



# *Artificial Intelligence in the Construction*



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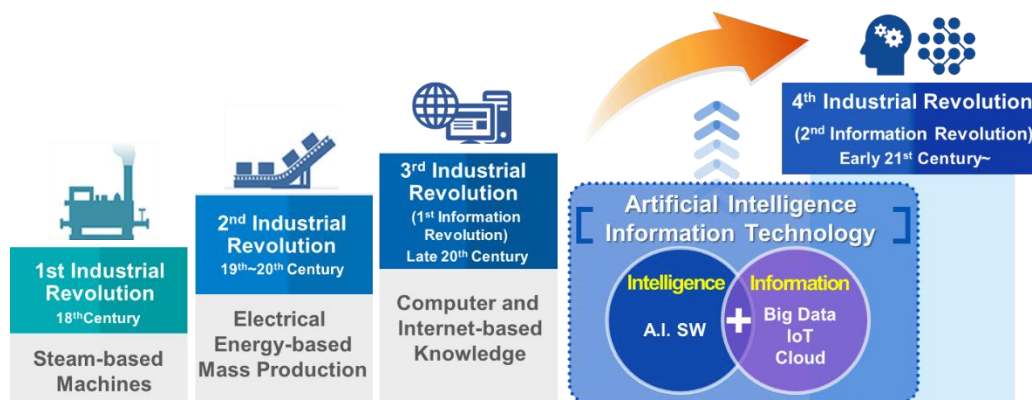
## Introduction

In light of technological advancements and the emergence of thousands of modern technologies, Artificial Intelligence is qualified to make a major transformation in all fields, such as: manufacturing, agriculture, energy, logistics and education; Where he is known for his superior ability to think, analyze data and translate information into real and tangible actions on the ground, and some recent reports in technological fields indicate that artificial intelligence technology will witness a significant growth in GDP estimated at about 14 trillion dollars by 2030, Although the term "artificial intelligence" is frequently used, especially during the recent period, many people are wondering about artificial intelligence projects.

**Artificial Intelligence:** A branch of Science, which deals with helping machines, finds solutions to complex problems in a more human-like fashion. This generally involves borrowing characteristics from human intelligence and applying them as algorithms in a computer friendly way.

### Brief History of Artificial Intelligence

- 1941 : First electronic computer (technology finally available ).
- 1956 : Term Artificial Intelligence introduced.
- 1960s: Checkers-playing program that was able to play games with opponents.
- 1980s: Quality Control Systems.
- 2000 : First sophisticated walking robot.



The ideal characteristic of AI is its ability to rationalize and take actions that have the most effective probability of achieving a selected goal. Once the general public hear the term computing, the primary issue they sometimes consider is robots. that is as a result of big-budget films and novels weave stories regarding human-like machines that make for mayhem on Earth. however, nothing might be a far from the reality. AI on the principle that human intelligence may be outlined in a very method that a machine will simply mimic it and execute tasks, from the best to people who are even a lot of complicated. The goals of AI embody learning, reasoning, and perception.

As technology advances, previous benchmarks that outlined AI become obsolete. for instance, machines that calculate basic functions or acknowledge text through optimum character recognition are not any longer thought of to embody AI, since this operate is currently taken associate consideration as a right |with no consideration |with a pinch of salt as an inherent laptop operate. AI is unendingly evolving to learn many alternative industries. Machines square measure wired employing a cross-disciplinary approach primarily based in arithmetic, computing, linguistics, psychology, and more. Why Artificial Intelligence? Computers square measure essentially well matched to performing arts mechanical computations , mistreatment mounted programmed rules. This enables artificial machines to perform straightforward monotonous tasks with efficiency and dependably, that humans square measure ill-suited to.<sup>[1]</sup>

## ❖ **Why Artificial Intelligence?**

Computers are basically similar temperament to playing mechanical computations, exploitation This permits artificial machines to perform straightforward monotonous tasks expeditiously and dependably , that humans are ill-suited to.<sup>[1]</sup> Artificial intelligence (AI) makes it doable for machines to learn from expertise, adjust to perform human-like tasks and new inputs. Most AI examples that you simply hear regarding today – from chess-playing computers to self-driving cars – rely heavily on natural language processing and deep learning . Using these technologies, computers will be trained to accomplish specific tasks by process massive amounts of knowledge| and recognizing patterns in the data.<sup>[10]</sup>

## ❖ **UAE Strategy for Artificial Intelligence**

In October 2017, the UAE Government launched ‘UAE Strategy for Artificial Intelligence (AI)’. This marks the post-mobile government phase, which will rely on various future services, sectors and infrastructure projects. The strategy is first of its kind in the region and the world and it aims to:

- Achieve the objectives of UAE Centennial 2071
- Boost government performance at all levels
- Use an integrated smart digital system that can overcome challenges and provide quick efficient solutions.
- Make the UAE the first in the field of AI investments in various sectors.
- Create new vital market with high economic value.

**Sectors: The strategy will cover the following sectors:**

- Transport – to reduce accidents and cut operational costs.
- Health – to minimize chronic and dangerous diseases.
- Space – to help conduct accurate experiments, reduce rate of costly mistakes.
- Renewable energy – to manage facilities.
- Water – to conduct analysis and studies to provide water sources.
- Technology – to increase productivity and help with general spending.
- Education – to cut costs and enhance desire for education.
- Environment – to increase forestation rate.
- Traffic – to reduce accidents and traffic jams and draw more effective traffic policies.

**Themes: The AI strategy has five themes:**

- The formation of the UAE AI Council.
- Workshops, programs, initiatives and field visits to government bodies.
- Develop capabilities and skills of all staff operating in the field of technology and organize training courses for government officials.
- Provide all services via AI and the full integration of AI into medical and security services.
- Launch leadership strategy and issue a government law on the safe use of AI.<sup>[2]</sup>

## ❖ **History of artificial intelligence**

The history of AI research was based at a workshop persisted the field of Dartmouth college throughout the summer of 1956. Those that attended would become the leaders of AI research for many years. Several of them foreseen that a machine as intelligent as a human being would exist in not quite a generation and that they were given millions of dollars to create this vision come back true.

Eventually, it became obvious that they'd grossly underestimated the issue of the project. In 1973, in response to the criticism from ongoing pressure from congress and James Light hill, British Governments and the U.S. Stopped funding undirected research into AI, and therefore the tough years that followed would later be referred to as an "AI winter". Seven years later, a visionary initiative by the Japanese government galvanized governments and industry to supply AI with billions of dollars, however by the late 80s the investors became enlightened by the absence of the required pc power (hardware) and withdrew funding once more.

Interest and Investment in AI boomed within the initial decades of the twenty first century, once machine learning was with success applied to several issues in industry and academia because of the presence of powerful computer hardware.<sup>[3]</sup>

## ❖ **What is Artificial Intelligence and Machine Learning?**

Artificial intelligence (AI) is a collective term for describing once a machine mimics human psychological feature functions, like problem-solving, pattern recognition, and learning. Machine learning is a subset of Artificial intelligence. Machine learning may be a field of AI that uses statistical techniques to offer pc systems the power to "learn" from information, while not being expressly programmed. A machine becomes higher at understanding and providing insights because it is exposed to additional information.

## ❖ **AI and Machine Learning for Smart Construction**

The potential applications of AI and machine learning in construction are vast. Requests for data, change orders and open problems are standard in the industry. Machine learning is sort of a good assistant that may scrutinize this mountain of information. It then alerts project managers concerning the important things that require their attention. many applications already use AI during this method. . Its benefits range from mundane filtering of spam emails to advanced safety observance.<sup>[4]</sup>

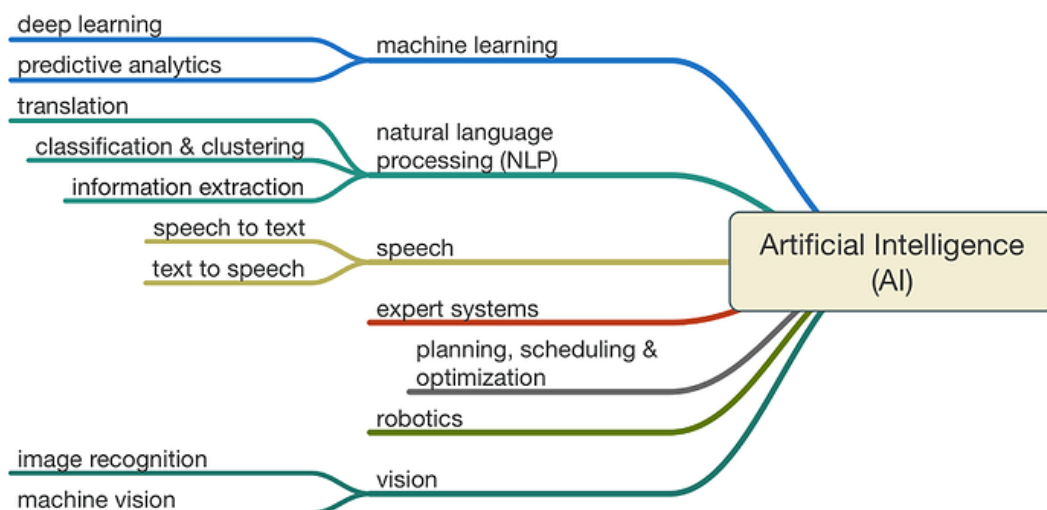
## ❖ **The Benefits of AI in Construction**

About 7% of the world's labor is used within the housing industry, thus it's a significant sector of the world economy. People and businesses pay \$10 trillion per annum on construction-related activities. Different sectors have used AI and different technologies to transform their productivity performance. Construction, as compared, has progressed at a glacial pace.

The global industry has big by just one % p.a. over the past few decades. Compare this with a rate of three.6 % in producing, and 2.8 % for the full world economy. Productivity, or the overall economic output per employee, has remained flat in construction. As compared, productivity has big 1500 % in retail, producing, and agriculture since 1945. One in every of the explanations for this can be that construction is one in every of the foremost under-digitized industries within the world and is slow to adopt new technologies. Adopting the newest technology will be discouraging for groups. However, machine learning and are helping make job sites more efficient and saving money in the process. AI solutions that have created a control in different industries are beginning to emerge in the construction industry.

## ❖ Applications of Artificial Intelligence

- **Expert Systems:** An Expert Systems may be a malicious program designed to act as associate professional during a specific domain (area of expertise).
- **Natural Language Processing (NLP):** The goal of NLP is to change folks and computers to communicate in a natural (humanly) language (such as, English) instead of during a computer-oriented language.
- **Speech Recognition:**
  1. The primary interactive technique of communication employed by humans isn't reading and writing, it's speech.
  2. The goal of speech recognition analysis is to permit computers to grasp human speech . so, they'll hear our voices and acknowledge the we are speaking.
  3. It simplifies the method of interactive communication between computers and people, so it advances the goal of NLP.
- **Computer Vision:**
  1. People typically use vision as their primary means that of sensing their setting, we generally see more than we feel, or hear, or taste or smell.
  2. computer vision research is to offer computers this same powerful facility for understanding their surroundings. Here AI helps computer to understand what they see through attached cameras.
- **Robotics**
  1. A mechanism may be an electro-mechanical device which will be programmed to perform manual tasks, or a reprogrammable multi-functional manipulator designed to maneuver materials, parts, tools, or specialized devices through variable programmed motions for performance of form of tasks.
  2. An 'intelligent' robot includes some quite sensory equipment that enables it to respond to change in its environment.<sup>[1]</sup>



## ❖ **10 Examples of AI in Construction**

### **1. Prevent cost overruns**

Most mega projects go over budget despite employing the simplest project groups. Artificial Neural Networks are used on projects to predict price overruns supported factors like project size, contract kind and also the competency level of project managers. Historical knowledge like planned begin and finish dates are unit employed by prophetic models to ascertain realistic timelines for future comes. AI helps employees remotely access real-life coaching material that helps them enhance their skills and information quickly. This reduces the time taken to aboard new resources onto comes. As a result, project delivery is expedited.

### **2. AI for Better Design of Buildings through Generative Design**

Building Information Modeling is a 3D model-based process that gives engineering, architecture and construction professionals insights to efficiently plan, design, construct and manage buildings and infrastructure. In order to plan and design the construction of a building, the 3D models need to take into consideration the engineering, architecture, electrical, mechanical and plumbing (MEP) plans and the sequence of activities of the individual groups. The challenge is to confirm that the various models from the sub-teams don't clash with one another. The industry is attempting to use machine learning within the kind of generative design to spot and mitigate clashes between the various models generated by the different groups within the planning and design section to prevent rework. there's software that uses machine learning algorithms to explore all the variations of an answer and generates design alternatives. It leverages machine learning to specifically produce 3D models of mechanical, electrical, and plumbing systems whereas at the same time ensuring that the whole routes for MEP systems don't clash with the building architecture whereas it learns from every iteration to return up with a best solution.

### **3. Risk Mitigation**

Every construction project has some risk that comes in several forms like Safety, Quality, Time, and Cost Risk. The larger the project, the additional risk, as there are multiple sub-contractors acting on completely different trades in parallel on job sites. There are AI and machine learning solutions today that general contractors use to observe and place risk on the job site, that the project team will focus their restricted time and resources on the largest risk factors. AI is to automatically assign priority to problems. Subcontractors are rated supported a risk score therefore construction managers will work closely with insecure groups to mitigate risk.

### **4. Project Planning**

In AI Startup launched in 2018 with the promise that its AI and robots hold the key to resolution late and over budget construction projects. The corporate uses robots to autonomously capture 3D scans of construction sites and so feeds that information into a deep neural network that classifies however so much on totally different sub-projects are. If things appear astray, the management team will step in to contend with small problems before they become major issues. Algorithms of the longer term can use associate AI technique called “reinforcement learning.” this system permits algorithms to learn based on trial and error. It will assess endless alternatives and combinations based on similar projects. It aids in project planning since it optimizes the simplest path and corrects itself over time.

### **5. AI Will Make Jobsites More Productive**

There are companies that are beginning to provide self-driving construction machinery to perform repetitive tasks a lot of with efficiency than their human counterparts, like pouring concrete, masonry, welding, and demolition. Excavation and preparation work are being performed by autonomous or semi-autonomous

bulldozers, which might prepare a job site with the assistance of a human programmer to actual specifications. This frees up human staff for the construction work itself and reduces the time needed to finish the project.

### ***6. AI for Construction Safety***

Construction employees are killed on the job 5 times more often than other laborers. According to OSHA, the leading causes of personal sector deaths (excluding highway collisions) within the construction industry were falls, followed by struck by electrocution, an object and caught-in/between. A Boston-based General Contractor with annual sales of \$3 Billion is developing an algorithmic program that analyzes photos from its job sites, scans them for safety hazards like employees not wearing protective equipment and correlates the images with its accident records. The corporate says it will probably compute risk ratings for projects thus safety briefings are often control once associate elevated threat is detected.

### ***7. AI Will Address Labor Shortages***

Labor shortage and a need to boost the industry's low productivity are compelling construction to invest in AI and information science. A 2017 McKinsey report says that construction corporations may boost productivity by the maximum amount as 50% through period of time analysis of information. Construction corporations are beginning to use AI and machine learning to better plan for distribution of machinery and labor across jobs.

### ***8. Off-site Construction***

Construction firms are increasingly relying on off-site factories staffed by autonomous robots that piece along parts of a building, that are then pieced along by human employees on-the-site. Structures like walls will be completed assembly-line vogue by autonomous machinery additional with efficiency than their human counterparts, leaving human employees to end the detail work like Plumbing, Electrical systems and HVAC once the structure is fitted together.

### ***9. AI and Big Data in Construction***

At a time when a massive amount of information is being created daily, AI Systems are exposed to an endless amount of information to find out from and improve daily. Each job site becomes a potential data source for AI. Information generated from images captured from drone videos, mobile devices, building info modeling (BIM), security sensors, and others became a pool of knowledge. This presents a chance for construction industry customers and professionals to investigate and benefit from the insights generated from the information with the assistance of machine learning and AI systems.

### ***10. AI for Post-Construction***

Building managers will use AI long when the development of a building is complete. Building info modeling, or BIM, stores info concerning the structure of the building. AI will be accustomed monitor developing issues and even offers solutions to prevent issues.<sup>[4]</sup>

## **❖ *The Future of AI in Construction***

Robotics, and the Internet of Things and AI can reduce building costs by up to 20 %. Engineers done virtual reality goggles and send mini robots into buildings under construction. These robots use cameras to trace the work as it progresses. AI is being used to arrange the routing of plumbing systems and electrical in modern buildings. Corporations are using AI to develop safety systems for worksites. AI is being is used to trace the period of time interactions of employees, objects and machinery on the location and alert supervisors of potential issues of safety, construction errors, and productivity problems.

Despite the predictions of large job losses, AI is unlikely to exchange the human manpower. Instead, it'll alter business models within the construction industry, reduce expensive errors, reduce worksite injuries, and create building operations more economical. Leaders at construction corporations should



prioritize investment based on areas wherever AI will have the foremost impact on their company's distinctive wants. Early movers can set the direction of the business and profit within the short and long run.<sup>[4]</sup>

## ❖ **Smart Construction: 7 Ways AI Will Change Construction**

Artificial Intelligence permits contractors to build smarter, cheaper and a lot of with efficiency, disrupting an industry that is changing speedily. What do you think of when you think about Artificial Intelligence? Smart devices? The IOT? Self-Driving vehicles? Sky net? everybody and his or her grandparent is talking about AI and permanently reason too. AI may be a hot topic because of its to change the way humans do just regarding everything. The world of construction is one among those industries poised to achieve an IOT from intelligent computing creating better buildings, communities, and cities for the globe to live in. Today you're getting to get a foundation on a number of the largest ways that AI is ever-changing the globe of construction.

### **1. Design Optimization**

One of the primary things to discuss once talking regarding AI and construction is the design process as well as the factors that influence it. Construction design now could be rather archaic, slow to adopt new technology, therefore slowing the process of creating a building. Using AI, contractors and owners will use a supervised learning system to from collected environmental information, material data, building information, etc. To identify the best way to create a building or maybe a community, a contractor might build a house in a new region or area. A construction AI system might advocate to a builder what specific design languages, materials, and cost area unit required to create the house based on available data, within seconds. Data is the name of the game and can be for several of the topics on this list. In short, AI permits contractors to investigate huge amounts of knowledge in real time drastically cutting the entire construction method all the way down to a fraction of what it had been years ago.

### **2. Quality Control**

The process of quality control is tedious however crucial for a contractor and business, similarly as its future occupants. Neural networks, the foundation of AI itself, may facilitate with this method. Neural networks could be used to asses drone collected images to compare existing models against various construction inconsistencies. Owners and Construction, will be able to spot any problems or potential threats to a building before they happen, saving on value and time.

### **3. The Construction Business Model**

AI is used to better understand customer's wants, making custom brand experiences. the globe of smart construction won't be any totally different. Understanding a client's wants primarily based of knowledge are going to be the new age of construction.

### **4. Project Selection, Creation, and Completion**

Though still a far-off, smart construction could also be fully passing a future AI system, an idea that is both exciting and scary for many in the industry. The proper AI system may probably work with clients on their designs, produce the final design and send a robot out to complete it, all whereas being pass by just a few individuals.

### **5. Smart 3D Printing**

Builders using 3D printing to create homes is no longer just a long-off fantasy. 3D printing homes have become commonplace and this new disruption is because of AI. Using smart robotics, contractors are able to build homes in hours instead of weeks or maybe years. Learning from simulations, builders would possibly use AI robots to construct homes within the close to future.

## 6. *Modular Construction and Prefab Homes*

Modular homes and Modular homes are a unique and relatively new addition to the construction industry. In short, these houses are often built offsite saving time and resources, eventually to be delivered to the area of their selecting. AI may eventually make this method even more efficient, rising offer chain coordination, an important part to the success of those kinds of homes.

## 7. *Project Management*

Managing a construction project includes a host of factors to think about, with each having the potential to delay a project for years. AI will manage all of those tasks while not breaking a sweat. Future construction programs can manage entire projects providing builders with risks of the project, constructability, and also the structural stability of various technical solutions for big commercial projects, single homes, and projects out of this world.<sup>[5]</sup>

## ❖ *Advantages & Disadvantages of AI*

### a. **Advantages**

- They will be used in the medicine field.
- Knowledge based expert system, which can cross-reference diseases and symptoms will greatly improve the accuracy of medical specialty.
- Object recognition will also be a good aid to doctors.
- Along with images from CT Scans or X-ray machines, they will be ready to get preliminary analysis of those images.
- His of course will be possible only if people solve legal questions that arise by giving power to a machine to control or influence the health of a human

### b. **Disadvantages**

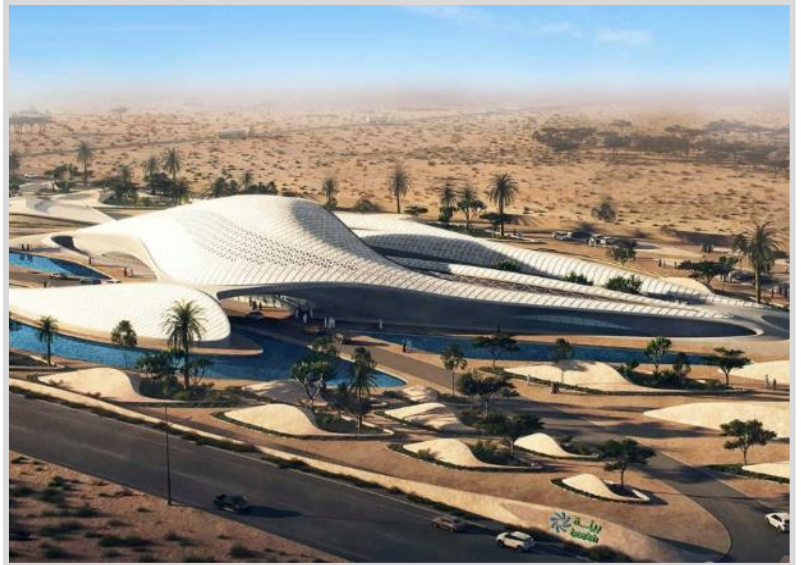
- ***Self-modifying:*** when combined with self-replicating, can lead to dangerous, unexpected results, such as a new and frequently mutating computer virus.
- ***Can be very expensive:*** maintaining a robot can be extremely expensive as they are very complex machines which require huge costs to repair and maintain.
- ***Not able to work outside of what they are programmed to do:*** robots can only do the work that they are programmed to do. They are not able to act any differently outside of the programming that is hold on in their firmware and internal circuits.
- ***Unemployment may rise:*** experts are debating the impact AI will wear the job market and whether it's something we should always welcome or worry. Even with computing technologies constantly improving and industrial robots turning into a lot of advanced, jobs could also be destroyed quicker than they're created.
- ***Robots do not get better with experience unlike humans:*** AI cannot be improved with expertise. Machines could also be able to store enormous amounts of information, however the storage, is not as effective because the human brain and with time, can lead to tear and wear. It stores a lot of information however the method it can be accessed and used is completely different from human intelligence.<sup>[7]</sup>

## ❖ Case study:

### AI-Powered Office Buildings through Bee'ah -Microsoft – Johnson Controls Partnership

The new headquarters of Bee'ah is that the 1st integrated building for AI within the MENA region and one in every of the smartest buildings within the world. Bee'ah declared, on April 23, 2019, that its new headquarters in Sharjah is ready to become the primary integrated office building For (AI) within the UAE and also the MENA region and one amongst the smartest building within the world, upon its opening within the fourth quarter of 2019.

Bee'ah's new headquarters are going to be equipped with a comprehensive suite of Artificial Intelligence (AI) and smart building solutions supported by Microsoft, adding another milestone to Bee'ah's digital transformation journey. that has fully grown wide and magnitude over the past few years, since the corporate diversified its vision to target each property and technology as pillars of the modern economy.



The chief executive officer (CEO) of Bee'ah cluster said: “Environmental property and digital technologies are common pillars in driving the economy of the longer term and are deeply nonmoving in everything we tend to neutralize Bee'ah. The new headquarters can embody their vision for the longer term and embody a lot of property solutions and advanced technologies”. The headquarters are going to be absolutely integrated with AI to support new seamless experiences to enhance efficiencies, jobs and performance. The Future Office can demonstrate its commitment to the continual advancement of its valued staff, and AI solutions can give new avenues for worker development and operational comfort.

From digital workspaces to smart back workplace integration, and from smart management of lobby visitors to visitor’s security, workers and visitors can expertise a range of up-to-date AI options through multiple touch points. The points of contact are going to be across numerous functions as well as human resources, procurement, customer service, administration, electrical and mechanical systems, plumbing system , furthermore as a "digital concierge" for every visitor. With the Digital Vault giving and dilated capabilities built on Microsoft Azure, Johnson Controls can work with Microsoft to equip the building with intelligent systems, software and hardware designed to enhance energy and create the foremost of available space.

The introduction of Bee'ah for the first integrated artificial intelligence and one of the smartest buildings within the world reflects the vision of the rulers of the Emirates to position the emirate as a world-leading model city that transcends the boundaries of innovation, as a part of its digital transformation platform. and also, the knowledge-based economy, that has witnessed several common achievements in recent years. Moreover, it's a testament to the UAE's overall AI strategy for 2031, that paves the approach for successive level of services, future and sectors infrastructure projects.<sup>[9]</sup>

## **Conclusion**

*In its short existence, AI has increased understanding of the character of intelligence and provided a powerful array of application in a very big selection of areas. it's sharpened understanding of human reasoning and of the character of intelligence generally. At a similar time, it's revealed the complexness of modeling human reasoning providing new areas and rich challenges for the longer term. Finally, we are able to say that using AI and adopting its future uses in all joints of government work in the UAE represents a fundamental engine for embodying the directions of the leadership of the UAE, and the visions of His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President of the State, in the message of the new season, that emphasised the need Implementation of quality projects and exceptional ideas throughout the coming period to continue leadership and excellence in all vital sectors of the country.*

## *References*

- [1] Vandana Gandhi, (Feb 15,2015), Slideshare, What is ARTIFICIAL INTELLIGENCE.PPT (PDF), Available: <https://www.slideshare.net/vandanagandhi9/artificial-intelligenceppt-44690011>
- [2] UAE Government, (16 Jan 2020), UAE Strategy for Artificial Intelligence, Available: <https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/federal-governments-strategies-and-plans/uae-strategy-for-artificial-intelligence>
- [3] Wikipedia, History of artificial intelligence, Available: [https://en.wikipedia.org/wiki/History\\_of\\_artificial\\_intelligence](https://en.wikipedia.org/wiki/History_of_artificial_intelligence)
- [4] Sumana Rao, (JAN 18, 2019), constructible, The Benefits of AI In Construction, Available: <https://constructible.trimble.com/construction-industry/the-benefits-of-ai-in-construction>
- [5] Donovan Alexander, (Feb 23, 2019)), interesting engineering, Smart Construction: 7 Ways AI Will Change Construction, Available: <https://interestingengineering.com/smart-construction-7-ways-ai-will-change-construction>
- [6] Defensetechconnect, (October 8, 2018), The Future of Smart Buildings: How Artificial Intelligence Enables Adaptability, Available: <https://defensetechconnect.com/2018/10/08/the-future-of-smart-buildings-with-cleve-adams-how-artificial-intelligence-enables-adaptability/>
- [7] Carbon60, (June 18, 2018), Advantages and disadvantages of artificial intelligence in construction and engineering, Available: <https://www.carbon60global.com/blog/advantages-and-disadvantages-of-ai>
- [8] Wired, (Oct 10, 2019), Want a week's vacation? Just ask the office block of the future, Available: <https://wired.me/technology/artificial-intelligence/beeah-uae-sharjah-office-of-future/>
- [9] Smart Cities World, (2020), Bee'ah creates the office of the future  
Available: <https://www.smartcitiesworld.net/news/news/beeah-creates-the-office-of-the-future-4106>
- [10] Jim Goodnight, (2021), SAS Insights, , Artificial Intelligence, what it is and why it matters, Available:[https://www.sas.com/en\\_us/insights/analytics/what-is-artificial-intelligence.html](https://www.sas.com/en_us/insights/analytics/what-is-artificial-intelligence.html)