where Retrofits of lighting are one of the simplest to behavior entailing little or no interruption to the everyday operations of the building. Here are few choices for the lighting modify project:

- Modify the old fluorescent lighting devices to energy star or Light-Emitting Diode (LED).
- Put occupancy sensor or a timer on the fixtures that are only used sometimes, making Automatically turn off the lights if not in use.
- Put a photo-sensor or dimmer for the fixtures so that when the natural night is available, photo-sensors will change the size of brightening of the fixtures to decrease needless lighting (Al-Kodmany, 2014).

SLS decreases maintenance costs, as faults in the lamps can be easy find out with SLS various sensors like fog sensors, motion sensors, light sensors where Such sensors are used to change the on-off time according to the nature and strength of the human light. Many systems of smart lighting solutions eliminate the need for traditional wall-mounted controls and can be hardware, installations also reduce operating costs, as well as flexibility in fixtures that are one of the reasons for low lighting fixture costs. Although manual approaches are prone to higher utilization costs, solutions of timer-based reduce energy in less populated areas through uncrowded evenings (Sikder et al., 2018).

This is an important technology that requires the promotion of its use, it reduces the electrical energy consumption that our country suffers from.

2.3.3 Techniques in windows

Building cooling and heating systems consume an energy of big amount. As a result, that, decrease the need for cooling and heating will reduce the request for power where better isolation helps in this regard through keeping in winter on the heat and storing the cold air indoors in summer. Well-isolated windows help to effectively isolate the building. For instance, if windows cover 15%-25% of the building envelope, it decreases for 40% to 70% of the overall heat loss the constructions (Al-Kodmany, 2014).

There are many methods to increase the insulation of windows:

- Choose window frames with a low U-factor.
- Change double pane windows for single-pane windows.
- Put low emissivity coating on windows to help reduce heat transport between outside and inside.
- Use of windows electrically controlled smart glass they are known by different names including active and switchable, and charged glass where it can Daylight monitoring and solar heat flow control in reaction to the solar intensity, the window tincture is powered by low voltage charge were changes in voltage will change the properties of the glass reflecting sunlight and absorbing it and there are also commercially available e-charged, self-

adhesive films were Depending on the received electrical charge, the e-charged glass and films shift from opaque to transparent, or faint along a grayscale in between (Dutta, Samanta, & Neogi, 2017).

- One of the techniques are used to absorb the thermal energy that comes from the sun's rays is to pump nitrogen gas between two layers of glass that are combined with one layer, to reduce the transmission of sunlight inside the building while keeping the interior space cool. Fig. 2.2 is explaining this privacy.

Figure 2.2: Design of Detail Structural Unit

Source: (El Basyouni, 2017)

Use of the screen with windows provides shade and protection from the hot summer sun, thus enabling the cool air from outside to pass into the house. Fig.2.3 is explaining this privacy.

Figure 2.3: Screen with Windows

source: (El Basyouni, 2017).

In this technique we can find many benefits:

- Enabling air to reach from three directions.
- Cover for those in the streets from the rain or the heat.
- While having a strong storm of wind and sand the windows will be closed completely on themselves to avoid bad climatic changes.
- When good weather with light sun rays the units would be opened horizontally to make shade from the glass part on the windows and acceleration the air movement inside the building (El Basyouni, 2017).

2.3.4 Plug loads

The plug load is the sum of energy pulled by a device plugged into an electrical outlet where plug loads constitute an essential part of the electrical demand in commercial buildings. We can definition of a delusory load as the electricity that flows into devices plugged-in even after they are switched off. However, modern improvements in technology enable devices to significantly reduce the energy consumption of phantom loads where strategically, intelligent buildings plug loads by controlling devices at the outlet automatically controlled known as smart plugs. The plug turns off devices when no longer being used or shuts off completely the electricity delivered to the plug itself to stop delusory load where the plug contains sensors discover when the primary device is on standby, on or off (King & Perry, 2017).

It is one of the important technologies that reduce the consumption of electrical energy and which requires promoting its use during the construction phase.

2.3.5 Security system

The area can include door window sensors, motion sensors, and temperature sensors, and in an ideal security system, the main control unit communicates with sensors placed throughout the monitoring area, such as work or home, to monitor various security conditions. In order to protect against assault, the center console has a control panel that is often enclosed in a large metal case. Usually the control panel is located at a remote location in the observation area with the sensors (Brunius, 2001).

This monitoring data helps in predicting potential incidents that will be planned in advance by taking appropriate measures to deter lack of convenience, safety and a high standard of living. In addition, smart homes in the neighborhood can be joined together via neighbor to create a smart cluster (Nguyen, Song, & Han, 2012).

In this case, homes are required to share some security details, such as outdoor screens, in order to spot incidents at the police station. Thus, this idea is not just a connection between neighbors but also the expansion and creation of a comprehensive smart city that can track and organize the entire operations in a smart city (Niyato, Hossain, & Camorlinga, 2009).

2.4 Management of the Smart Cities

In the last two decades, in scientific literature and international politics the idea of smart cities has become more public, and to understand this concept it is substantial to realize why cities are considered key elements for the future. Where cities play a major role in economic and social aspects all over the world and have a major environmental impact (Mori & Christodoulou, 2012).

to be a smart city means using all resources and available technology in a coordinated and intelligent method to develop urban centers that are at once integrated, safe and habitable and the smart cities can define as a city that raises the quality of life of its residents (Giffinger, Fertner, Kramar, & Meijers, 2007).

However, numerous researchers dispute that life quality may not represent a separate dimension of a smart city, as do all the actions taken in the other areas should have the objective of improving the quality of life, such that this represents the core compound (Shapiro, 2006).

There are some the benefits of smart cities as follows:

- Enhance and reduce infrastructure cost and time.
- Reducing operating and maintenance costs.
- Optimizing new utilization opportunities that will produce future revenue.
- Economically propitious and innovative in building, planning, and utilization measures.

- Reducing waste through recycling of materials and elimination of waste at building sites.
- Increase utilization of renewable energy and environmentally friendly materials.
- Building in zones of low environmental value, reuse of current structures, probably modifying their jobs (Al–Haboobi & Ghasemlounia).

Below are some of the construction's technologies of the developed world in smart cities:

2.4.1 The prefabricated system

With modern architecture evolving creative concepts, buildings cannot depend on traditional modules. Where, the builder of the project is able to set down the building in a traditional way in compliance with the desires and the specifications of the customer. The construction is then modified and separated into units in length and width by the technique named prefabricated build. in this technology, the innovative system that can be adopted in implementation to accelerate the construction process and the possibilities of changes in design it and it has been proven that prefabrication of buildings minimizes construction waste to 52 percent (Jaillon, Poon, & Chiang, 2009).

as results in importantly improved efficiency in the energy, time, and cost required for building (Aye, Ngo, Crawford, Gammampila, & Mendis, 2012).

We can summarize some of the advantages of the prefabricated building as follows:

- All building materials, including floors, elevator shafts, corridors, and facilities, can be incorporate all components.
- The modules are built in a quality-controlled manufacturing facility. The width, height, and length can differ from project to project.
- Modules can be quickly separated from the main structure for possible reuse or relocation.
- Modular architecture decreases the building period by more than 50 percent for a site-intensive building (Lawson, Ogden, & Bergin, 2012).

- Reducing the project implementation time by ensuring the project starts to produce income for the company even faster than it does during traditional design.

One example of using prefabricated system techniques in live construction is the construction of a school in the Netherlands. As the Fig. 2.4. Where the building system used is based on traditional and prefabricated concrete elements for the outer walls standardized, steel columns, and prefabricated floor elements, as well as all wall components, are load-bearing. Elements of the wall that face the outside There are windows and thermal holes in the housing displacement while wall components facing the inner are fir resistant well as both the floor and wall elements contain piping and cabling for ventilation and heating.

Figure 2.4: Floor Plan of One Block of Rooms, with Infill

Source: (Wallis, Bilan, Smith, & Kazi, 2010)

The only fixed portion of the system is the core, where vertical transport which includes stair, elevator, and humid functions which includes kitchen and lavatory are centered. For the rest, the whole system is elastic. This means that floors can be eliminated or added and the building can be expanded. The light

internal walls needed for compartmentation can be put wherever on a 30 cm grid. The cladding is the visible portion of the external wall, is fixed on the wall of load-bearing component, and can be substituted. In the original design, the building has 4 stories, although it is feasible to add a few or delete some. It can be modified the job of the whole building, or any of its elements, for example, a wing or one or two floors. All parts and components are joined with connections of dry, and can then be facilely disjointed. The supplier assessments that the major constructional components have over 120 years of life. The cladding is assessed at 30 years, fundamentally for reasons of fashion. In other words, after or before 30 years and whatever the customer wants, another one can be substituted the cladding, give the appearance of building an extra modern. Internal walls are assessment to be moved once every 10 years as average and have a lifespan of 30 years. Thanks to the option of using Prefabricated standardized components and parts, the whole-building can be erected in slightly more than one year (Wallis et al., 2010).

2.4.1.1 The new prefabricated system

A modern design of the constructions consists of steel elevator as the prefabricated core, as in Fig.2.5 show this technique.

Figure 2.5: 3D of a Single Elevator Without Walls of Stiff

Source: (Gunawardena, Ngo, Mendis, & Alfano, 2016).

When using this technique will not be the centric Ingredient in the lateral-load-resisting system. Where the prefabricated components are accumulated

vertically and linked horizontally by bolted plates. Lateral loads transport through these links and enhanced very by the introduction of modules with solid concrete. We can also use a better technique by adding a stiff plate to the frame of an elevator as in Fig.2.6.

Figure 2.6: 3D of a Single Elevator with Walls of Stiff

Source:(Gunawardena et al., 2016).

In this technique, the fluffy steel sheets could promote wall panels for infill. Because these solid modules, which are strategically located in the major structure, resist most of the lateral loads and transport them to the foundation, the need for a solid centric center becomes lesser critical where the structure able now act as a simple modular system and the benefits of this technique can be summarized as follows:

- This technology has the possibility significantly to minimize building time by fully eliminating the costs and time in building the conventional core of a low-rise construction.
- The centers of elevators and stairs able be accommodated in the prefabricated same parts.
- Offer the chance to use advanced materials such as composites, high-strength concrete, and high- strength steels to create more rigid walls.
- Ability to further, decreasing building cost and time to be a great complement to the scope of innovations created by architects, this modern system is very promising in being developed as a sustainable and economical solution for modernistic building (Gunawardena et al., 2016).

- The modern system supplies a lot of freedom to architects in design the structure is not limited by core location will take critical lateral loads. Fig. 2.7. Compared with traditional structures which the core must situate in the middle so that the structure shear centers concur with the mass center to decrease forces of torsional.

Figure 2.7: Conventional Placement of the Core Building: (a) Concentric Core for Minimizing Torsional Forces, (b) Eccentric Core for Higher Torsions on the Structure
source:(Gunawardena et al., 2016).

Because the rigid units bear the lateral loads, the building is possible to move the elevator center, as the architect pleases, despite the need for vertical transport. Fig.2.8 shows different plans for the new system.

Figure 2.8: With New System, Four Different Conceptual of the Elevator Shaft Become Possible

Source: (Gunawardena et al., 2016).

- The elevator core cannot be vertically staggered. so, architects would have more flexibility to shift the location of the center of the elevator at various

levels of the construction. Which is not commonly potential in traditional building. As in Fig.2.9.

Figure 2.9: Two Different Designs of the Elevator Core Become Possible by the New

Source:(Gunawardena et al., 2016).

2.4.1.2 The system of precast prestressed concrete pavement in the roads

Pavement reconstruction and rehabilitation are the main activities of all agencies of the highway. Where rehabilitation in urban areas is a challenge for agencies of the highway due to traffic congestion and safety issues relating to the building. There are many agencies that also continue to grapple with the problem Therefore, huge agencies have begun in recent years to investigate strategies for reconstruction and rehabilitation pavement quicker method. A promised alternate is the efficient utilization of the technology of modular pavement, mainly fundamentally, pavement of precast concrete systems supplies for rehabilitation and quick repair for the pavement that last. There are many purposes for using Concrete pavements precast were using prefabricated panels for quick rehabilitation of asphalt and concrete pavements. The concrete paving of precast applications Involves isolated maintenance, ramp, and intersection rehabilitation, the expanded mainline sections of pavement, and urban repair of the streets. systems of precast concrete pavement are assembled or fabricated off-site, installed on a prepared foundation, and transported to the project site therefore, the components of the system require minimum treatment of time or field before opening to traffic. The specific benefits of the use of

precast concrete pavement versus cast in place pavements of the concrete include the following:

- Concrete with better quality.
- Minimal limiting weather restrictions through the decrease construction season by panels which can be placed in light rainfall or cool weather.
- Better conditions for a concrete cure: Curing of precast concrete panels occur under controlled conditions at the factory.
- Shortened time until traffic is opened: It is not necessarily on-site curing of concrete; precast concrete pavements can be installed during the night where Lane closes to be prepared to open the next morning for traffic.

Precast concrete pavement applications able to be split into two categories:

- Applications continuously (S. Tayabji, Ye, & Buch, 2013b).
- Concrete pavement intermittent maintenance.

panels replacing extremely broken, deteriorated joints or cracked joint repairs in full-depth. Fig. 2.10 and 2.11 show the first method to repairs of intermittent pavement.

Figure 2.10: First Method for Intermittent Pavement Repair

Source: (S. Tayabji et al., 2013b).

Figure 2.11: First Schematic to Repairs of Intermittent pavement

Source:(S. Tayabji, Ye, & Buch, 2013a).

In Fig.2.12 shows there are two planning to repairs of intermittent by the dowel bars are positioned in the current concrete pavement by drilling and grouting of epoxy, like that repair's holes are drilled in pre-cast repair plates and in the same place for the dowel bar which was installed in the old road plate and then Then the perimeter gaps of slots and joints are filled with quick-setting grout.

Figure 2.12: Second Planning to Repairs Intermittent

Source: (S. Tayabji et al., 2013b; S. D. Tayabji, 2019).

And the other way of roads repair containing slots in one side of the panel along the bottom to accommodate the dowels bars, and the other side has embedded dowel bars at sits that match the locations of the gaps before installation the gaps are filled through a fast-setting patching grout (S. Tayabji et al., 2013b).

This technology can be used in the restoration of concrete roads that contain damaged parts in Iraqi roads.

2.4.2 Technology management by Nano coating

Nanoarchitecture would be the upcoming modern architectural direction of the new era. The circumstances indicate that the possible effects of Nanotech will exceed even those of the previous revolution against classicism. The use of nano-coatings to resist the harmful effects of water on various structures of buildings where nanotechnology is a recent thrust in materials science, it transacts with the boundary between molecules, atoms, and the macro world, where finally, the features are determined through the essential conduct of atoms (Schodek, Ferreira, & Ashby, 2009).

Nanotechnology involves the behavior of materials at the nanoscale, a radical change might occur in material performance and new applications in construction sectors would be possible if Nanotechnology can be applied innovatively. Current research shows that the lotus leaf itself uses nanotechnology to obtain non-wetting, super water-repellent, or superhydrophobic surfaces for self-cleansing (Kumar et al., 2011).

The self-cleaning property of the lotus leaf is linked to its special surface structure. as shown in Fig 2.13. Lotus leaf has a Nanostructure with randomly oriented cone-like protrusions (Yamamoto et al., 2015).

Figure 2.13: Cleaned Lotus Leaf in Dirty Water

Source: (Safiuddin, Hossain, & Collins).

The Nanostructured lotus leaf surface has an extremely high water-repelling capacity. As a consequence, the lotus leaf is strong repels water, where dirt carries away by rolling off them on the leaf, which allows the lotus to remain clean (Robbins, 2001).

The lotus effect renders nano lotus leaf bio mimicked coating suitable for myriad applications in various construction sectors such as buildings, bridges, pavements, and drainage infrastructure (Gonzalez, Safiuddin, Jingwen, & Tighe, 2016).

One of the most advanced developments is the use of nanomaterials, which give different advantages in their coating. These techniques can be illustrated as follows:

- Self -cleaning: lotus leaf has a super hydrophobic surface. It remains clean and dry where the water drops are so loosely bound to the leaf surface with a little contact area that any slight movement causes them to fall off quickly (Forbes, 2008).

  This feature is used in mechanism clean dirty surface in the case of nano lotus leaf bio mimicked coating when it is applied on various structural elements or bridges, pavements, and buildings where the wall remains clean because the water droplets clean the dirt when they roll down on the vertical surface coated with nano lotus leaf bio mimicked coating. These coatings can use too in skyscrapers, because they minimize the need for expensive surface cleaning also, the exterior walls or facades of houses, where you can take advantage of this feature in the dirt weather, where once the rain falls, it will help in cleaning the facades of the houses and repaint them in a renewed form as seen in Fig. 2.14.

Figure 2.14: Comparison of Conventional and Nano Lotus Leaf Bio Mimicked Coating

Source: (Safiuddin et al.).

Because of the super water-repellency of nano lotus leaf bio mimicked coating, water droplets cannot be retained on the glass surface, therefore superior optical clarity will be achieved in many applications such as windows, skylights, and glazed curtains walls. as seen in Fig 2.15. as well as use it as an Anti-fogging will achieve Clarity for surfaces exposed to steam.

Figure 2.15: Comparison of Conventional and Self-Cleaning Glasses

Source: (Safiuddin et al.).

- Nano lotus leaf bio mimicked coating could be used as a water-repelling coating on pavements accelerated drying, thus allowing them to be dry quickly during the rainy season and will lead to safe driving and enhanced durability and for similar purposes, it can also be used on sidewalks for safe walking.

- Nano lotus bio mimicked coating may be used on the roofs of buildings to decrease the absorption of snow-melt water or rainwater, thereby reducing the development of algae or bacteria and thereby improving it.
- Nano lotus can be added to various metal and alloy surfaces to decrease corrosion resistance by super hydrophilicity.
- Nano lotus leaf bio mimicked coating can be applied on the inner surface of building drainage structures such as sanitary sewers to increase the flow of wastewater or sanitary waste by reducing surface friction.
- It can be applied to tunnel lining for keeping the tunnel structures dry and to resist the growth of mold in it.
- Nano lotus leaf bio mimicked coating can be considered for use in culverts to improve the movement of water from upstream level to downstream direction, it can also be used in irrigation channels for a similar reason.
- It can be used on various components of bridge structures such as docks, railings, and abutments to improve their service life with increase water resistance.
- It may be used as a floor finishing agent to create a water-repellent surface for better service life where water is a factor in the corrosion processes of many flooring products. Where water repellent decreases the entry of water into flooring structures and therefore improves the working life of the flooring.
- Anti-graffiti: surfaces permeable with a coating of a permanent anti-graffiti coating, where an anti-graffiti task is intended as a preventive measure to avert bad writing graffiti to construction or buildings like walls, noise barriers, and piers of bridges. where because high hydrophobic properties able to remove graffiti more easily with suitable detergents even in cases permeable, and materials that are highly absorbent like lime sandstone, concrete, bricks, and other similar materials .
- Nanotechnology allows scratch tolerance to be enhanced while maintaining transparency. where scratch-resistance is a desirable property for numerous

coatings and materials which applied to materials of various types like metal, ceramics, and wood.

- Use them with anti-bacterial products especially in medical and health facilities as an alternative to traditional anti-microbial products that contain active ingredients like biocides which could be released into the atmosphere where antimicrobial Nano-coatings are claimed to provide the advantages of traditional antimicrobial materials without affecting the environment and safety issues where items are widely distributed between floors and walls touch surfaces like door grips, handles, and light switches are accumulators for germ (Sahar, 2014).

Due to the great benefits of using lotus paint, governments should be a benefit from applying its techniques in various areas of construction, as it will save as it will save them large sums compared to the use of other traditional paints.

2.4.2.1 Substrates types and preparation techniques

Nano lotus leaf bio mimicked coating can be applied on manifold substrate materials such as concrete, glass, stucco, metal, fiber cement board, exterior insulation and finishing system (EIFS), masonry, and primed or pre-painted wood depending on the purpose of applications. In any sort of application, it must be ensured that nano lotus leaf bio mimicked coating is well-adhered with the substrate to avoid premature blistering and de-lamination where a suitable bond coat as a primer should be used before applying nano lotus leaf bio mimicked coating to guarantee good adhesion and substrates must be cleaned to remove salt, dirt, and grease or oil where if the coating is applied on old surfaces, it must be free of mildew, efflorescence and algae substrates must not have any contaminants on the surface that might affect the adhesion of nano lotus leaf bio mimicked coating and Pitting, cracking, spalling, blistering, delamination, water damages or any other surface defects should be remedied appropriately before adding the primary on substrate materials. Also, the substrates must have a sufficiently rough surface profile for the required level of

adhesion of the coating and high-pressure water-blasting, abrasive blasting, shot-blasting, or at least sanding should be employed as per requirements for the preparation of substrates to achieve good adhesion of the coating (Safiuddin, 2017).

2.4.2.2 Coating application techniques

Nano lotus leaf bio mimicked coating can be applied by dipping, rolling, brushing, and spraying as per applicability to the substrates. A variety of spraying equipment such as an aerosol can, industrial sprayer, and non-aerosol pump sprayer can be used to bio mimicked nano-lotus leaf coatings and it can be applied in two coats to the primed substrate where the first layer must be dried before applying the second layer to achieve the targeted surface structure and thickness to coating (Safiuddin et al.).

2.4.3 Skyscrapers

Many American architects of the 19th century went to Paris for training and education brought back with them concepts that affected their architecture where in 1889, the Eiffel tower in London reaching 300m, with its outstanding architectural qualities, it was surely a spark for new heights and was known as naming the US (United States) where it is an obviously US innovation that begins in Chicago then exported to Europe developments, cultural, and architectural innovations including a skyscraper. The structure of the steel-framed of 10 story building insurance is well known as the first skyscraper in Chicago, built-in 1885, then a chain of skyscraper fairly big was built at the turn of the century where the skyscrapers are an engineering masterpiece and the symbol most controlling of the cities and a human- wonder that challenges gravity through reaching to clouds, it embodies the unrelenting human ambitions to higher build. It conjures up some correct questions in our minds and the first question that is asked often: why skyscrapers?

The main reason because the cities carry on horizontally extend, to protect them against reaching breaking point, the skyscrapers as structure kind is a potential

alternative by vertical space conquering by densification and agglomeration. Where the advancing industrialization has encouraged the Skyscraper typology as a significant life in high-density alternative in all of the world's increasingly dense city centers megacity (Saroglou, Meir, Theodosiou, & Givoni, 2017).

The second reason is the immense The skyscrapers' size and impressive height engages the imagination of people, memories, and emotions the skyscraper becomes a symbol for the city (Kashef, 2008).

In most instances, tall buildings are the most impressive element of the metropolitan landscape. There is clear proof that esthetic issues are the most significant environmental quality evaluators for metropolitan inhabitants. In fact, all cities today are very worried about their picture as a possible tourist destination where a review of visitor literature, postcards created for sale to visitors, and the use of setting shots on television shows that proved the form of the urban skyline is an incredibly important part of this picture (Heath, Smith, & Lim, 2000).

challenges and opportunity for developing sustainability in skyscrapers should be designing their so nature in rising above the city makes that innovation in it is formed the urban field can be greatly improved through achieving greater heights with fewer materials tall buildings have made a symbol for the seemingly limitless ability of architecture, a constantly renewable promise for the future. The various record projects that were announced before the start of the new millennium point to our enduring faith in the capacity of this architecture typology to continue to evolve where the typology of the skyscraper is becoming ubiquitous as a response to urbanization and population increase (M. M. Ali & Al-Kodmany, 2012).

Population growth, economic prosperity, and the necessity for spaces of functional for inhabiting have generated one of the maximum exciting times to witness around the world the growth of huge tall skyscrapers. Architects, countries, and companies from across the globe constructing and designing in the last 50 years, there was a growing scale of the tallest and most stunning buildings in a comparatively short period of time. Not only are buildings high to

enormous heights never before been imagined, but they are also being built in such Time for short spans because of Computer technological advancements where the scale and height of skyscrapers have nearly doubled and continues to rise where it is considered Burj Khalifa as seen in Fig 2.16 is the present tallest building in the world were completed in 2010 in Dubai, United Arab Emirates (UAE) and is 2,828 m high, has 163 occupied floors, and the cost to construct is $1.5 billion us`d (Soh, 2014).

Figure 2.16: Burj Khalifa

Source: (Google).

In addition to the aesthetic feature of skyscrapers, which give cities the advantage of urbanization and make them a tourist destination, there are other features and technologies that can be used to implement them in the cities of Iraq to move them forward to keep pace with the developments of smart cities and it can be summarized some of this technology in skyscrapers as:

- Skyscrapers because a large number of elevators are required maybe become a centric point of stress because of the scare of fire or crime, some of the latest approaches to this issue are utilized by several architects by the concept of zoning was previously explained in paragraph 2.4.1.1. In this case, will serve some of lower elevator's floors only, others for the middle

floors, and others for just the upper levels also land, sky, and intermediate halls are designed for the comfort of those waiting for the elevators.

- In 2009, a design name of the designer was named of dynamic architecture creator David Fishing was suggested a tower 60-story revolving UAE named the Dynamic Tower to be constructed in Dubai; each floor rotates at a pace for one turning every 90 minutes independently (Soh, 2014).

every floor consist of 40 solo modules that are collected in a factory and including all systems of the building furniture and kitchen are pre-installed, the heart of the construction is a shell of concrete that functions as an axis for the floors to rotate and housed inside of it the concrete heart represented by electrical conduit, elevators, plumbing pipes, and 79 of a wind turbine that is the source of power for floors revolving, such as Propellers of aircraft sandwiched between the floors to collect wind power (Rocca, 2009).

The purpose of this innovation is to give the affluent residents a continuously shifting 360-degree view of the skyline of Dubai. This visionary building is possibly applied because of the advancements in technology. Fig.2.17 is shown this technology.

Figure 2.17: Dynamic Tower, Dubai, UAE

Source: (Dewidar, Farid, & Zaghloul).

The structure is based on a core of reinforced concrete approximately 22 mt diameters that carry a whole vertical load and all the steel structure will be made floors and will become a platform of Monolithic with a cantilever up to 15 m, floors will be linked with a core in a method that will allow a continuous rotation to any direction with no noise or vibrations. This architecture is revolutionary even of the way it is built. In fact, that it is moving to the wind, allows for 1,3 times greater earthquake resistance in building (Vollers, 2008).

- **Double-skin building facades (DSF'S):**

  emerging in Europe is a new era of commercial buildings, with designs of innovative in the Netherlands, Germany, and United Kingdom (UK). Architects and engineering are working together to design new buildings of typology that are environmentally friendly, architecturally sleek, and energy-efficient. One of this technique is DSF'S that uses air movement and sun shading between inner and outer glass membranes (Arons, 2000).

  describes the DSF'S as a pair of glass skins separated by an air corridor also known as intermediate space or cavity ranging in width 20 centimeters to a few meters. As in Fig.2.18.

Figure 2.18: Max Planck Gesellschafts Corridor-Style Cavity

Source: (Arons, 2000)

The skin of glass may cover the entire and over structure or a portion of it. As in Fig.2.19.

Figure 2.19: South Facade Debi's Headquarters

Source: (Poirazis, 2004).

The major glass layer, usually insulating and works as part of a curtain wall or a conventional structural wall while the additional layer, commonly, single glazing is placed either behind or in front of the major glazing where the layers make the air space between them use for the benefit of the building mainly as insulation against sound and temperature extremes. It can deem the double-skin facade is a European architectural trend driven primarily by the:

- The esthetic wish for a whole glass facade leads to raising transparency.
- The actual need to enhance the inner environment.
- Enhance the voices in buildings located in areas of noise pollution.
- Reduction in energy consumption during the occupation stage (Poirazis, 2004).

The layers of the Facade are described as following:

- **External facade:** glazing provides weather protection and improved external noise sound shielding. Generally, it is stiffened sole glazing.

This external facade can be completely glazed (Shameri, Alghoul, Sopian, Zain, & Elayeb, 2011).

- **Inner facade:** the indoor layers consist of double-pane or single glass with operable windows or without them (Wong, 2008).

Insulation can be used of double-glazing units through low coating or solar control glazing. The interior window can be opened by the user to allow natural office ventilation in this layer is not fully glazed.

- **Intermediate space:** Its air gape between two panes where it is natural completely, fan-supported or mechanically ventilated and the gap width between 200 mm to more than 2 m where its width effects on maintaining the way of the façade. On other hand, able automatically controlled solar shading is integrated into the gap of air. In reality, Modern construction practices have been very important in cool climates, in particular. The major reason for using architecture in DSF'S is that it makes direct interaction with the building's surroundings in its transparency properties. in fact, it allows entering the building huge quantities of daylight without glare. Finally, it has a charming aesthetic value which is more desired by developers, owners, and architects (Gratia & De Herde, 2007).

- **Wind energy harnessing:**

It is a renewable energy source that can be usefully used at greater altitudes of skyscrapers with a substantial wind speed. Skyscrapers can be shaped to turn winds into an area-containing turbine without causing any detrimental structural effects on its occupants and the surroundings. The wind speed can be amplified by this profiling of the structure to provide more energy (Al-Kodmany, 2010).

- **Windows and curtain walls:**

Designers incorporated windows into structural glass facades, window walls, curtain walls, wall claddings. As well as, designers in new architecture are attempting to keep the frame sections as tight as possible where a maximum outcome in this respect is structural glazing without any

externally visual frame parts by windows being a portion of the outer envelope. Nowadays, windows would also influence the buildings' esthetic appearance through their color, windows and form structure can be changed color by painting them. As well, Parts of aluminum windows may be processed using various coloring techniques, obtaining red, gold, brown, or other colors. The most frequently used plastic for manufacturing windows is the impact-resistant polyvinyl chloride (PVC) and the color most in use is grey or white although nowadays other colors can Application also. Fig.2.20 explains the shapes of curtains walls frames insulated with double glazing (Sebestyen & Pollington, 2007).

Figure 2.20: Curtain Wall Frame

Source: (Sebestyen & Pollington, 2007)

The benefit of this technique can be summarized as follows:

- ❖ Provide solar energy.
- ❖ Sound insulation.
- ❖ Supply ventilation and heat isolation (Muneer, Abodahad, & Kubie, 2000).

- The major reason skyscrapers are not considered appropriate for children and families is the lack of open, recreational, plazas, communal spaces such as gardens and streets. But why not create these spaces within skyscrapers at height, with the added benefit of security, view, and shelter? The case study in Singapore shows the path for social sustainability for skyscrapers. In a

city-state where 86% of the population live in social housing, the majority of which are skyscrapers (Yuen et al., 2003).

The towers of Singapore adopted the concept of sky gardens, with numerous integrating some shapes of social spaces as seen in Fig.2.21. These contain fitness centers for the elderly, jogging tracks, children's play areas, and more, each at an altitude over the city (Oldfield, 2012).

Figure 2.21: Selecting numerous spaces of social in skyscrapers in Singapore; (a)

The Duxton and Pinnacle composed of Seven towers and 50 Store Residential linked through Skybridges Housing Recreational and social Spaces; (b) the storey 26 for jogging road in The Duxton and Pinnacle tower; (c) The Sky Garden Seating Area on the 50th floor in Duxton and Pinnacle tower; (D) the 50th Floor Sky Garden and Gathering Area, Pinnacle and Duxton; € Sky Garden at the Singapore National Library; (f) residential 46 story tower on the 30th floor of residents' gardens in Icon Loft tower; (g) inner View of Residents' Gardens in Icon Loft tower

Source: (Yuen et al., 2003).

2.4.4 Technology in roads

Research and innovation in the field of smart transport construction persist continuously for more than 30 years. To make this happen, a change of mentality must take place within a country and its people where technologies are yet submissive to varying degrees of research and development (R&D) to adaptation to new technologies in the road sector, using innovative practices in design and implementation and take advantage of these technologies, especially the technologies of generating electricity which our country suffers from. Road construction is a quick-growing field and thus new ideas are needed special material, and technical growth. On the other hand, Roads have become an extremely important transportation system with growing globalization. Where innovation in road building provides significant benefits to community and industry where the idea of innovation in the road construction industry has been documented by many developers and researchers. Many studies have identified the rise in technical knowledge of innovation in the road field in relation to the roads and their material. Where the growing exchange of knowledge between various developing and developed countries across the globe offer new options and possibilities for roadway societies to promote the wider realization of innovative services or products used in countries to achieve a practical and effective cost optimization of roads supervision and its administration (Caerteling, Di Benedetto, Dorée, Halman, & Song, 2011; Lundberg, Engström, & Lidelöw, 2019; Wolfe, 1994).

It can summarize some of these techniques in roads as follows:

2.4.4.1 Paving tile for the guidance of blind persons

In stairways, sidewalks, curb ramps, crosswalks, roadway crossings railway

stations, and subway stations there is often a need for pedestrians to detect the locations to make facilities safe and accessible for visually impaired, and blind persons. Therefore, the marking tile is disclosed for this purpose. The innovation relates to a concrete pavement tile that produces a clear sound when touched by a blind person's cane. Practically, it is useful to combine the sound sources in roads for people are visually impaired for warning purposes and guidanece. The innovation to this problem by providing a pavement tile with an upper metal plate is supported as in Fig. 2.22. Through the plate and tile in its circumference which it able be supplied with bumps, ledges, and projecting tears, in the form of longitudinal strips or buttons projecting to upwardly thereof to supply a speciality textured upper surface. Projections to the top are lower at each of the edges exposed than elsewhere on the tile so that they make signal action for the blind (Szekely, 1994).

Figure 2.22: Guidance of Blind Persons by Paving Tile

Source: (Grahmbeek & Grahmbeek, 2002).

The plate stays without the pavement tile produces an obviously recognizable sound when touched with the cane of a blind person, on condition, that the center of the plate has just a distance is only several millimeters above the tile, as in Fig.2.23. When the plate loaded with a heavy load, it will bend through elasticity but not permanently bend so that the sound will no longer be produced (Grahmbeek & Grahmbeek, 2002).

Figure 2.23: Plate Paving Tile for Guidance of Blind Persons with Connection Lips are Supporting in the Middle

Source: (Grahmbeek & Grahmbeek, 2002).

The configuration of the markers and shape is set by the Australian standards 1428.4. As following:

- A single version is circular, about 5 mm in height and 35 mm in diameter with edges at about 45°, beveled or inclined.
- Second version is of similar height but extended with about 35 mm of width. The markers have a size and a shape that the visually impaired person can readily sensor by means of a cane or foot. Current there are many methods of fitting, like the following:
  - ❖ Indicators shall contain the structure of rubber tiles or ceramic where a plurality of markers is molded in the upper surface at the regulation center to center space 50 mm. Other fixing ways for current walk paths include drilling a grid of holes and then individual fitting markers, each of them formed with an elongated pin expanding from the underside of it. The pins fit inside the holes and are secured by a sticker (Mccuskey, 2004).

This technology can be implemented in the streets of Iraq for the visually impaired and blind so that they can complete their daily needs in the areas close to their residence.

2.4.4.2 Resting areas

Traditionally, the design parameters of the sidewalk are based on the normal Pedestrian agile citizen with good vision and agility, where the design parameters do not suit the needs of growing people with disabilities. The design of sidewalks is vital for all pedestrians, but especially for the disabled, who

have limited choices to travel and depend on the pedestrian environment. For example, persons with vision impairments, children, and older adults frequently depend on the sidewalk for traveling independently into their communities to exercise, shop, walking to school, and recreation. Therefore, requires a change in the design of the sidewalks to make it fulfill the needs of the largest number of people. One of the solutions for making sidewalks more suitable for all segments of society is to use resting places especially on long or steep roads where it is difficult for the elderly without resting area. Also, cross slopes can be avoided where possible by combined with flat resting places because both manual wheelchairs and driven may become very difficult and unstable to operate on sloping areas when areas with ramps and steep sidewalks are icy, snow-covered, or wet. Therefore, Established design specifications for building and site ramps allow a maximum grade of 8,3 percent over the distance of 9,1 meters to be built before landing level (Boodlal, 2003).

one of the solutions for problems Where the gradient of the sidewalk equals or exceeds that of a maximum allowed ramp, the level of rest shall be given for when the level of a landing path does not exceed 2% in any direction. when design rest areas along paths of travel and must space no more than 30 meters apart to maximize the usability of the paths for people with reduced ability as well as resting areas should be wide enough to allow users to pass one another (Designs, Axelson, & Chesney, 1999).

The design of the resting area must consider the needs of the wheelchair users and blind people, which will fulfill the need of other users where blind people need a rest area because they can't move more than 50 m. In the meantime, the design of benches the user of the wheelchair should not have the armrest to transfer to fixed benches. In addition, space should keep clear next to the fixed benches in order to accommodate the users of the wheelchair (Sharip, Mustafar, & Zen).

This area may be larger with Include additional services such as drinking fountains, handrails, and benches, as in Fig.2.24. As well as, in steep mountain

regions, it recommends the construction of large sidewalk pavement that enables wheelchair users to ride in a zig-zag motion.

Figure 2.24: Benches Level Landing Includes a Rest Point, Which Would not Impede the Flow of Foot Traffic

Source: (Boodlal, 2003).

2.4.4.3 Energy harvesting technology in pavements

The phenomenon of Solar Roads is they can store maximal energy and then turn it into electricity. the generated energy can be used in generating electricity for commercial areas, local homes, and street lighting in warm weather, Pavement surfaces are usually hot leading to structural failures and even the urban heat islands effect, too. In this way, the removal of the excessive heat because of solar radiation and collecting solar energy from pavements could remove both urban heat islands' effect and structural failure potentials (Dawson, Mallick, Hernandez, & Dehdezi, 2014).

harvest of solar energy is creativity absorbs solar radiations and allows us to create a paved surface that remains clean in the meantime. popular solar collection methods include the following:

- Installing solar panels along roadways: Fig.2.25, along roadways, solar panels are installed to harvest solar radiations, contributing to a reduced greenhouse gas emissions and external energy use. This design has been widely used in practice for powering trace lights and signals the lights on roadways (Sharma & Harinarayana, 2013).

Figure 2.25: Solar Panel Energy Harvesting Technologies for Pavements

Source:(Sun et al., 2018).

- As photovoltaic pavements, installing solar panels under the transparent top layer: Solar panels are installed under the Photovoltaic paving surfaces consisting of a transparent high strength plate on top. The top layer is used as a waterproof layer that permits the passage of sunlight and turns the solar panel layer into electricity (Sun et al., 2018).

Tempered glass photovoltaic pavements are made, as in Fig.2.26. Placed between two porous rubber layers on bike lanes, parking lots, roads, and even solar cells.

Figure 2.26: Solar Energy Harvesting Technologies by Photovoltaic Pavement

Source: (Sun et al., 2018).

2.4.4.4 Solar roads in Netherlands

They are infrastructures for transport capable of generating electricity by Solar cells placed beneath a semi-transparent layer to ensure dense traffic circulation. They constitute an innovation in the Netherlands from prefabricated concrete modules from solar cells laid on the earth. which have a tempered glass layer that is translucent from solar cells of light crystalline silicon that will convert the photon energy to electricity (Venugopal et al., 2018).

whole the solar panels on roads are in turn connected to an intelligent meter which increases the output of these roads and improves their energy output. this is leading to traffic lighting and efficient street or grid lighting on the road. the system durability is a well-researched result from the engineers involved in the project's 5 years of production. Solar panels are designed in a way that breakage or damage to a specific solar panel causes only that panel to shut down while the other panels continue to function effectively, increasing the flexibility of those paths (MacDonald, 2015).

These roads are solar panels built in such a way that they allow passing a high volume of light and are maintenance-efficient and should continue for at least 20 years (Arun & Stephen, 2016).

The Netherlands organization for applied scientific research on it has called innovative solar roads, as in Fig.2.27.

Figure 2.27: Pre-Fabricated Slabs of the Solar Panel

Source: (Abaid, 2017).

The layers of this path can be summarized as follows:

- **Layers of road surface:** This is a translucent glass layer or a mixture of glass components bonded together using a transparent resin of highly resistant epoxy or polyurethane, that provides traction and enables the solar collector cells to pass the sunlight. Where the road surface can accommodate heavy transport loads at high traffic periods. They are waterproof in design so that the electronic layer underlying it is saved and to treat the road surface with a non-adhesive substance cover. Road construction is done by preserving the slopes as slow the collection of dirt and dust and the damage to solar cells is reduced. Because there cannot be the modification of these solar roads to sun's ray's direction, the electric energy generation from roads of these solar panels is around 30 % less than solar cells that are put on the house roofs for the power generation process and electric water heating (Arun & Stephen, 2016).
- **Electronic layer:** This layer is composed of an array of cells, most of them are composed of a solar collector's cell with LED paintings. The role of these cells is to store solar energy for future use. In addition, these panels can heat themselves leading to the melting of accumulation of ice and snow in the northern climate so the manual removal of ice and snow on the roads is not needed. there is a connected system leading to the building of an intelligent system of highways every 12 feet of these panels.
- **Basic plate layer:** This layer is made up of a series of cells, most of which consists of a solar cell with led paintings. The function of the base plate layer is to disperse the energy obtained by the electronic plate, where every base plate has four sides, both power and data. The layer of the base plate also protects the electronic layer above it because it is waterproof. Fig.2.28 shows the bikes solar road in Amsterdam.

It is worth noting recently that modernistic top layer translucent was discovered built of glass bonding aggregate to each other using polyurethane. The goal is to build a material composite that supports the traffic vehicle slip resistance,

protects solar cells, and allows the passage of sunlight (Vizzari, Chailleux, Lavaud, Gennesseaux, & Bouron, 2020).

The choice of polyurethane instead of epoxy is due to its good transparency and good adhesion to glass and resistance to exposure to sunlight. In fact, previous experiments have shown that the epoxy in a short time, becomes brittle and yellow (Bouron, Chailleux, Themeli, Dumoulin, & Ropert, 2017).

Figure 2.28: The Bikes Solar Road

Source: (P. K. Oad, 2016).

These new roads are more reflective than previous surfaces. They definitely are you can clearly see its reflections on the road surface as well as, naturally, these roads more reflective than conventional concrete roads. Fig. 2.29 demonstrates the high reflection of these solar roads because of the installation of the solar panels which gives it an aesthetic advantage as well as electric power generation feature.

Figure 2.29: High Reflectance of The Solar Road

Source: (P. K. Oad, 2016).

We can summarize the benefits and potential of these solar roads as:

- They are generating a large quantity of energy that is not sustainable for the road itself, but also can be used to light local households' production enough quantities of energy, thereby giving an excellent opportunity for lighting.
- road provides a lovely vision of stellar nights by the LED lights that lighten the road.
- This technology can be taken advantage of in our country because the sun is strong and lasts for long hours in the day in order to help generate electricity.

2.4.4.5 Plastic roads

Nowadays plastic is all over today's life, and the disposal of plastic waste is a major concern because it is a non-biodegradable product and it causes environmental pollution and problems such as cancer. In addition to contamination caused by the construction of conventional asphalt roads and their upkeep is the reason behind the birth of plastic roads. Therefore, plastic waste applications have been considered in many developed countries in recent years in road building with considerable interest where the use of these materials in road manufacture is dependent on technological, environmental, and economic parameters (Bale, 2011).

The Netherlands undertakes a pilot study to make a new kind of road even more reliable and easier to use recycled plastics, in Fig.2.30. In reality, They're the ones with the first solar highways in the world (P. K. Oad, 2016).

Figure 2.30: Recycled Plastic Roads

Source: (P. Oad, Kajewski, & Kumar, 2020).

It can summarize the benefits of plastic roads as follows:

- Bear a lot of temperature variance and upkeep is less necessary relative to ordinary asphalt highways.
- Those kinds of roads are very simple to produce and they have three times as much life as normal roads.
- Faster build time-saving.
- Greater longevity as they are prefab and homogeneous
- According to environmental studies, 2 percent of all emissions of roads amounted to 106 m tons of CO2, due to the asphalt which could also be eliminated.
- The innovation is green because it fully recycles the content that is used in this technology.

- Because plastic roads are put immediately on the sand surface, a foundation is not needing it, which ensures that heavy construction is less necessary on-site.
- The damaged element can be easily replaced and refurbished or recycled into a new element, which prolonged life expectancy contributes to a circular economy (P. Oad et al., 2020).
- When designing plastic roads, it found in its great superiority over asphalt roads in several major technology's economic aspects, and road paving performance, Table 2.1 as seen.

Table 2.1: Plastic and Asphalt Roads Comparisons

Surface features	Plastic ways	Asphalt ways
Recycled materials sustainable	******	
Long-life span-up to three times	******	
Lightweights	******	
Passed the time test		******
Modular for quicker upkeep and installation	******	
A flat place to walk and drive	******	******
Rough to allow for resistance to skid and traction	******	******
Is not soften at high temperatures	******	
Water can be treated, moved, or stored	******	******
Use of experience and Mass production		******
Impervious to a pothole	******	
Able to engineered and designed	******	******

Source: (Hashem & Cardiño, 2020).

- Quick access to cables and pipelines is provided by the hollow architecture.
- Low maintenance due to the high weather and weed resistance of the material.
- Lightweight.
- It has better prospects in the context of noise reduction.

On the other hand, some of the problems in these roads are contrasted to asphalt, plastic can be more slippery, and can be beaten by making the surface of plastic rougher. Volker Wessels is a Netherlands construction firm and is the first to become conscious of plastic roads. It told this plastic road would be

practically maintenance-free because wind and corrosion would have no impact. At a temperature of -40(°F), the road would be fine, but it can withstand even high temperatures such as 176°F. The company has said that because of its hardness roads would last longer than normal roads. It indicates that those types of roads are so simple to make and have three times more life than normal roads (Oad, P. K, 2016).

It is worth noting that the application of the first road construction of plastic bags and glass in south Australia (P. Oad et al., 2020).

2.4.4.6 Energy harvesting piezoelectric

In 1880, Jacques and Pierrer Curie discovered Piezoelectricity (Manbachi & Cobbold, 2011).

An Israeli firm called Innowattech has developed customized piezoelectric generators that can be used the waste the kinetic energy of the highway and convert it into electricity. This technology is being used in road solutions like the kinetic energy that is converted into electrical energy is harvested and used for road signaling systems, lighting the diodes that emit lights, and road lighting. With the help of piezoelectric electric generators, 6 cm have planted these generators underneath the road level and are located at a distance of more than 30 cm apart. Innovation policy expert groups (IPEG) in a true meaning are crystals of piezoelectric nature that are capable of using mechanical energy that is generated as an outcome of any difference in movement, weight, and temperature changing, and the mechanical energy generated by the harvesting process are then transformed into electrical energy and stored in the storage device by the condenser. Innowattech announces that these IPEG are very easy to use and not too pricey because the process of installation is inexpensive. They are put in between the road layers and are mounted with the aid of electronic cards to store the electrical energy that is generated by traffic. Fig.2.31 shows this system. Mostly, this system is utilized to cover it with concrete or an asphalt layer. These systems can be implemented as a new road is built, and even during the upkeep of a current road surface (P. K. Oad, 2016).

Figure 2.31: Energy Harvesting Piezoelectric

Source: (P. K. Oad, 2016).

The benefit of this system can be summarized as follows:

- Installation cost of these systems is lower than the costs of installation of either solar or wind systems.
- Technology this method able to decrease the usage of non-renewable energy sources for kinetic energy generation, leading to saving an enormous size of costs. It will reduce electricity production costs by up to 80 percent.
- It provides the roads with continuous electricity, regardless of weather conditions.
- The system has contributed to the creation of intelligent roads in the area, leading to the self-sufficiency of roads as they are not dependent on the provision of electricity in the lighting area energy (Probst et al., 2013).
- This is an electric energy system to the roads that have been proved against damage or robbery.

2.4.4.7 The glow-in-the dark roads

One of the main tasks for drivers is to follow the road. During the day, when the visibility on the roads under good weather is undisturbed, it is not difficult to compare with at night on unlighted roads drivers often complain about insufficient signaling in the terms of night driving. in this technique, the road will glow in the dark without being illuminated by the vehicle's headlights and detect the effect of ice on the roads due to a new type of material for road

markings, modern technologies, and new road materials. The Netherlands road building has come through another revolutionary discovery through Implement smart road which is like Tron and shine in the dark. This will be the world's first path to shine in the dark (P. Oad et al., 2020).

The idea behind this project is to build interactive and safe roads. These roads are paved with paint which glows without light and absorbs daytime energy. These paints will glow for up to 8 hours. This project was awarded the best concept of the future at the Netherlands design prizes. This can be so efficient and smart energy conservation and saving initiative. this technology could replace the lighting columns that are on the side of highway roads. In places where electricity and lightings are not present, this technology can also be a safer solution to highways. (P. Oad et al., 2020).

The roads of glow-in-the-dark are treated with a particular photo-lionizing powder making additional lighting needless. The powder lights up the road contours at night for up to 8-10 hours in the light of day which daylight charged. Dynamic paint turns into visuals in response to fluctuations of temperature. As in Fig.2.32. It allows the road's surface to directly relay adequate and appropriate information to drivers. (Roosegaarde, 2016).

Figure 2.32: Glowing Lines and Dynamic Paint

Source: (P. Oad et al., 2020).

On these roads, economic benefits are linked to the energy amount that can be achieved by permanently switch off the lights by using the glow-in-the-dark roads. On the other side, not only can these roads shine in the dark but they also offer signs for the weather. Therefore, this technique will also be used to paint markers like snowflakes across the surface of the road. When temperatures fall to a certain point, these images will become visible, as in Fig.2.33. It indicates that the surface of the road will likely be slippery (Fiolić, Ščukanec, & Sokol).

Figure 2.33: Warnings of a Possible Ice Thanks to a Special paint

Source: (Fiolić et al.).

There are some problems related to the introduction of this technology, like the high cost of the technology glow-in-the-dark paints as well as the questionable product longevity of these devices in the future, this will lead to problems including high-quality maintenance costs of these products and their environmental effects. As this is still a test project, there There's still a need to check the environmental and toxicity effects of these paints (P. K. Oad, 2016).

This technology is considered one of the important technologies that can be used in new roads instead of using electric poles in order to reduce the use of

electrical energy that our Iraqi country has suffered for more than 20 years (Al–Haboobi & Ghasemlounia).

With this technology, a part of 500 m of the highway has been prepared. The project is named the Smart Highway Project and headed by Mr. Daan Roosegaarde from Studio Roosegaarde and Mr. Heijmans, a Netherlands civil engineer. (P. Oad et al., 2020).

2.5 The Management Systems in Smart Cities

Engineering management has been proven to be a significant factor in successful project fulfillment in a number of studies (Olomolaiye, 1990).

The development of engineering management and notion underpinning management is the science, or the art, of fulfilling the goals by people (Olum, 2004).

History witnesses how people used managerial skills to build their legacy history like the Romans (Kwok, 2014).

engineering management in the building sector faces some critical things that are so various from other decisions are made every day in building processes based on assumptions, incomplete information, and the construction professional's personal experience. Project adjustments and changes are unavoidable because they are a fact-of-life at every point of the project's life cycle. Therefore, there are found many models of management as a technology. Management is the input of intangible capital in which produce is monotonically raising. Management systems tasks can be classified into:

- Design management: where management is a production approach choice (Bloom, Sadun, & Van Reenen, 2016).
- Change management: It plays an important role in effectively is critical to the success of building projects and the success of the development managing changes. Construction of change management demands an integrated solution to coordinate and discipline the process, such as schedule and personnel, documentation, drawing, process, flow, information, and cost. The building industry needs an active construction variation

management process. Many decisions must be taken during a construction process, often based on insufficient knowledge, conclusions, and personal perceptions of building professionals. In all building projects, change is the common denominator, although the variety, scale, and complexity of projects can differ greatly between projects (Hao, Shen, Neelamkavil, & Thomas, 2008).

2.5.1 Definition the engineering management

It is a mass responsibility for implementation, successful planning of projects planning coordination, and management of the project from its start to its completion for the production of a project that is functionally and financially applicable completion in time of the required quality standards and the stated cost (Thite, 1999).

The engineering management for the construction projects can be the most significant to lead the successful project is relying on experience, skills, and knowledge. As the engineering management has the expertise, it will be quick to achieve success; it will complete the project on schedule, with its budget and good job efficiency and schedule, organize, track and evaluate all facets of a project and motivate everyone involved to securely and under the defined time, cost and performance standards to meet the project aims. The engineering management is the single point of blame for fulfilling this. additionally, it could be described as the science and art of changing seeing into reality and it has focused on the delivery of the success criteria from the beginning of the stages until the implementation (Atkinson, 1999).

2.5.2 The role of the engineering management in construction technology

In process of technology construction, the role of the engineering management can be various. It relies on a number of things, such as the size of the construction project. In order to manage the engineering processes, an individual should be well structured, be able to multi-task, has a rational process of thinking, and can do so, has strong self-discipline, identifies root reasons, has good analytical skills, be an ideal estimator and budget manager. The

engineering management is generally responsible for preparing and identifying the project, this results in the completion of a project definition and a project plan once the project begins, it must successfully manage and dominate the work, this is inclusive.

- Tracking managing, identifying, and solving project problems.
- Knowing and gathering measurements to provide a feel of how the project is going and how deliveries generated are appropriate.
- Managing the overall plan of work to guarantee work is specified and finished on time and within budget (M. Ali & Chileshe, 2009).
- Control, planning, and monitoring of whole project aspects and the motivation of all those included in it to achieve the project aims at the time and to the specified performance, cost, and quality.

2.5.3 The factors for the success or failure of engineering management

Conventional engineering management practices have developed as requirements over time with developing the management and control of building projects. Nevertheless, improvements have been made conventional approaches have proven to be inadequate to achieve specifications for future programs where engineering management is managed since time old, but in the 1990s there have been Important expansions in technology which have resulted in the production of so powerful software packages for the building industry that have changed the manner in which construction projects are engineering managed. The growth and technologies of personal computing have revolutionized how many people work and handle techniques and (ICT) information communication technology (M. Ali & Chileshe, 2009).

Project progress depends not only on the accomplishment of the project leader but also on the commitment of functional managers to success or failure. The definition of engineering management suggests a shorter definition term and more specific context of success. On another side, it's the importance of strategies to accomplish the goals of the enterprise and its highlights how

effective the application of strategies is contributing to a successful project (Munns & Bjeirmi, 1996).

The factors which may cause the engineering management would be unable to achieve success include:

- The wrong person to be a project manager.
- Non-supportive upper management.
- Insufficiently specified tasks.
- The lack of techniques for managing projects.
- Misused management techniques (Avots, 1969).
- That a successful engineering manager is the most important impact on the percentage time of bricklayers. also noted that the impact of management factors on productivity could be important. referred to most failures project in terms of cost overruns and time or gives up to lack of purposeful leadership in the industry.

2.6 The Most Important Challenges Facing the Creation of Smart Cities in Scope of Constructions in Iraq?

There are many applications and technologies available in Iraq that qualify Iraqi cities to turn them into smart cities but it needs more planning and smart management in addition to many challenges facing the establishment of smart cities in Iraq it can be listed as follows:

- Urban planning is not standard what is required, the critical security situation, political conflicts, lack of services.
- The lack of development in Iraqi cities where there has not been a modernization until now that would qualify it to transform our cities into smart cities with the exception of the residential complex in Basmaya near Baghdad province as in Fig. 2.34, which contains great qualifications that qualify it to transform into a smart city.

Figure 2.34: Basmaya Site

Source:(Google).

- Some sectors may not be aware of how other sectors work within the city's development system and its operations, and how the different components.
- Not spreading modern strategies in construction and losing a promotion.
- Administrative corruption in various aspects of the country and the absence of departments seeking to contain development sites in their facilities.
- Just a constructive approach than requiring a system update rather policymakers should encourage people to contribute to decision-making processes for a sustainable city (Rana et al., 2019).

3. METHODOLOGY

The main problem of this survey was the lack of use of technology in building homes and cities and the lack of facilities to spread advanced technologies in the field of construction in Iraq, especially in the south and middle Iraqi cities, which caused our cities is not to become intelligent. Fig 3.1 shows Iraq's cities geographic location.

Figure 3.1: Geographic location Iraq

Source:(Google).

In this thesis, an attempt was made to collect most of the construction techniques in developing countries for application in Iraq. This survey consists of two parts, each part consists of seven questions. The first part about technological applications in homes. the second part, about smart cities in the developing countries of the world and how they can benefit from it to transform Iraqi cities into smart cities. It used the questionnaire method to find answers to these questions. The questions are designed with multiple choices in all questions. The questions included educational level, years of experience, and engineering major. The aim was to conduct a survey of 60 engineers in Iraq from 05.12.2020 to 09.01.2021.

The questionnaire was published on the social media sites of the engineers' category in Iraq from various disciplines. This survey was conducted over the phone. The time period for obtaining responses from survey respondents required 34 days. The complete questionnaire form is placed in the thesis appendix.

This survey was analyzed using the SPSS statistical software. 3 types of scales were used to collect the results including the arithmetic mean, Cronbach's alpha and Std. Dev anisotropy.

4. RESULTS AND DISCSSION

All results of the questionnaire in parts 1 and 2 were conducted using the SPSS analysis. Following, there are two-part of questions in this thesis:

4.1 Questions Part1 and Part 2

Table 4.1: Questions in the Part1 of Questionnaire

1.1	Although many countries of the world have adopted smart, sustainable, and green to homes policies, these initiatives are few if not non-existent in Iraq?
I.2	Smart and sustainable homes provide comfort and luxury for their residents, improve public health and energy use with high efficiency and make our lives more developed.
I.3	Is it necessary to benefit from the technology of developing countries and to spread it within the media and include it in the school curricula for its application in our country?
I.4	An HVAC system is one of the technologies that should be encouraged to be applied in homes.
I.5	It is possible to implement some simple techniques that have not been taken into consideration for their presence on the windows in providing a lot of electrical energy and comfort and transferring the traditional home to a smart home.
I.6	There are many modern technologies such as technologies that apply to plug loads and SLS that must be promoted and presented in the local markets at reasonable prices to encourage their application in Iraqi homes.
I.7	Despite the great challenges in Iraq, it requires governments to support smart products and ways to use them in homes, such as the security system, considering the home as the first building block for building a smart city.

Tables 4.1 and 4.2 clarify all the questions in the questionnaire related to the topics of smart homes in Table 4.1 and smart cities in Table 4.2 below, which were explained in the topics of the message in general. In these questions, I explained everything related to technology applications in homes and

constructions and the obstacles that hinder their implementation in our country. With this questionnaire the scientific significance of this thesis.

Table 4.2: Questions in the Part2 of Questionnaire

2.1	Do you think that living in a smart city would impact your life and can make a developed person?
2.2	Do you agree in the era of development, we must move forward to transform our cities into smart cities, by making use of the technologies of developing countries and their dissemination and application?
2.3	The pre-fabricated building technology applied in the developed countries of the world is considered one of the smart and fast technologies that must be promoted in the various areas of construction to move our cities to the management of intelligence.
2.4	Promoting and using of modern world technologies in-state projects such as nanotechnology due to their clear impact on urbanization and sustainability.
2.5	Do you agree that we judge modernity in cities when we see it from the first time by the appearance of their skyscrapers?
2.6	Do you agree that there are many modern technologies in the road sector applied in the developing countries of the world that should be followed, the most important of which is the electric power generation that our country suffers from?
2.7	The current challenges of building smart cities in Iraq are due to the loss of awareness of, promotion, implementation of modern technology, administrative corruption, and lack of awareness of the expertise of engineering departments.

Below are the results of the questionnaire using some measures.

4.2 Arithmetic Mean $(\bar{x})$

It is one of the measures used to extract the results of the questionnaire.

4.2.1 Arithmetic mean for questions part 1

The results of components have been tabulated according to $\bar{x}$ and rank important.

Table 4.3: Results Questions Part 1 According to $\bar{x}$ and Rank in Importance

Questions No.	Sample (N)	$\bar{x}$		Std. Deviation	Rank
		Data	Standard (std.) Error		
1.1	60	4.22	0.11	0.85	2
1.2	60	4.32	0.11	0.83	1
1.3	60	4.03	0.14	1.06	6
1.4	60	4.15	0.13	1.04	3
1.5	60	4.13	0.12	0.96	4
1.6	60	4.12	0.13	0.99	5
1.7	60	4.02	0.12	0.93	7

Table 4.3 shows the results of part 1 of the questionnaire questions with an arithmetic mean scale that consists of 60 samples of engineering. Generally, what stands out from the table is that question 1.2 is in the first place, related to the importance of using technology in our life for developing it. On the other hand, regarding question 1.2, whose mean was 4.32, and had the lowest deviation and error of 0.83 and 0.11 respectively, compared to the rest of the other samples. The results are positive, and the largest group supports the use of technology in this research to develop Iraq's homes and live-in smart cities. where the results can be compared in terms of importance, as shown in table 4.4.

Table 4.4: Classified According to Rank

1.2	First rank importance with a mean of 4.32
1.1	Second rank importance with a mean of 4.22
1.7	Third rank importance with a mean of 4.02

Table 4.4 shows that the second question occupies the first place, which includes Smart and sustainable homes provide comfort, luxury, and health for their residents make our lives more developed. It is illustrated the importance of this aspect of the thesis that researchers can use in the field of establishing modern methods in homes to transform our homes into developing once.

4.2.2 Arithmetic mean question's part 2

Table 4.5 explains results question part 2 according arithmetic mean rank.

Table 4.5: Results Questions Part 2 According to $\bar{x}$ and Rank in Importance

Questions No.	N	$\bar{x}$		Std. Deviation	Rank
		Data	std. Error		
2.1	60	3.92	0.13	0.98	3
2.2	60	4.02	0.11	0.83	1
2.3	60	3.87	0.15	1.14	4
2.4	60	3.53	0.15	1.16	6
2.5	60	3.48	0.13	1.02	7
2.6	60	3.95	0.14	1.05	2
2.7	60	3.73	0.13	1.01	5

Table 4.5 displays the results of part 2 of the questionnaire questions with an arithmetic mean scale that consists of 60 samples of engineering. what stands out from the table is that question 2.2 is in the first place, On the other hand, question 2.2, whose mean was 4.02, and had the lowest error and deviation of 0.11 and 0.83 respectively, compared to the rest of the other samples. The results are positive, and the largest group supports the use of technology in this research to develop Iraq's cities. where the results can be compared of importance, as illustrated in table 4.6.

Table 4.6: Classified $\bar{x}$ According to Rank

2.2	First rank in importance with a mean of 4.02
2.6	Second rank in importance with a mean of 3.95
2.1	Third in importance with a mean of 3.92

Table 4.6 displays that the second question occupies the first place, which includes we must move forward to transform our cities into smart cities, by making use of the technologies of developing countries and their application. It is illustrated the importance of this aspect of the thesis that researchers can use in the field of establishing modern method construction in cities to transform our cities into developing.

4.3 Cronbach's Alpha Scale

It is another of the measures used to extract the results of the questionnaire.

4.3.1 Cronbach's Alpha scale for questions part 1

Table 4.7 shows reliability results for the first part of the smart home by Cronbach's Alpha scale

Variables = 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7

Scale = all variables

Model = alpha.

Table 4.7: Cronbach's Alpha Analysis for Part 1 Reliability

Cases	N	Percent (%)
`Valid	60	98.4
Excluded*	1	1.6
Total	61	100

* Deletion Based on All Variables.

Table 4.7 illustrates the percentages of scale Cronbach alpha in part 1. In general, what stands off from the table is the utilization of the method cancellation based on whole variables in the procedure and discover the proportion for the valid and excluded. With regard to the percentage of 60 samples and excludes to the sample 1 is 98.4 %and 1.6% respectively and the total of the sample after excluded is 61 with 100%. definitively, the results can be concluded according to table 4.8.

Table 4.8: Results Cronbach's Alpha in Part 1

Cronbach's Alpha	N
0.860	7

Table 4.8 displays that the percentage of Cronbach Alpha is 0.86. This value is considered perfect and accepted by scale, and it is capable in the future to utilize these technologies in developing homes in Iraq and approve it by the companies and government to fulfill savings in many economic, reduce energy consumption, and environmental improvement.

4.3.2 Cronbach's Alpha mean for questions part 2

Table 4.9 shows reliability results for the second part of the smart cities by Cronbach's Alpha scale.

Variables = 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7

Scale = all variables

Model = alpha.

Table 4.9: Results Cronbach's Alpha Analysis in Part 2

Cases	N	Percent (%)
Valid	60	98.4
Excluded*	1	1.6
Total	61	100

* Deletion Based on whole Variables.

Table 4.9 illustrates the percentages of scale Cronbach alpha in part 2. Generally, the table shows the use of the method elimination based on all variables and detecting the proportion for the valid and excluded. With regard to the proportion of 60 samples and excludes to the sample 1 is 98.4 %and 1.6% respectively and the total of the sample after excluded is 61 with 100%. Finally, the results can be deduced according to table 4.10.

Table 4.10: Results Cronbach's Alpha in Part 2

Cronbach's Alpha	N
0.88	7

Table 4.10 illustrates that the percentage of Cronbach Alpha is 0.88. This value is considered accepted and good in scales, which means, we are capable in the future to utilize these technologies in developing cities in Iraq and approve them by the companies and government to fulfill savings in many aspects of the economics.

4.4 Std. Dev Variance scale

Following are frequencies results for the part1 and part 2 by (Std. Dev) variance scale:

Variables = 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 2.1, 2,2, 2.3, 2.4, 2.5, 2.6, 2.7

Scale = all variables

Model = Dev variance

4.4.1 Std. Dev Frequency Variance for Education Level

Table 4.11 illustrates the results of frequency by Std. Dev Variance scale in education level.

Table 4.11: Frequency Dev Variance for Education Level

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
Diploma		4	6.6	7	7
Bachelor		17	27.9	28	35
Master		35	58.4	58	93
Ph.D.		4	6.6	7	100
Total		60	98.4	100	
Missing	System	1	1.6	2	
Total		61	100		

Table 4.11 outline the frequency of four samples for education level are diploma, bachelor, master, and Ph.D. From the table, the degree master is the biggest frequency and percentage from the other samples, are 35 and percent 58.4 respectively. This indicates that the largest percentage of engineers of the master's degree, agree to apply using technology in homes to make it more sophisticated because they recognize the benefits of using technologies in development homes.

4.4.2 Frequency Std. Dev Variance for Years' Experience

Table 4.12 shows the Frequencies in Years' Experience to Iraqi engineers' category.

Table 4.12: Std. Dev Frequency Variance for Years' Experience

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
0-5		6	9.8	10	10
5-10		5	8.5	9	19
10-15		13	21.3	21	40
More than 15 years		36	59.5	60	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.12 shows the frequency for four samples for years of experience, 0-5, 5-10, 10-15, and more than 15 years. Stands out from the table is that over 15 years of experience is the largest frequency and percentage from other the samples, at 36 and 59.5 respectively. This indicates, this category is the most participant in the questionnaire and supportive of modern technologies used in homes, which indicates the importance of this thesis aspect because it provides economic benefits and comfort to the resident.

4.4.3 Frequency Std. Dev Variance for engineering specialization

Table 4.13 explains the type of engineering specialization.

Table 4.13: Frequency Dev Variance for Engineering Specialization

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
Architecture engineering		2	3.3	3	3
Civil engineering		42	69.9	70	73
Computer engineering		5	8.2	8	81
Electrical engineering		4	6.6	7	88
Mechanical engineering		1	1.6	2	90
Other		6	9.8	10	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.13 shows the repetition of six samples for engineering majors, architecture, civil engineering, computer engineering, electrical engineering, and mechanical engineering, among others. what stands out from the table is that civil engineering has the largest frequency and percentage from other samples at 42 and 68.9% respectively. This indicates that the engineering category specializing in construction is the largest group that supports the use of modern technologies in homes because of their awareness of the importance of this aspect and thus its impact on the development of society as a whole.

4.4.4 Frequency Std. Dev Variance in question 1.1

Table 4.14 explains the frequency by Std. Dev variance in question 1.1.

Table 4.14: Frequency Std. Dev Variance in Question 1.1

Valid	Frequency	Percent (%)	Valid Percent	Cumulative Percent
Strongly disagree	1	1.6	2	2
Disagree	2	3.3	3	5
Neutral	4	6.6	7	12
Agree	29	48.5	48	60
Strongly agree	24	39.5	40	100
Total	60	98.4	100	
Missing system	1	1.6		
Total	61	100		

Table 4.14 shows five samples for approval. They include Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree. From the table, those who agree are the largest frequency and percentage of other samples, are 29 and 48.5% in frequency and percentage sequentially. this indicates the largest group agrees that shortage using technology in our country despite its spread in developed countries.

4.4.5 Frequency by Std. Dev Variance in question 1.2

Table 4.15 explains the frequency by Std. Dev Variance in question 1.2.

Table 4.15: Frequency Std. Dev Variance in Question 1.2

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
Disagree		3	4.9	5	5
Neutral		5	8.2	8	13
Agree		22	36.5	37	50
Strongly agree		30	49.5	50	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.15 shows the repeat of four samples for approval. They include disagree, natural, agree, and agree strongly. Highlights from the table, those who strongly agree to represent the largest frequency and proportion from the other samples. the maximum frequency and percentage are 30 and 49.5%. This indicates they strongly agree that smart homes make life more developing, it

concludes the importance of the thesis part.

4.4.6 Frequency Std. Dev Variance in question 1.3

Table 4.16 explains the frequency in question 1.3 as follows:

Table 4.16: Frequency Std. Dev Variance in Question 1.3

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
strongly disagree		3	4.9	5	5
Disagree		1	1.6	2	7
Neutral		11	18	18	25
Agree		21	34.5	35	60
strongly agree		24	39.5	40	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.16 shows the frequency for five sample. Strongly disagree, disagree, natural, agree, and strongly agree. those who strongly agree, with greater frequency and proportion than other samples, at 24 frequency and 39.5% percent. This indicates the largest group that strongly agrees with the use of technologies in developing countries and their application in our country in various fields.

4.4.7 Frequency Std. Dev Variance in question 1.4

Table 4.17 explains the frequency in question 1.4 as follows:

Table 4.17: Frequency by Dev Variance in Question 1.4

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
Strongly disagree		2	3.3	3	3
Disagree		4	6.6	7	10
Neutral		4	6.6	7	17
Agree		23	37.7	38	55
Strongly agree		27	44.5	45	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.17 shows five samples, including strongly disagree, disagree, natural agree and strongly agree. From the table highlights who strongly agree on, are

represented the highest frequency and proportion from other samples, at 27 and 44.5% respectively. This indicates important using HVAC technology in homes to make them sophisticated.

4.4.8 Frequency Std. Dev Variance in question 1.5

Table 4.18 explains the frequency in question 1.5 as follow.

Table 4.18: Frequency Dev Variance in Question 1.5

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
strongly disagree		2	3.3	3	3
Disagree		2	3.3	3	6
Neutral		6	9.8	10	16
Agree		26	43.5	44	60
strongly agree		24	39.5	40	100
Total		60	99.5	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.18 shows five sample, include strongly disagree, disagree, natural, agree, strongly agree. the table shows those who agree, represent the largest frequency and percentage from other samples at 26 and 43.5% respectively. This indicates important applying technologies on windows turn to transfer traditional homes to smart.

4.4.9 Frequency Std. Dev Variance in question 1.6

Table 4.19 explains the frequency in question 1.6 as follows.

Table 4.19: Frequency Std. Dev Variance in Question 1.6

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
strongly disagree		3	4.9	5	5
Disagree		1	1.6	2	7
Neutral		5	8.2	8	15
Agree		28	46.5	47	62
strongly agree		23	37.7	38	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.19 shows five samples. Strongly disagree, disagree, natural, agree, strongly agree. and shows, those who agree, represent the largest frequency and proportion at 28 and 46.5% respectively. This indicates the importance of new applications on loads and SLS, so promoting them in the local markets.

4.4.10 Frequency Std. Dev Variance in question 1.7

Table 4.20 explains the frequency in question 1.7 as follows.

Table 4.20: Frequency Std. Dev Variance in Question 1.7

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
Strongly disagree		1	1.6	2	2
Disagree		3	4.9	5	7
Neutral		10	16.4	16	23
Agree		26	42.6	43	66
Strongly agree		20	33.8	34	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.20 shows five samples. Strongly disagree, disagree, natural, agree, strongly agree. Those who agree, represent the largest frequency and percentage from other samples at 26 and 42.6% respectively. This indicates the importance of supporting the smart methods and products that were mentioned in the thesis by governments.

4.4.11 Frequency Std. Dev Variance in question 2.1

Table 4.21 explains the frequency in question 2.1 as follows.

Table 4.21: Frequency Std. Dev Variance in Question 2.1

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
Strongly disagree		3	4.9	5	5
Disagree		2	3.3	3	8
Neutral		7	11.5	12	20
Agree		33	54.1	55	75
Strongly agree		15	24.6	25	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.21 shows five samples. Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree. Highlights from the table are those who agree, represent the largest frequency and proportion from other samples, are 33 and 54.1% respectively. This indicates that the larger group agrees that living in smart cities will affect the lives of residents and make them more development.

4.4.12 Frequency Std. Dev Variance in question 2.2

Table 4.22 explains the frequency in question 2.2 as follows.

Table 4.22: Frequency Std. Dev Variance in Question 2.2

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
Disagree		6	9.8	10	10
Neutral		2	3.3	3	13
Agree		37	61.7	62	75
Strongly agree		15	24.6	25	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.22 shows four samples. disagree, neutral, agree, strongly agree. Highlights from the table are those who agree, making up the largest frequency and percentage from other samples. at 37 and 61.7% respectively. This indicates the largest group agrees to use the developing countries' techniques and spread them in our country. This means the great importance of this aspect.

4.4.13 Frequency Std. Dev Variance in question 2.3

Table 4.23 explains the frequency in question 2.3 as follows.

Table 4.23: Frequency Std. Dev Variance in Question 2.3

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
strongly disagree		6	9.8	10	10
Neutral		7	11.5	12	22
Agree		30	49.2	50	72
strongly agree		17	27.9	28	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.23 shows four samples. Strongly disagree, natural, agree, strongly agree. The table highlights, those who agree represent the largest frequency and percentage from others. At 30 and 49.2% respectively. This indicates the important thesis aspect that explained the speed of implementation of prefabricated construction and its benefits.

4.4.14 Frequency Std. Dev Variance in question 2.4

Table 3.24 explains the frequency in question 2.4 as follows.

Table 4.24: Frequency Std. Dev Variance in Question 2.4

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
Strongly disagree		4	6.6	7	7
Disagree		8	13.1	13	20
Neutral		12	19.7	20	40
Agree		24	39.5	40	80
Strongly agree		12	19.7	20	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.24 shows five samples. Strongly disagree, Disagree, Neutral, Agree, strongly agree. Highlights from the table are those who agree, make up the largest frequency and proportion from others. at 24 and 39.5% respectively. This proves the importance of this aspect of the thesis by using nanotechnologies in the various aspects of construction, as it is one of the important advanced technologies that have multiple benefits.

4.4.15 Frequency Std. Dev Variance in question 2.5

Table 4.25 explains the frequency in question 2.5 as follows.

Table 4.25: Frequency Std. Dev Variance in Question 2.5

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
Strongly disagree		3	4.9	5	5
Disagree		6	9.8	10	15
Neutral		18	29.5	30	45
Agree		25	41	42	87
Strongly agree		8	13.1	13	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.25 shows five samples. Strongly disagree, disagree, neutral, agree, strongly agree. Standing out from the table are those who agree, have the highest frequency and proportion from others, at 25 and 41% respectively. Which proves the importance of the thesis aspect that includes encouraging applying of skyscrapers as it is a destination of progress in addition to its role in reducing horizontal population density.

4.4.16 Frequency by Std. Dev Variance question 2.6

Table 4.26 explains the frequency in question 2.6 as follows.

Table 4.26: Frequency Std. Dev Variance in Question 2.6

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
Strongly disagree		3	4.9	5	5
Disagree		2	3.3	3	8
Neutral		10	16.5	17	25
Agree		25	41	41	66
Strongly agree		20	33.8	34	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.26 shows five samples. Strongly disagree, disagree, natural, agree, strongly agree. The table shows those who agree, have the highest frequency and percentage from others in 25 and 41% respectively. that means necessary to

use and implement smart applications in construction due to their economic, environmental, and electrical saving.

4.4.17 Frequency Std. Dev Variance in question 2.7

Table 4.27 explains the frequency in question 2.7 as follow.

Table 4.27: Frequency Std. Dev Variance in Question 2.7

Valid		Frequency	Percent (%)	Valid Percent	Cumulative Percent
Strongly disagree		2	3.3	3	3
Disagree		5	8.2	8	11
Neutral		13	21.7	22	33
Agree		27	44.5	45	78
Strongly agree		13	21.7	22	100
Total		60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

Table 4.27 shows a repeat of five samples include strongly disagree, disagree, neutral, agree, and strongly agree. Highlights from the table are those who agree, have the largest frequency and proportion of other samples. With regard to the maximum frequency and percentage of approval, it is 27 and 44.5%, which explains the importance of the thesis side that discussed the challenges that Iraq faces, which are attributed to the reasons for the loss of technological development in it, including administrative corruption and loss of support for the development of cadres who possess the talent and creativity.

5. CONCLUSIONS AND RECOMMENDATIONS

The thesis deals with the subject of technological development in various areas of construction in various countries of the world, which is considered a high-speed development, as the world produces every day and every hour, a new technology that has a clear impact on human thought and the need to make the most of the positive effects of this development in the field of development and planning of homes and cities Because this field does not exist in our country. Where we can, through our exposure to the issue of smart buildings and smart cities in the countries of the world, we can say that these projects are not fictional projects and can be achieved on the ground by following modern strategies. It should be noted what distinguished the research from previous research, as it focused on technological developments in various fields of construction and did not pay attention to one aspect only.

The results of the study, which targeted the different engineering groups, indicate the importance of making use of the technologies of developed countries in all fields and applying them in Iraqi homes and cities to transform them into smart and sustainable homes and cities, as the hypotheses of the research were within what is expected in scientific research. Since the transformation to intelligence process requires the development of smart vision, goals, and strategies that are translated into projects, the following is recommended:

- Using innovative and modern methods to improve the current construction process by adding automation and computerized control.
- Future research should focus on the outcomes of urgent issues related to implementation and maintenance in sustainable construction.
- It requires decision-makers and ministries to take into account technological developments in school curricula and local procurement, which encourages

suppliers to make smart investments locally to change stereotypes and traditional images in the design and construction process.

- Forcing the senior direct leaderships of local governments to face the challenges facing the Iraqi reality and to move forward to overcome these obstacles.

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