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SMEs in Energy Sector
Foundation | Ubiquitous Blue-Green Energy Management

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Vita of authors
Preface

We are living in an era that the world confronts global and urbanization challenges such as environmental concerns, climate change, poverty, slum, economic challenges, social instability, health challenges and so on. It is vital to deal with these challenges to maintain the world and environment for future generations as well as improving livability and quality of life at present. Sustainable development is introduced as a path to deal with these challenges and create more livable and sustainable world. Different paths and techniques could be applied to achieve sustainable development through sustainable and smart cities. Therefore, smart and sustainable cities and countries could deal with global challenges, even making the world as a better place for living. Since we reached the 70ies the technologies and IT became able to change and improve the various energies, business, and even impact our lives. Besides this, they can change the global policy from fossil energy and coal to sustainable renewable energies. In these days, technology and technologies based on information technologies would play significant roles in creating solutions and techniques towards sustainable development. Hybrid businesses, ubiquitous cities, digital cities, smart citizens, ubiquitous and intelligent services including smart mobility, ubiquitous education and so on, are main solutions based on technologies towards sustainable development.

One of tools based on technologies could influence on developing sustainability is smart and sustainable energy management that is declared as Ubiquitous Blue-Green energy management by authors. Ubiquitous Blue-Green energy management founded on renewable energies as well as environmentally friendly strategies, sustainable water management and sustainability pillars could reduce environmental challenges like air pollution, water contamination, water shortage, climate change, resource preservation, environment maintenance and so on; towards improving environmental sustainability that is a necessary indicator for sustainable development and existing of livability in this world in future. Fundamentally, Ubiquitous Blue Green Energy Management could develop sustainability through its advantages such as: applying renewable energies, energy efficiency, improving energy security and energy quality, preserving natural resources, being accessible at anytime and anywhere, reducing environmental concerns, cost reduction, improving productivity and efficiency of a business, controlling and managing business processes towards reducing risks, developing successful business with high efficiency, productivity and sustainable cities. Fundamentally, Ubiquitous Blue-Green energy management as a component of urban infrastructure is able to create Ubiquitous Blue-Green city where sustainability, high quality of life and livability are existed. Such urban areas could supply humans ‘needs and make high quality of life as well as sustainable development.

In this book, Ubiquitous Blue-Green energy management and how it could be developed are illustrated and it covers:

- Ages and Waves
- High Technologies including Intelligence Artificial, Machine Learning and Robotic
- Technologies such as Virtual Reality, Smartness, Digitalization, Technologies based on Internet and Information
- Ubiquitous such as Ubiquitous Computing, Ubiquitous Infrastructure and Ubiquitous City,
- Fossil Fuels
- Renewable Energies
- Future of Energies
- Energy Management
- Sustainable and Smart Energy Management
- Blue-Green Strategies
- Ubiquitous Blue-Green Energy Management and its Benefits
- Case Studies: South Korea as Ubiquitous and Germany as Digital Country
- Relation among Ubiquitous Blue-Green Energy Management and Sustainable Development

In particular, Ubiquitous Blue-Green Energy Management is a technique to create sustainable, smart and livable urban areas as well as sustainable environment. Therefore, it is vital to introduce and illustrate it in order to apply it more towards Ubiquitous Blue-Green cities that are able to make the world as a better place for living.

Experts from the "German Mittelstand", and International Sustainability Management has written this book which is oriented directly to Managers of Global SMEs.

This book is based on the newest updated relevant articles, books, the experience of Professor Dr. Hamid Doost Mohammadian and some other sustainability and energy management leadership that is my main focus in the concept to bring target point of each item to prevent any time and resource wasting to whom they want to read and follow sustainable and smart energy management subjects.
Introduction

Content

1. Introduction

References

1. Introduction:

Nowadays, the 1st, 2nd, 3rd and 4th waves (ages) were passed. Before 1970 fossil energies, industries and various businesses could affect and improve technologies, economy and humans' lives. Since we reached the 70ies, the new and highly technologies such as IT, smartness and digitalization impact energies, business, environmental issues, quality of humans' life and sustainability. Besides this, they can change the global policy from fossil energy and coal to sustainable renewable energies. Fundamentally, energy is one the controversial issues in recent decades. It could be an indicator to make sustainable development be improved or be worsen. So, sustainable energy management is required to achieve sustainable development. Sustainable energy management is needed to be kept with rapid urbanization in order to improve sustainability. Therefore, sustainable energy management should be revised in a way to aligned with sustainability. Ubiquitous sustainable energy management through ubiquitous ideas, digitalization and innovation could be a tool to be kept up with rapid urbanization in order to gain sustainable development. Generally, environmentally sustainable development is not only concerned on Green strategies but also Blue-Green strategies. Blue-Green Strategies are based on Green strategy and Water Management made being environmentally friendly. So, Ubiquitous sustainable energy management could achieve Blue-Green Strategies not to only struggle with environmental challenges, but also improve Sustainable Development.

Sustainability is one of the keys to gain sustainable development. Environment, economic, and social well-being are three traditional pillars of sustainability. Based on, author's opinion sustainability has seven different dimensions. Environment, economic, social, educational, cultural, technical, and political aspects are formed sustainability. These aspects make a puzzle that all of the segments directly or indirectly are related to each other. The bellowed figures show seven aspects of sustainability and its' classification. In order to achieve sustainability all these seven parameters should improve approximately equable. Sustainability is occurred when the figure is more regular. In addition, the ratio could influence on achieving sustainability.

Generally, the blue shape is more sustainable than the red one. Not only blue one's ratio is higher but also blue one's regularity is more proper than the red one. These two reasons make blue shape more sustainable than the red one. In other words, approaching high ratio of sustainability and developing approximately equable are required to achieve sustainability and sustainable development.

In this book, ubiquitous idea as a new mean through techniques such as innovation, high technologies, smartness, digitalization, and innovative management to gain sustainable energy
management is examined. However, this book and suggested strategies are based on Prof. Dr. Hamid Doost Mohammadian's experience on sustainability such as cooperating with Danish Sustainable Platforms Company, working with Erasmus+ project titled IoE (Internet of Energy-Education & Qualification) as an academic leader in Germany since 2017, cooperating with former mayor of Copenhagen, consulting the German MV state Minister of Energy and Infrastructure to cooperate with Iran in 2016, many of authors’ publications and researches are in the field of sustainability, IT, digitization, hybrid knowledge, etc. In this context authors have published the theories and models developed by Prof. Dr. Hamid Doost Mohammadian such as “The 5th wave/tomorrow age theory” as well as the “i-Sustainability Plus theory” which combines innovation, sustainability and digitization. i-Sustainability Plus theory which made of the trinity open innovation, sustainability and 4.0 smart high technologies e.g. digitization and ubiquitous. This construct which is including the idea of sustainable ubiquitous business, city and society are probed as a new idea of urban living in tomorrow’s cities and societies. The idea of Sustainable Ubiquitous Energy Management derived from the combination of real life, high technology, and virtual reality and also seven pillars of sustainability model (7PS) for which again digitization is a prerequisite. In recent decades, digitization is a remarkable driver of sustainable development.

The digital transformation driven by 4.0 technologies is having a disruptive impact on many sectors, including energy. These innovations allow us to respond to both the growing energy demand and the lower carbon emission requirements. The application of Internet of Things (IoT) technologies to vast types of devices has led to electrical networks being monitored and controllable in a capillary way. Big data techniques and predictive models allow smart management of networks, from a national scale up to micro networks, facilitating the spread of distributed generation and storage systems. New intermediaries and new business models appear in the energy market.

The energy economy has changed from a power economy to a data and power economy, leading to the concept of the “Internet of Energy”.

The aim of this book is to report on new scenarios, technologies, and applications related to the concept of the Internet of Energy and discuss challenges and risks. Examples of this work include the description of new business models and new operating methodologies related to the energy sector, the impact of the digital transformation on the players of the energy sector, new policies and strategies for the monitoring and control of macro and micro energy grids, and new models of data monetization in the energy sector. The Book also aims to cover the impact of 4.0 technologies on the energy sector, including the large-scale deployment of IoT, the employment of big data and machine learning for energy forecasting, the use of cloud platforms for the control of smart grids, and the new cyber-risks for the energy sector.

Technology development has led to new opportunities for business improvement. Internet of Things, Internet of Energy, cyber-physical systems, big data, and machine learning are new techniques used in Industry 4.0 that enable businesses to better manage resources and provide them with the flexibility to respond to business conditions.

These days, rapid and unplanned urbanization, energy consumption and global situations causes global challenges for today and global crises for tomorrow such as poverty, slum, economic problems, environmental challenges, climate change, social instability, insecurity and health disease because of the contagion.
These challenges are significant threats not only for the world, energy resources, social consequences, and environment, but also for humans' being. They could make quality of life and livability worsen and destroy future of the living in the plant. So, it is vital to struggle with these challenges to preserve the world and humanities. Generally, sustainability and sustainable development are introduced as keys to deal with them. Further, as we have been living in the technology 4.0 such as Information Communication Technology, cloud computing, Internet of Things (IoT), Internet of Business (IoB), Internet of Energy (IoE), Internet of Manufacturing (IoM) and digitalization could be used as techniques to deal with global challenges. In other words, high technologies and digitalization have changed humans' life through inventing new techniques such as renewable energies and they could struggle with urbanization problems through new and innovative techniques and creating sustainable development.

Therefore, sustainability, high technologies and digitalization could be tools to create new urban areas with high quality of livability, and less global challenges especially environmental problems cause of fossil energy, lack of energy resources and greenhouse gases emission through comprehensive sustainable urban plan.

Besides of these techniques and tools, culture could play an important role in achieving sustainability. In other words, culture and education related to sustainability, sustainable businesses in energy sector and importance of it could improve energy consumption problems. In this Book (Volume 1), the authors will discuss about the Ubiquitous Sustainable Energy Management with a focus on Foundations and Blue-Green Ubiquitous energy management are introduced as a key to struggle with today’s challenges and tomorrow’s shocks/crises. The main aim of the study is to create a practical model to suggest how Blue-Green Ubiquitous energy management could be used as a tool to design modern business settings in order to achieve sustainable development and sustainable areas with high livability and quality of life through struggling with global challenges especially in energy sector. In order to achieve the aims of this issue, some questions should be answered:

1. How would Ubiquitous/smart energy management struggle with global challenges?
2. What is the role of ubiquitous concept in creating sustainable energy management?
3. How would Blue-Green Ubiquitous Energy Management be gained?
4. How would rapid urbanization, energy consumption and lack of resources make quality of livability worsen and create environmental challenges especially emission of greenhouse gases increased?
5. What is the role of comprehensive modern sustainable urban plan to make high sustainability and less emission of greenhouse gases?

In addition, two sub-goals are supposed to gain main aim of the book. The first sub-goal is to indicate what Blue-Green Ubiquitous infrastructure is and the last aim of the study is to find out how would modern business settings would struggle with urbanization challenges through improving livability and reducing greenhouse gases emission cause of energy consumption.

Energy managers are the secret warriors of the twenty-first century. Together they comprise a vital phalanx of the collective army whose essential role is to defend the world from destruction by climate change. For the most part unseen and unnoticed by the public, they toil in buildings everywhere, from hospitals to hotels, factories to data centres, from office blocks to leisure
centres. After all, the energy used in buildings forms about 40 percent of all energy used and 36 percent of the world’s CO₂ emissions.

Energy managers see things that are invisible to the majority. Their training leads them to sense the hidden flows of energy as it courses through pipes, wires, spaces and materials. They don’t perceive a static situation, such as a boiler switched on, a light glowing, the window open, a tap dripping. They see this as part of a set of processes through time, visualizing it as a series of transformations from one type of energy to another, such as, to take the example of a motor, from electricity to kinetic energy to dissipated heat energy.

This effect has yet to filter down to many smaller companies and organizations. Nevertheless, for a management board to have appointed a position of energy manager signifies that they have acknowledged the importance of sustainable energy use within their organization. Then there are the tens of thousands of building managers and facility managers, only part of whose responsibilities includes being responsible for energy management. With their labor, their employer often saves a considerable amount of money, more than enough to pay their salary, and reduces the risk of exposure to volatile energy price increases. But it is not just money they save, although that may be their employer’s primary motivation. They are also saving carbon, which is increasingly a quantified activity featuring in company annual reports, and as such doing their bit to challenge the advance of global warming and promote the good reputation of the company for sustainable housekeeping.

Based on D3: (three revolutions of the 21st century: Digitalization, Decarbonization and Decentralization), we will discuss how Sustainable Ubiquitous Energy Management can help and support us to achieve the D3.

Based on Prof. Dr. Hamid Doost Mohammadian experience on challenges and sustainability, digitalization and energy management concerned on Pars Oil Gas Company (P.O.G.C) in Iran, Denmark and Germany, solutions are proposed:

- Proper education and training
- Cultural domination practices
- Waste collecting sorting
- Using waste as energy sources
- Changing risks and threats to opportunities
- Network cycle
- Recycling and reusing wastewater and greywater
- Smart building
- Sustainable mobility
- Preventive and encourager regulation
- Changing lifestyle
- Focus on business process
- Utilizing new, updated and customized techniques to make the impact of waste on Environment less
• Exploring about side effects of technologies used in order to improve them and achieving sustainable world

(1) High standards to achieve sustainable environment and sustainable development:
  • Consumption of energy
  • Transportation of contaminated and dangerous goods concerned on ADR (road Europe) RID (rail), AND (inland waterways Europe), IMDG (sea), IATA and ICAO (air), o
  • Standards related to environment such as “Technical Inspection Association” TÜV (Deutsch: Technischer Überwachungsverein)

(2) Utilizing taxes to improve sustainable development

(3) SMEs in energy sector

(4) IoB (Internet of Business)

(5) IoM (Internet of Manufacturing)

(6) IoE (Internet of Energy)

(7) Making difference between operation and implementation

(8) Comprehensive management urban plan with sustainable infrastructure and risk mitigation:
  • PRM - Project Risk Management
  • FRM – Financial Risk Management
  • GRM – Govern Mentality Risk Management
  • ERM – Enterprise Risk Management
References:

Feil, A. Schreiber, D. 2017. Sustainability and sustainable development: unraveling overlays and scope of their meanings. Cad. EBAPE.BR. V. 14


Doost Mohammadian, H. Rezaie, F. (2019). Sustainable Innovative Project Management: Response to Improve Livability and Quality of Life: Case Studies: Iran and Germany, Inventions, MDPI, Published: 29 September 2019,


Sustainable urban mobility (Methodology and indicator calculation method for World Business Council for Sustainable Development). Sustainable Mobility Project 2.0 (SMP2.0) Indicators Work Stream - 2ndEdition

Towards Ubiquitous Concept

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1. Waves and Ages

The world has changed through humans’ civilization development and technology enhancement like water and steam power, mass production to information technology during the humanities history. Based on industrial revolution four ages (waves) are declared. Different periods were mentioned for these ages. For instance, according to one theory industry 1.0 was commenced around 1780’s through introduction of water and steam water machine, although the other theory believed that first Wave civilization emerged around 8,000 B.C.

In this book, these ages are declared founded on Alvin Toffler theory.

1.1 The First Wave

The first wave emerged around thousand years ago as a result of the agricultural revaluation. This wave was introduced agricultural wave and industry 1 had happened at end of this age. In this period, everyone made their own products to supply their needs. After a while, people transited to villages from hunting and nomadic life towards creating social culture. This wave maintained until 1650-1750, though agricultural civilization override the planet.

1.2 The Second Wave

The second wave begun in 18th century when mass production played a role as main mean of production. In particular, his revolution introduced railways to the industrial system in order to participate in mass production at large scale. This wave made industry 2 or industrial age. Generally, industrial revolution, mass production, consumption, education, media, corporations, political parties, and a new family structure are main features of this wave.

New era of economy and managerial concept including standardization, specialization, centralization, synchronization, economies of scale and corporations created through mass production. Furthermore, industrial revolution and power machine made urbanization around factories and new way of life.

Fundamentally, wonderful things and fundamental changes happened during this age via its bureaucracy and pyramid power structure. The main development in technology and economy had occurred during this wave are:

- **Steel:**
  
  By 1850s, iron had established, although for many uses steel needed. Therefore, it was needed to make wrought iron to steel. Making cheap steel was the main challenge in that period. The development and growth of steel industry solved this challenge.

- **Chemistry:**
  
  In chemistry field, Germany and Britain were the main leaders. Knowledge science affected production techniques; for instance, modern organic chemistry was created. In addition, new artificial materials were invented like synthetic plastic. Improvement in pharmaceutics such as aspirin was the other outcome of chemistry enhancement in second wave period.
• **Electricity:**
In particular, new knowledge in electricity field was utilized to solve economic challenges through its economic potential. Telegraph was one of the outcome of electricity in communication. The other improvement based on this field was electricity as a prime means of transmitting and energy. Fundamentally, electricity as an industrial power made a huge change on manufacturing productivity.

• **Transportation:**
Transportation systems were improved through applying steam power and this improvement was continued by new power sources like Diesel in 1897. Gas as new source of fuel and development of the airplane are the other outcome of second wave in transportation system.

• **Production Engineering:**
Producing goods and services through fields introduced before; was benefits of second wave.

• **Agriculture and Food Processing:**
Food suppling through production, distribution, preservation, and preparation changed by applying new technologies. Food productivity, improving nutritional deficiencies and manufacturing can food are the main changes happened in agriculture and food processing systems.

• **Household Technology and Human Welfare:**
These improvements made life style be changed. Rising income, more flexible working hour, emerging social insurance, improving nutrition, and eventually enhancing life made better quality of life and welfare for humans. This was the outcome of improving technology and applying it in different industries.

The signal of the third wave had received by the end of World War 2 on mind.

### 1.3 The Third Wave

Advent of the Information Technology at 20th century, created third wave named as post-industrial society. Industry 3.0 had happened in this period. This wave was introduced as information or knowledge age. Besides of information technology, other socio-political issues including individual rights, freedoms, democratization, and internationalization of trade and movements of goods and services played important roles in this wave.

Demassification, de-centralization and consumerism are main concept of third wave. Generally, high-level automation in production changed extremely industry in this age. This wave was based on not labor, capitals, land; but knowledge. This knowledge influenced not only industry, but also marketing information, innovation, management, culture, advanced technology, software, education, training, medical care, and financial services and eventually every aspect of industry, business and life. In other words, this wave influenced on family life, education, employment, and polities as well as industry. In particular, it was required to train people and employees to be aligned with information technology in order to benefit from these changes.

Third Wave civilization was founded on interactive, de-massified, media, feeding extremely diverse and often highly personalized imagery into and out of the mind-stream of the society.
The main features of these age are:

- **New Technologies:**
  Industrial productivity could enhance through applying new technologies such as information technology via computers, data processing, aerospace, sophisticated petrochemicals, semiconductors, advanced communications and etc.

- **Space Industry:**
  Space industry was born through this age. Many companies in the United States and Europe regard the “high frontier” as the source of the next revolution in high technology and are acting accordingly”.

- **Pushing into Sea:**
  It was realized that sea is able to provide treasure and wealth to people; for instance, through ending world hunger via giving protein, providing oil reservoirs and etc.

- **The Gene Industry:**
  Advent and improvement of genetics made a huge change in this wave. Improving the production of food, wood, wool, and other natural goods; growing reserve organs for ourselves, cloning soldiers to do fighting were the main outcomes of genetic in this period.

- **De-massification of the Media:**
  In this age, media wasn’t mass. It was small aimed, specialized and local.

- **Others:**
  Manufacturing based on knowledge-production and information processing, a transformation of democracy, more flexibility in life such as flexibility in working-hour, network economy, changing of corporation and organization behavior based on new era of business are the other main features of third wave.

At the second half of 20th century, improving new technologies and high technologies like digitalization made this era finished and new era was emerged.

1.4 The Forth Wave and Industry 4.0

Fourth wave is introduced digitalization age. Industry 4.0 has been emerging at the second half of the 20th century through digitalization and automatization of every part and manufacturing process of company. This age makes not only huge changes in production, but also in every aspects of life.

Industry 4.0 was introduced by German government. It is founded on technological changes on manufacturing and policy framework for companies in order to be able in market and survive in global competitiveness.

Industry 4.0 was introduced by German government founded on technological changes on manufacturing and policy framework for companies in order to be survived in global competitiveness. In other words, Industry 4.0 is a kind of strategy for German government to support industrial sectors towards their development and making Germany sustainable in machinery
and automotive manufacturing as well as economic and environment. Besides of Germany, Switzerland, Austria (GSA) region, United States and China try to apply Industry 4.0 and IoT in businesses in order to improve businesses performances through creating new business models and cost saving; towards promoting economic situation and making country sustainable.

In particular, Industry 4.0 is about intelligent and smart networking of products and processes that is based on five technology areas: Embedded systems, smart factories, strong networks, cloud computing and IT (Information Technology) security; although Rüßmann et al, realized that industry 4 is founded on 9 different technology areas: automated robots, simulation, horizontal and vertical system integration, industrial IoT, cyber security, cloud-based services, additive production (3D printing), augmented reality, and big data analysis.

Industry 4.0 contains:
1. Factory 4.0
   - Robots
   - Autonomous Vehicle
   - 3D Printing/ Additive Manufacturing
   - Advanced Manufacturing System
   - Sensors
   - Industrial Mobile Devices (Platforms)
   - Nanotechnology and Advanced Materials
2. Cyber Security (Information Security)
3. Software for Data Processing-Big Data-
4. Logistics 4.0
5. Mass Customization
6. Internet of Thing (IoT)
7. High-Quality Team of Employees and Experienced Team of Associates

The main idea of Industry 4.0 is to apply power and potential of these technologies in different categories such as:
- Applying internet and IoT
- Integration of technical processes and business processes in the companies,
- Digital mapping and virtualization of the real world,
- ‘Smart’ factory including ‘smart’ means of industrial production and ‘smart’ products.

Industry 4.0 have several advantages and benefits. The most important ones are:
- Reducing cost including production costs, logistic costs and quality management costs
- Creating more friendly and effective environment
- Sustainable energy management and applying natural resources more sustainable
• Development of new business models and practices towards business productivity, efficiency, revenue growth and better quality of products
• Improving mass production concerned on economically cost
• Improving quality of products
• Improving customer services and products
• Reducing the processes and time of releasing new product to market

Fundamentally, Industry 4.0 could influence not only on businesses, but also on sustainability, quality of livability and life towards creating sustainable countries.

The main challenge of industry 4.0 is about adjusting leaders, managers, entrepreneurs, labors and generally capitals to utilizing new methods and processes based on Industry 4.0 and creating significant changes. To conquer this challenge, education and training play vital roles. In other words, qualified employees and adjusting to new business model and development of new revenue models founded on industry 4.0 are needed to achieve privileges of it.

2. Towards High Technologies

We are living in an era that technologies play important roles in humans’ life. Industry 4.0 era or Society 5.0 that we are in, are founded on these technologies and applying them in different aspects of life.

High technology is about applying advanced scientific research and knowledge, especially which are related to electronics and computers in order to be aligned with humans demands and sustainable development. Fundamentally, high technology is one of the tool utilized to create ubiquitous concept and theory. In this section, three main tools including artificial intelligence, machine learning and robots are noticed.

2.1 Artificial Intelligence

Artificial Intelligence (AI) is about the science making computers and machines be intelligent and be able to learn, judge, performs tasks needing humans’ intelligence such as visual perception, speech recognition, decision-making, and translation between languages and etc. Besides of this definition, there are popular meanings for AI like:

➢ The concept concerned on machines that are able to enhance and do some capabilities and performances done by human intelligence such as learning, adapting, self-correction, etc.
➢ The development of human intelligence via the use of computers and mechanical tools.
➢ The study of techniques to utilize computers and tools more effectively.

Generally, all these definitions focus on think like humans, act like humans, think rationally and act rationally. In other words, AI is about fields founded on these four categories.
An AI system is a machine-based system that is able to do human-defined objectives like making predictions, recommendations or decisions that impacts on or virtual environments. It has three main elements:

- **Sensor:** Collecting raw data from environment is its responsibility.

- **Operational Logic:** It is the key power of an AI system. It provides output founded on inputs created by sensors for the actuators.

- **Actuators:** Outputs are performed by actuators. Recommendations, predictions or decisions influencing the environment are developed.

The history of AI is back to ancient Greek era, that different ideas about humanoid robots haven been existed. However, it is introduced officially in 1956 in a conference of artificial intelligence session at Dartmouth College by McCarthy.

In specific, AI lifecycle consist of four phases such as design, data and modeling including planning and design, data collection and processing, model building and interpretation; verification and validation; deployment; operation and monitoring.

Philosophy, sociology, psychology, computer science, neuron science, biology and maths are the main AI technological domains.

Two different types of AI are declared:

**General AI:** It is about the theory and development of intelligence that comparable to that of the human (and perhaps ultimately well beyond a human’s general intelligence). However, the technology for General AI simply does not exist yet.

- **Spatialized/Narrow AI**

It is about machines or systems which are able to do specific tasks better or quicker than human such as self-driving cars, fraud detection, data analysis, google translate and etc. this kind of AI is a category that is now existed.

There are six factors to achieve success of AI field:

- **Organization and Governance:**
  Organizations founded on skills, capabilities, new path of working and modern governance are required to achieve success of AI.

- **Delivery Model:**
  Development a model based on exploratory analysis, optimization, IT development to support data experimentation is a fundamental tool to gain success of AI.

- **Open Source Platform and Libraries:**
  Utilizing model libraries through advanced AI users and open source platforms by citizens are paths to supply specific needs via AI usage.

- **State of the Art AI Ecosystem:**
  Proper ecosystem consisting AI leaders and breeds such as special solutions, strategies and capabilities could benefit from high technology advantages.

- **IT and Data Infrastructure:**
Strong IT and data infrastructure are fundamental tool to use AI effectively, even the right performance of treatment and computing.

**Target AI Architecture:**
Designing a target AI architecture makes proper situation of AI usage for all.

These days, AI is used in different industries and business domain, ranging from healthcare, finance, manufacturing to education, etc. Diagnosing diseases, education, approaching document for lawyers and others, manufacturing, agriculture, transportation, financial systems, and eventually living make be improved as well as be easier through AI and machine learning. In addition, AI is a tool applied in energy sector in order to improve energy saving and energy efficiency through smart grids, electricity trading, power consumption and etc. Fundamentally, AI could transform economies, achieve productivity gains, improve efficiency and lower costs. So, it could influence on improving livability and quality of human life.

### 2.2 Machine Learning

In recent decades, machine learning has been one of main pillars of information technology and plays important roles in daily humans’ life.

Machine learning is about the science that makes computer learn in order to solve problems instead of human programmed. In other words, ML is about the ability of machine to learn and improve its performances and processes by themselves. Data plays an essential role in machine learning. In addition, learning algorithm is applied to find out and learn science, knowledge and properties through the data. The field focuses on letting algorithms learn from the provided data, collect insights, and make predictions on unanalyzed data based on the gathered information. However, machine learning solely represents a set of methods that able to learn patterns in existing data, thus generating analytical models that can be utilized inside larger IT artifacts.

Supervised learning, unsupervised learning, semi-supervised learning and reinforcement learning are different techniques of machine learning:

- **Supervised Machine Learning Algorithms:**
  It is based on finding out the relationships between the feature set and the label set, which is the knowledge and properties we can learn from labeled dataset.

- **Unsupervised Machine Learning Algorithms:**
  clustering, probability density estimation, finding association among features, and dimensionality reduction are the main targets of unsupervised machine learning. It is able to learn more than of properties that is mentioned simultaneously.

- **Reinforcement Machine Learning Algorithms:**
  Reinforcement learning is used to solve problems of decision making (usually a sequence of decisions), such as robot perception and movement, automatic chess player, and automatic vehicle driving.

Besides of these three keys, semi-supervised learning is the fourth ley of machine learning that has been popular recently. It contains both labeled and unlabeled data, and eventually
learns knowledge through data. Therefore, its definition is between supervised and unsupervised learning.

Machine learning contains three sections:

1. The computational algorithm at the core of making determinations.
2. Variables and features that make up the decision.
3. Base knowledge for which the answer is known that enables (trains) the system to learn

The main disciplines contributed to machine learning are:

- **Statics:**

A long-standing problem in statistics is how best to use samples drawn from unknown probability distributions to help decide from which distribution some new sample is drawn. A related problem is how to estimate the value of an unknown function at a new point given the values of this function at a set of sample points. Statistical methods for dealing with these problems can be considered instances of machine learning because the decision and estimation rules depend on a corpus of samples drawn from the problem environment.

- **Brain Models:**

Brain modelers are concerned on how networks approximate the learning phenomena of living brains.

- **Adaptive Control Theory:**

Control theorists is about studying of problem of process controlling that have unknown parameters and need to be calculated during operation.

- **Psychological Models:**

Psychologists have studied the performance of humans in various learning tasks. An early example is the EPAM network for storing and retrieving one member of a pair of words when given another.

- **Evolutionary Models:**

Since the distinction between evolving and learning can be blurred in computer systems, techniques that model certain aspects of biological evolution have been proposed as learning methods to improve the performance of computer programs.

Machine learning is applied as a tool to deal with business challenges. In particular, it is used in businesses to improve client's experience. Manufacturing, retail, healthcare and life sciences, travel and hospitality, financial services and energy are the main cases utilized ML to improve their performances.

Based on Data Corporation Global Development Survey, machine learning applications created in the areas such as:

- Internet of Things (11.4% of the total)
- Professional, Scientific and Technical Services (10%)
- Manufacturing industries (9.4%)
- Telecommunications (8.3%)
• Utilities / energy (8.1%)
• Robotics (7.2%)
• Finance / insurance (6.8%)

2.3 Robotics

Since mid-20th century, the research and robotic development has emerged through industrial environment that using machine instead of humans are attractive. Basically, robots are applied for works and tasks that are too dirty, dangerous or distant whether are done by humans.

Robotic is about science or studying of robot technology to do humans’ tasks such as dynamic system modeling and analysis, mathematics, physics, biology, mechanical engineering, electrical and electronic engineering, computer science and engineering, and automation (sensors, control, and actuators) technology.

The word robot is derived from Czech word pa6oTa (robata) that means work or labor in Russian.

In particular, the development of robotic technology is based on automation-watchmaking and applying innovation in industrial machinery.

The history of robotic came from ancient Greek and at the 20th century, the modern term of robotic has emerged and developed. At 1920, the Capek brothers introduced the term of robot founded on modern language. Between 1938 and 1942, Isaac Asimov published a story to introduce three features of fictional robot behavior:

1. A robot may not injure a human being or through inaction allow a human to come to harm.
2. A robot must obey orders given it by humans except when doing so conflicts with the first law.
3. A robot must protect its own existence as long as this does not conflict with the first or second law.

Based on his views, the difference between humans and robots are being intelligence and non-intelligence.

Eventually, in 1958 the evaluation of fictional robot to real one was occurred by General Motors in automobile production. In 1961, applying of robotics in assembling line in industry was the first usage of robotics in real world. Since 1980’s this science has developed and utilized in different industries to do several humans’ tasks which are too dirty, dangerous or distant to be done by humans. Robots could be active, semi active or passive. Active devices are programmable and could do tasks independently. Semi active devices and passive robotic devices translate movements from an operator’s or surgeon’s hands into powered or unpowered movements of the robot end-effector arms.

The most important challenges in robotic are about high-dimensional, continuous states and actions. It could be solved by proper algorithms. Fundamentally, learning play significant role in robotic research and development. Machine learning algorithms could influence on enabling robots to teach themselves as well as tackling challenges confronted with. Machine learning is
applied in different areas of robotics like Robot vision, Robot navigation, field Robotics, humanoid Robotics, legged locomotion, off-road rough-terrain mobile Robot navigation, modeling vehicle dynamics, medical and surgery Robotics to do their tasks efficiently. In specific, machine learning has vital roles in robotic development. The advanced concept of machine learning plus optimization has been recently reported effective for developing learning systems.

Three main reasons are introduced for increasing utilizing robots in recent years:

- Robots are less expensive than humans
- Robots are more capable than humans
- Based on growing of manufactured goods, robots are good tools to be a leader in manufacturing

Robots are used in different industries such as agriculture, automobile, construction, laboratories, manufacturing, military, transportation, law enforcement and warehouses in order to do tasks in better path. In addition, robots will be used in service sectors like health care, transportation, hospitality and etc.

Fundamentally, utilizing robots make a transformation in businesses through their privileges such as:

- Save cost of exposition
- Improving product quality
- Promoting work environment quality
- Raise the production output level
- Make product manufacturing more flexible
- Intensify the yield and waste reduction
- Make safety workplace
- Reducing employee turnover
- Reduce capital costs
- Standard size for operation with maximum utilization
- Saving energy
- Improving innovation of technology
- Developing new businesses
- Improving issues related to human labor
The below table shows the most important advantages and disadvantages usage of robotic:

<table>
<thead>
<tr>
<th><strong>Advantages</strong></th>
<th><strong>Disadvantages</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased flexibility</td>
<td>Cost</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Expense</td>
</tr>
<tr>
<td>Minimizing errors</td>
<td>Loss of haptic perception, with risk of iatrogenic</td>
</tr>
<tr>
<td></td>
<td>injuries</td>
</tr>
<tr>
<td>Efficiency</td>
<td>Lack of trocar versatility, greater size and number</td>
</tr>
<tr>
<td></td>
<td>of ports</td>
</tr>
<tr>
<td>Improve product quality</td>
<td>Unavailability of sealing devices</td>
</tr>
<tr>
<td>Reducing operator cost</td>
<td>Difficult intestinal mobilization</td>
</tr>
<tr>
<td>Improved ergonomics</td>
<td>Laborious omentectomy</td>
</tr>
<tr>
<td>for surgeon</td>
<td></td>
</tr>
<tr>
<td>Increase productivity</td>
<td>Technical problems in obese patients</td>
</tr>
<tr>
<td>Reduce capital cost</td>
<td>Constrained operating field in retroperitoneal access</td>
</tr>
<tr>
<td>Reduce labor turnover</td>
<td>Safety issues</td>
</tr>
<tr>
<td>Repeatedly</td>
<td>Return on investment</td>
</tr>
</tbody>
</table>

**Table 1: Advantages and Disadvantages of Robotic (Adopted from References)**

3. **Towards Ubiquitous Energy**

In this section, new concepts such as virtual-reality, smartness, digitalization, ubiquitous created through high technologies are declared. Fundamentally, these could be used as techniques to achieve sustainable development which is introduced as a solution to maintain the world for future generations and improve livability and quality of life for present generation.

3.1 **Virtual Reality**

Virtual Reality (VR) is now existed everywhere and utilized by everyone. It has been existed since late 1960s in a name such as synthetic environment, cyberspace, artificial reality, simulator technology and etc. This field has become popular among public and developed at late 1980s. in 1990s, the research about VR had continued and the appearance of films such as The Lawnmower Man influenced on developing of VR. In particular, VR has become popular and usable since 1990s. In future, VR via technology enhancement could be developed as well as being cheap and high quality to become more popular and usable more than present.

Virtual reality (VR) is about technology that allows a user to collaborate in computer-simulated environment based on real world or imaginary world. VR is a path to feel and touch past, present and future. In particular, success of VR depends on setting realistic expectations for technology and technology enhancement.

VR is founded on hardware components including computer workstation, sensory displays, process acceleration cards, tracking system and input devices and software components consisting of 3D modeling software, 2D graphics software, digital sound editing software and VR simulation software.
The three dimensionality of VR immersion, presence and interactivity make VR different from representational technology. Virtual reality does not imitate real reality, nor does it have a representational function.

Basically, virtual reality (VR) and virtual environment (VE) are used interchangeably as VR is related to associated unrealistic expectations, many people especially researchers use VE instead of VR.

Fundamentally, VR are applied in several industries, services such as car design, robot design, medicine, chemistry, biology, education, building design, construction and so on. The below table presents diverse fields that VR is applied:

| Military Application | • Utilizing different solutions concerned on VR such as virtual boot camp, flight simulation, battlefield simulation, medic training on the battlefield
|                      | • Applying VR in military helps soldiers to be ready in dangerous situation. |
|Commercial, service and Industry Applications | • Utilizing VR in engineering like architecture, designing and etc.,
|                      | • Applying virtual manufacturing system in different industries
|                      | • Virtual prototyping in design evaluation
|                      | • Applying VR in layout planning, inspection, machining and so on
|                      | • Utilizing VR in industries and commercial services in order to reduce cost, time, improving efficiency and productivity |
|Health and Medicine | • Improving health condition through VR technology for training, using VR as a path of therapy and so on.
|                      | • Improving medicine field by docking of molecules applying visual and auditory displays |
|Business | • In business VR play in different ways like marketing, virtual tour of business environment, training new employees, using technologies in processes and so on. |
|Entertainment | • Influencing VR on video games, computers, films, immersive cinema and so on as an entertainment tool |
|Education: | • Enhancing and expanding education especially vocational training through VR education
|                      | • Developing distance and virtual learning
|                      | • Creating new era of education path and life-long path through VR in future |
|Wealth | • Promoting social interaction or social connectedness, for instance utilizing VR services for adults or whom face loss and limitations in mobility, cognitive ability, socialization and so on.
|                      | • Improving social and emotional well-being towards better quality of life |
|Text-Based VR | • Creating Virtual world to have better quality of life |

Table 2: Diverse applications of VR in a variety of fields (Mathew, 2014)
The most important challenges about virtual reality are to find out better tracking systems, realizing ways to make interacting in virtual environment simpler and more popular, reducing the time and processes concerning on building virtual spaces. It is required to apply technology to create virtual world and environment that making more realistic environment needs more time. In particular, challenges concerned on VR could be categorized in two groups:

a) **Technical Challenges:**

- All features or functions of virtual environment can only be streamed by streaming all data to the user live over the Internet with minimal local caching of frequently used data.
- Due to the proprietary communications protocols, it is impossible to make use of a network proxy or caching service to minimize network load when many people are all using the same location.
- New and modern technologies need much cost that small and medium scaled people and businesses couldn’t afford it.
- As technologies are growing fast, citizens and people should aware of them and being aligned with high rate of growth to able to utilize the. However, people aren’t aware of developing high technologies and this make them not to able apply high technologies in proper path.
- Making safe and sustained virtual environment are needed that requires processes, functions and high cost.
- High powerful computers and systems with powerful processes are needed.

b) **Cultural Challenges:**

- Liability is one of main cultural issues that needs to be provided.
- Unsolved legal issues like virtual violence, sexual harassment, virtual assault is one of main cultural challenges of using VR in different fields.
- Many laws breaker and criminal activities such as money laundering, sexual harassment, exchanging of child abuse environment and terrorist attack occur on virtual environment.
- Inventory loss issues is still present; inventory loss in which items in users inventory including those things which have been paid for can disappear without warning or enter a state where they will fail to enter in a world when requested.
Fundamentally, development of VR influences on not only industries and all businesses, but also impacts on daily life. It could be used as a technique to improve quality of human life and livability. Basically, VR has advantages and disadvantages that is presented in below figure:

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactivity</td>
<td>Difficult to develop</td>
</tr>
<tr>
<td>Repeatable</td>
<td>Technical challenges</td>
</tr>
<tr>
<td>Unique</td>
<td>Cultural challenges</td>
</tr>
<tr>
<td>Accessible</td>
<td>Lack of flexibility and functionality issues</td>
</tr>
<tr>
<td>Improving efficiency and productivity of businesses towards economic sustainability</td>
<td>High awareness, knowledge and expert in VR to be able to apply them in different fields</td>
</tr>
<tr>
<td>Social Well-being and social sustainability</td>
<td>Health challenges like dizziness and disorientation</td>
</tr>
<tr>
<td>Improving industries, manufacturing and businesses</td>
<td>Training and education obstacles</td>
</tr>
<tr>
<td>Economic sustainability</td>
<td>Security challenges</td>
</tr>
<tr>
<td>Reducing environmental concerns</td>
<td></td>
</tr>
<tr>
<td>Improving quality of livability and life</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Advantages and Disadvantages of VR (Adopted from References)
3.2 Digitalization

Digitalization has been one of issues that could influence on changing society, life and businesses in present and near future. We are living in an era that digitalization could be used as technique not only would make changes in way that we live, but also could develop sustainability. Digitalization has emerged since end of the 20th century and these days are one of controversial issues as a technique to make the world as a better place for living through changing society, economic and environment.

Digitalization reflects the adoption of digital technologies in business and society as well as the associated changes in the connectivity of individuals, organizations, and object. In other words, digitalization focus on applying of connectivity and networking of digital technologies to improve businesses, services, manufacturing, trade between people and eventually life.

Digitalization is about process and networking of digitizing and making digital data. Digitalization is introduced as “the changes associated with the application of digital technology in all aspects of human society”. Also, digitalization is concerned on transforming products and services to digital ones in order to gain advantages like productivity and efficiency. In particular, when we talk about digitalization, three areas are concerned on:

1. Digitization: where the analog items are converted into digital versions (i.e. electronic version of paper documents);
2. Digitalization: where digital technologies are used to change business models, create revenue, improve business and value-producing opportunities; and
3. Digital transformation: where digital technologies are applied to change old aspects.

Generally, third, fourth ages and improving technology influence directly and indirectly on developing and growing of digitalization. AI, machine learning, robotic as well as Industry 4.0, ICT, IT, IoT and so on (these technologies based on internet will be introduced in following context) could be utilized as techniques to advance digitalization. According to these techniques, definitions are declared for digitalization that below tables presents them:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gardner glos-</td>
<td>Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business.</td>
</tr>
<tr>
<td>sary, 2018</td>
<td></td>
</tr>
<tr>
<td>Globe, 2018</td>
<td>Digitalization is the straightforward process of converting analog information to digital. Digitalization refers to the use of digital technology, and probably digitalized information, to create and harvest value in new ways.</td>
</tr>
<tr>
<td>I-scoop.eu,2018</td>
<td>Digitalization means turning interactions, communications, business functions and business models into (more)digital ones which often boils down to a mix of digital and physical as in omnichannel customer service, integrated marketing or smart manufacturing with a mix of autonomous, semi-autonomous and manual operations.</td>
</tr>
</tbody>
</table>
Industry 4.0 is being encouraged by the introduction of digital technologies that push the specialization of the value chain and also connectivity between actors. Industry 4.0 heralds greater operational efficiency and development of new products, services and business models.

Digitalization is the innovation of business models and processes that exploit digital opportunities.

Digitalization (i.e., the process of converting analogue data into digital data sets) is the framework for digitalization, which is defined as the exploitation of digital opportunities. Digitalization by means of combining different technologies (e.g., cloud technologies, sensors, big data, 3D printing) opens unforeseen possibilities and offers the potential to create radically new products, services and BM.

<table>
<thead>
<tr>
<th>Author</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luz Martin-Pena et al., 2018</td>
<td>Industry 4.0 is being encouraged by the introduction of digital technologies that push the specialization of the value chain and also connectivity between actors. Industry 4.0 heralds greater operational efficiency and development of new products, services and business models.</td>
</tr>
<tr>
<td>MITSloan Management Review, 2018</td>
<td>Digitalization is the innovation of business models and processes that exploit digital opportunities.</td>
</tr>
<tr>
<td>Rachinger et al., 2018</td>
<td>Digitalization (i.e., the process of converting analogue data into digital data sets) is the framework for digitalization, which is defined as the exploitation of digital opportunities. Digitalization by means of combining different technologies (e.g., cloud technologies, sensors, big data, 3D printing) opens unforeseen possibilities and offers the potential to create radically new products, services and BM.</td>
</tr>
</tbody>
</table>

Table 4: Definitions of Digitalization (Parida and et al., 2018)

Digitalization has four main stages:

1. **Planning Processes including:**
   - Recognition material that could be digitized and rights concerning thereto
   - Recognition of required and proper resources
   - Selection and making decisions on standards
   - Identifying and defining of methods and evaluating timing
   - Assessment and anticipating of current and upcoming risks and challenges

2. **Pre-digitalization Processes including:**
   - Selecting the materials to be digitized
   - Controlling quality of objects that would be digitized
   - Prioritization of digitization
   - Identifying required treatments or possible ones
   - Selecting of metadata
   - Bibliographic and archival preparation.

3. **Digital conversion including:**
   - Digitization
   - Providing required and professional equipment
   - Quality control
   - The creation of digital masters from which access copies are made

4. **Post-digitalization processes including:**
   - Control of metadata concerned on long-term protection
- Submission of information to delivery and repository systems, data collection and management
- Making digitized copies and metadata available online
- Evaluating the project
- Quality control

Digitalization is changing the society through increasing utilizing of digital technologies in every aspects of lives including businesses, industries, manufacturing, services and so on. In means that digital technologies change all business aspects and humans' life. In addition, digitalization could reduce environmental concerns through digital transportation, manufacturing and etc. Therefore, digitalization is able to impact on all aspects of sustainability including environment, social and economic. Fundamentally, the main benefit of digitalization is that it could be a technique to achieve sustainable development. Digital society and economy could influence on creating sustainable economy and society towards sustainable development. In other words, more digitalized societies are able to perform better in acquiring sustainability goals. Furthermore, digitalization could make unparallel opportunities to promote human existence. The main fields that digitalization is used as path to develop sustainability and give opportunity access for better life for humans are:

- Digital environment, the energy transition, resource efficiency and "green technologies"
- Digital businesses towards sustainable economic
- Applying digitalization in labor market and social welfare
- Digital manufacturing to reduce time and cost with high efficiency and productivity
- Digital construction
- Digital services like banking, shopping and etc.
- Digital education
- Digital consumption
- Health services based on digitalization
- Mobility concerned on digitalization
- Eventually, digitalization towards smart cities and services

Fundamentally, digital transformation could influence on every aspect of life and sustainability that is presented in below figure:
Improving technologies, innovation, enabling digital infrastructure, online services, digital services to increase efficiency of resource use, productivity and sustainability, processes and services based on digital infrastructure and analytical packages for exploration and monitoring are main principals of digital transformation.

Although digitalization makes privileges, there are challenges related to enhancing and applying digitalization. The most important ones are:

- **Cost**: High cost of digitalization makes challenges for users and many companies couldn’t afford digitalization cost.
- **Security Challenges**: Secure and safe digital environment needs to deal with secure and privacy risks in order to protect data.
- **Competitive Threats**: Digital services such as digital models, digital advertising and so on applied by competitors are significant threats for businesses. Therefore, each business requires to anticipate digital services used by its competitors to utilize superior digitally enabled products and services.
- **Time**: One of main challenges is about proper time to apply digital services and products. The delay to start of digitalization make competitors and new entrances to able to surpass in market.
- **Technology Barriers**: Technologies like AI, Robotic, ML, ICT, IoE and so on are needed to achieve digitalization.
- **Education**: Education and training are fundamental challenges of digitalization. In particular, expert and knowledgeable labors are required to aware of digitalization and techniques developed it in order to able to apply digitalization in proper path.
- **High Speed in Growing of Digitalization**: Rapid growth of high technologies and digitalization make challenges for experts, citizens and so on be aligned with.
- **Overestimation of Internal Capabilities**: Overestimation of internal capabilities to undertake the digital transformation is a challenge concerned on digitalization.
• Proper Governance Strategies: Each government is responsible to choose and create proper governance strategies founded on its culture, costumes, norms and economic needs to benefit from digitalization privileges.

Fundamentally, digitalization could be influence on economy, social, environment and eventually every aspects of life in order to achieve sustainable development towards high quality of life and livability. Therefore, it could be one of controversial and significant issues that is required for sustainability.

3.3 Smartness

Smartness, being smart, smart world, smart citizens, smart cities and so on are controversial phenomena these days. Smart is defined as “the quality of being intelligent, or able to think quickly or intelligently in difficult situations” by Cambridge.

Smart and smartness are phenomena that has been applied and used in recent decades. Technologies make life, services, manufacturing, products and so on, be filled with intelligence, sensing and communication abilities that creates smartness in these objects. Context aware, pro activity, self-organized and being intelligence based on high technologies are the main features of smartness.

Intelligence is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test taking smarts. Rather it reflects a broader and deeper capability for comprehending our surroundings—“catching on,” “making sense” of things, or “figuring out” what to do. Therefore, smartness as a technique towards being intelligence could make proper condition in different aspects of lives and fields of businesses towards living smart.

Smartness is about changing traditional networks and services more flexible, efficient and sustainable through applying high technologies especially information and telecommunication technologies and digitalization in order to improve processes, functions and operation for benefit of its inhabitants. Fundamentally, smartness could make context be aligned and facilitated with rapid citizens’ demands, modern needs and improve processes, functions and operation in order to enhance citizens’ satisfaction and quality of life.

Based on authors’ view, smartness makes smart cities through applying technologies and digitalization. Smart city is founded on smart services and smart life including smart industry, smart manufacturing, smart agriculture and aquaculture, smart material and fabric, smart environment and ecosystem, smart earth, smart grid and energy, smart logistics and retail, smart building and structure, smart roads and transportation, smart vehicles and networks, smart machine and robots, smart homes, smart appliances and goods, smart wearables and implants, smart medicine and hearth care, smart elderly and kiddy care, smart foods and living, smart learning and education, smart management especially smart energy management, smart technologies, smart communications and smart people. In addition, intelligence decision making plays important role in creating smart cities. Smart economy, smart transportation, smart environment, smart society, smart governance, smart people and eventually smart living make a cycle to create smart city.
Based on several resources and researches, different keys are required to design smart city. These are illustrated in below table:

<table>
<thead>
<tr>
<th>Source</th>
<th>Key Dimensions of a Smart City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mahizhnan, 1999</td>
<td>IT Education&lt;br&gt;IT Infrastructure&lt;br&gt;IT Economy&lt;br&gt;Quality of Life</td>
</tr>
<tr>
<td>Giffinger et al., 2007</td>
<td>Economy&lt;br&gt;Mobility&lt;br&gt;Environment&lt;br&gt;People&lt;br&gt;Governance</td>
</tr>
<tr>
<td>Eger, 2009</td>
<td>Technology&lt;br&gt;Economic Development&lt;br&gt;Job Growth&lt;br&gt;Increased Quality of Life</td>
</tr>
<tr>
<td>Thuzar, 2011</td>
<td>Quality of Life&lt;br&gt;Sustainable Economic Development&lt;br&gt;Management of Natural Resources through Participatory Policies&lt;br&gt;Convergence of Economic, Social, and Environmental Goals</td>
</tr>
<tr>
<td>Nam and Pardo, 2011</td>
<td>Economic Socio-Political Issues of the City&lt;br&gt;Economic- Technical-Social Issues of the Environment&lt;br&gt;Interconnection&lt;br&gt;Instrumentation&lt;br&gt;Integration&lt;br&gt;Applications&lt;br&gt;Innovations</td>
</tr>
<tr>
<td>Barrionuevo et al., 2012</td>
<td>Economic (GDP, Sector Strength, International Transactions, Foreign Investment)&lt;br&gt;Human (Talent, Innovation, Creativity, Education)&lt;br&gt;Social (Traditions, Habits, Religions, Families)&lt;br&gt;Environmental (Energy Policies, Waste and Water Management, Landscape)&lt;br&gt;Institutional (Civic Engagement, Administrative Authority, Elections)</td>
</tr>
<tr>
<td>Kourtit and Nijkamp, 2012</td>
<td>Human Capital (e.g. Skilled Labor Force)&lt;br&gt;Infrastructural Capital (e.g. High-Tech Communication Facilities)&lt;br&gt;Social Capital (e.g. Intense and Open network linkages)&lt;br&gt;Entrepreneurial Capital (e.g. Creative and Risk-Taking Business Activities)</td>
</tr>
<tr>
<td>Chourabi et al., 2012</td>
<td>Management and Organizations&lt;br&gt;Technology&lt;br&gt;Governance&lt;br&gt;Policy Context&lt;br&gt;People and Communication&lt;br&gt;Economy&lt;br&gt;Built Infrastructure&lt;br&gt;Natural Environment</td>
</tr>
</tbody>
</table>

Table 5: Key Dimension of Smart City  
(Albino and et al., 2015)
Smart cities are forward-looking, progressive and resource-efficient while providing at the same time a high quality of life. They promote social and technological innovations and link existing infrastructures. They incorporate new energy, traffic and transport concepts that go easy on the environment. Their focus is on new forms of governance and public participation. Smart cities create urban settings with features such as:

- City’s network infrastructure that enables political efficiency and social and cultural development
- Applying smartness and high technologies in all aspects of living and businesses towards smart strategic urban plan
- Focus on business-led as towards urban development and innovative and smart strategies, policies, solutions and actives to improve urban growth and development
- Focus on social inclusion and social capital in urban development
- Emphasis on green environment as a fundamental tool for future

Fundamentally, smart city makes sustainability, efficiency, high quality of life and smartness in urban settings. In particular, smart cities create smart world that could improve everyday things with abilities of sensation, communication, computation and intelligence so that many tasks and processes could be simplified, more efficient and productive. Smart world is able to tackle global challenges and make the world as a better place for living through smartness, high technologies and developing sustainability.

3.4 Technologies Based on Internet and Information

Besides of digitalization, technologies based on internet and information including IT (Information Technology), ICT (Information and Communication Technology), IoT (Internet of Things) and IoE (Internet of Energy) play significant roles in new concept like ubiquitous and even digitalization. In other words, these technologies help us to be digitalized, smart and ubiquitous besides of AI, ML and robotics.

In particular, these technologies make significant changes in energy management that is the main issue in this book. So, these are declared in this section:

- **Information Technology (IT):**

Information technology was evolved officially in 1970s, however in World War 2 had been emerged and applied. After 1940s, many researches, investigation and development had been done to progress their funding to able to utilize information technology in services and eventually replace manpower with Machin power.

IT is a technology which applies computers to gather, process, store, protect, and transfer information. In specific, the Information Technology Association of America defined information technology as "the study, design, development, application, implementation, support or management of computer-based information systems".

Information is about processing data processed for some specific purpose. In addition, information is kind of communication applied to make knowledge for the person whom receive it.
In IT science, information is processed by computer that hardware, software and human being are the main components of a computer.

Furthermore, transferring information is done by networks including Local Area Network (LAN), Wide Area Network (WAN), Internet, Intranet, Extranet, World Wide Web (WWW) and other services based on Internet.

IT has the ability to lower coordination cost without increasing the associated transactions risk, leading to more outsourcing and less vertically integrated firms.

These days, applying information and communications technology (ICT) is more common than IT, because ICT is a kind of technology working on a computer which is not connected to the network. Therefore, ICT in following text is declared comprehensively.

- **Information and Communication Technology (ICT):**

  Information and Communication Technology (ICT) is an extended context of IT that is based on providing accesses to information via telecommunication. ICT is about all computer-based advanced technologies to control, manage, communicate and transfer information. ICT includes all communication devices and applications like radio, television, cellular phones, computer and network hardware and software, and satellite systems, even the various services and applications associated with them, such as videoconferencing and distance learning. Generally, ICT is about the digital processing and applying information to manage, store, retrieve and transfer information by electronic computers.

  As information is the center of social, economic, political and environmental activities, ICT could influence on all aspects of life and make significant changes in society. In addition, it is a tool to meet the demand of today’s citizens. ICT is a powerful technique that could be utilized in different businesses and services including medicine, healthcare, manufacturing, industry, urban planning, transportation, education and learning, finance, public management, energy production and so on, to improve their productivity, efficiency and processes as well as developing sustainability. So, ICT has a great impact on country situation, sustainability and quality of citizens’ life. The main advantages of ICT are: reducing poverty, improving education situation through global education, promoting gender equality, empowering women, improving health conditions, enhancing businesses, creating successful businesses with high productivity and efficiency, improving economic sustainability, reducing environmental risks, improving social instability, achieving sustainable development and creating areas with better quality of life. Fundamentally, ICT is a tool to deal with global challenges, making better quality of livability and livability for humans. Therefore, it has to be utilized in different services and aspects of life that not only societies, but also the world could benefit from its advantages.

  There are challenges that make applying of ICT in different services hard. The most important ones are:

  - **Human Resources:**

    Knowledgeable and expert capitals who are able to use ICT in different businesses, governance and urban plan are required to benefit from ICT’s advantages. In addition, citizens and people who are aware of ICT and be open to using it, would play important role in manipulating ICT.
• Technical Challenges:

Technical infrastructures, especially electricity and communication networks, proper hardware and software for availability, proper infrastructure for dealing with cyber-attacks and affordability, accessibility of ICT and so on, are the main technical challenges that need to be solved to benefit from usage of ICT in better path with more efficiency and productivity. Furthermore, technical challenges are main barriers for applying ICT in different businesses and services.

• Legal Issues:

Developing countries do not have proper and necessary rules to apply and utilize technology-related issues. Late adopting to technology is the main reason for lacking of legislation. Privacy, content ownership, security breaches, and so on are the main challenges related to legal phenomena.

Fundamentally, ICT is a path to reduce global challenges, achieve sustainable development and improve quality of life. So, it is needed to apply in various businesses and services to benefit from its privileges.

➢ Internet of Thing (IoT):

Internet of Thing in 1999 was used by Kevin Ashton for the first time. He invented the term to clarify the rule of joining Radio Frequency Identification (RFID) docketts, applied in businesses for supply chain performances to gain better productivity and efficiency, to the Internet in the context of tracking and counting products without any intervention from human; and these days it has been applied in ubiquitous communication, cloud computing, data analytic and so on.

Internet of Thing is a new version of ICT founded on interrelating embedded systems through sensors and electronic applications. The words “Internet” and “Things” mean an inter-connected world-wide network based on sensors, communication, networking, and information processing technologies.

Enabling things to be connected anytime, at anywhere; with anything and anyone through any path/network and any service is the main target of IoT that could influence on various businesses and services.

Although IoT has many advantages like energy consumption, reducing time, money saving, developing smart services and all advantages that ICT has, there are challenges that applying of IoT difficult. The main challenges in this area are: high cost for specific components, data management, interoperability, technical challenges like proper technology infrastructure, sensors and so on, security challenges, data management, education barriers to train knowledgeable and expert capitals who are aware of IoT to apply in different services and etc. Fundamentally, these challenges are significant threats for IoT usage. It is required to deal with these challenges to be able to apply IoT to benefit from its privileges.

IoT could transform the way we live today through creating intelligent and smart services, businesses, daily tasks and chores. IoT is able to make smart and intelligent services like smart building, smart transportation, smart infrastructure, smart businesses, smart life and so on towards designing smart city that could improve sustainability. Therefore, IoT is a fundamental tool not only to improve environmental and economic sustainability, but also to develop sustainability and create smart and sustainable city.
Internet of Things is a new revolution of the Internet that could achieve sustainable development in society and the world in order to improve quality of life in living areas.

**Internet of Energy (IoE):**

At the end of 20th century Internet of Energy has emerged in order to improve energy issues concerned on energy consumption to energy challenges including reducing greenhouse gas emissions, waste energy, depletion of natural resources, usage of fossil fuels, sustainable energy management, utilizing renewable and clean energy, making renewable resources, environmental changes and etc.

IoE makes changes in energy issues including sources, loads, developing clean energy, renewable energy, plugging in electric vehicles and so on. IoE is about utilizing electricity infrastructure, making energy production cleaner and more efficient, causing more power in the hands of the consumer. IoE is founded on dynamic network connecting the energy network to internet in order to improve energy efficiency and being environmentally friendly.

Fundamentally, improving energy efficiency, creating and applying of renewable energies, saving energy and money, optimizing time processes, making new resources for renewable energy like waste as an energy, promoting businesses’ processes, efficiency and productivity are the main advantages of IoE usage. These benefits could improve environmental sustainability and economical sustainability as well as social sustainability. therefore, it could help businesses and societies to be more sustainable. In particular, energy and the combination of energy with information and communication technology could influence on efficiency and productivity of the businesses, even costumers and the World through its opportunities and privileges.

To be able to apply IoE and benefit from its advantages, it is needed to tackle IoE challenges. The main challenges are:

- **Technical challenges:**
  IoE is founded on complex networks like smart grid, sensors etc. and involving decentralized monitoring and control. So, technical sustainability, technological development and proper infrastructure based on IoE environment are required to able to adopt to IoE requirement and progress it in right path.

- **Human Capitals:**
  To utilize IoE in proper path, capitals, expert and eventually citizens paly important roles. Therefore, education and training could influence on efficiency of IoE as well as utilizing IoE in proper way through organizations. Besides of education, applied science and vocational training (IoE- Education A-AV) are required to train proper leaders, managers, developers and labors to be aware of IoE and its usages towards sustainable energy management.

- **Privacy and Security Challenges:**
  The secure connection among people, processes, data and things, privacy and protecting are required to gain successfulness in IoE. This phenomenon hasn’t been progressed and developed completely. It is needed to improve security issues in high technology services like IoE to be able to apply them in different processes and performance of SMEs.

- **Business Model Challenges:**
Transition of old model to new business models founded on IoE and high technologies are needed. Therefore, new business models like hybrid, agile and etc., knowledgeable and expert capitals, new processes are required that make businesses not willing to utilize such technologies.

IoE is a fundamental tool to improve energy challenges and achieve sustainable development.

4. Ubiquitous

In this section, ubiquitous concept and ubiquitous city are declared. Previous sectors presented techniques such as digitalization, high technologies and so on that influence on creating and developing ubiquitous concept. In following context, ubiquitous concept towards ubiquitous city are declared.

Fundamentally, ubiquitous city through its services and features could be a path to develop proper energy management towards sustainable development. Therefore, it is needed to mention in this book.

4.1 Ubiquitous Concept

Ubiquitous is derived from the noun ubiquity, meaning omnipresent or being presence everywhere or in many places at the same time.

For the first time in late 16th century, ubiquitous emerged in print and in 1830 it officially appeared. In addition, iniquitousness appeared around 1874.

Ubiquitous concerned on overstating for things and people that seem to turn up everywhere, has been more popular than ubiquity.

Ubiquitous service is based on electronic device capable of using wireless, Internet, and other networking capabilities that are so pervasively embedded in the environment that the devices can be used virtually anywhere and anytime. As computer power and technology communication could influence on several areas ranging from industrial to private sector, ubiquitous concept is able to change all aspects of life that make new city infrastructure.

Artificial Intelligence, Virtual Reality, Robotic and digitalization founded on high technologies play significant roles on developing and growing of ubiquitous concept to design ubiquitous computing and cities. Ubiquitous solutions are utilized to realize path and strategies towards integrating information technology into everyday life devices and activities in order to design more sustainable and livable urban areas.

In particular, ubiquitous cities based on ubiquitous computing and services could be solution to design modern urban areas align with growing urbanization and citizens’ demands, even deal with urbanization challenges. For instance, South Korea is applied ubiquitous concept as a path to redesign its cities that are able to make high quality of livability and life in urban areas.

Generally, ubiquitous is an eastern idea that is similar to western concept named digitalization. In other words, ubiquitous could be introduced as a concept is similar to digitalization idea that is developed in the proceeding of digitalization.
Ubiquitous computing, ubiquitous management and ubiquitous city including different ubiquitous services are the main phenomena concerned on ubiquitous concept that influence on humans’ life and sustainability. These issues will be declared in the following context.

4.2 Ubiquitous Computing

In early 1990s, Mark Weiser introduced the concept of Ubiquitous Computing that make the world as a place where computing devices could be available in objects, environment and humans being by themselves. He introduced Ubiquitous Computing project at the Xerox Palo Alto Research Centre in the US. He provides a vision of a built environment which digital networks link individual residents not only to other people but also to goods and services whenever and wherever they need.

His concept is about that world could be disappeared into the context and be hidden for users through applying technologies. According to this concept, transforming position has three dominants at the time: virtual reality, artificial intelligence, and user agents.

At the next decade, Mahadev Satyanarayanan wrote an article named Pervasive computing: vision and challenges in the following of Weiser concept. Fundamentally, improvement of technologies and integration of them make ubiquitous services be developed, improved and grown.

Ubiquitous computing is concerned on “everything, always, everywhere” for data processing and transmission through the ubiquity of ICT systems.

The main characters of ubiquitous computing are:

- **Embeddedness**: Small intelligent devices are embedded in the physical world and connected to the fixed and/or wireless network.
- **User Model**: It is required to be aware of users in order to organize applications concerned on user characters. Therefore, user model founded on user profile is vital.
- **Mobility**: Flexible, agile and mobile infrastructure is required for client devices operation.
- **Nomadicity**: The system could supply proper set of computing and communication capabilities and services to nomads as they move from place to place that is clear, integrated, convenient, and adajustable.
- **Proactiveness**: the system needs to be self-triggered to capture a priori what its users want to increase the service quality.
- **Invisibility**: It is concerned on unobtrusive as possible that enable the user to put the least data.
- **Portability**: Services based on hands-free or at least one-handed light devices are needed.
The below table presents the main researches and definitions related to ubiquitous:

<table>
<thead>
<tr>
<th>Researcher</th>
<th>Definition</th>
<th>Keyword</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ubiquitous Network (Ken Saka-</td>
<td>Ubiquitous computing is being able to use computers anywhere at any time.</td>
<td>Connecting Network</td>
</tr>
<tr>
<td>mura); 1987</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ubiquitous Computing (Mark</td>
<td>Anytime and anywhere</td>
<td>Availability</td>
</tr>
<tr>
<td>Weiser); 1991-1996</td>
<td>Device is available whatever you are.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multiple Devices/ User (any device)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The most profound technologies are those that disappear.</td>
<td>Calm/ Invisible/ Unconscious</td>
</tr>
<tr>
<td></td>
<td>The computer which is not connected to network is not ubiquitous computing.</td>
<td>Connecting Network</td>
</tr>
<tr>
<td></td>
<td>According to the user’s conditions.</td>
<td>Context</td>
</tr>
<tr>
<td></td>
<td>The service should be changed.</td>
<td>Awareness</td>
</tr>
<tr>
<td>Friedemann Mattern; 2001</td>
<td>Everyday objects will become smart and they will all be interconnected.</td>
<td>Connecting Network</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hiroshi Ishii; 2004</td>
<td>The most important philosophy of ubiquitous computing in the context of interface design. It is concerned with the ultimate from of the user interface that disappears, rather than the number and distribution of embedded computers.</td>
<td>Transparency</td>
</tr>
<tr>
<td>SOUPA; 2004</td>
<td>Computer systems will seamlessly integrate into the life of everyday users, providing them with services and information in an “anywhere, anytime” fashion.</td>
<td>Anywhere</td>
</tr>
<tr>
<td></td>
<td>We believe in this open and dynamic environment, intelligent computing entities must be able to share knowledge, reason about their environment and interoperate.</td>
<td>Anytime</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pervasive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Computing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interoperate</td>
</tr>
<tr>
<td>IBM; 2005</td>
<td>Passive computing delivers mobile access to business information without limits from any device, over any network, using any style of interaction. It gives people control over the time and the place, on demand.</td>
<td>Any Device</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Any Network</td>
</tr>
<tr>
<td>Nam et al.; 2007</td>
<td>Technology environment in which computers are invisibly embedded in every object and linked with anyone each other so that information sharing and anytime communication is possible in anywhere, anytime anyplace and any place.</td>
<td>Anyone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anytime</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anyplace</td>
</tr>
</tbody>
</table>

Table 6: Definition of Ubiquitous Computing  
(Lee and et al., 2008)

Although there have been many researches on ubiquitous concept and applied in different knowledge areas, there are technological challenges such as profile management, context prediction and so on, that need to be resolved in order to able to use ubiquitous in more areas and in better paths. In addition, requiring defense mechanism as a path to preserve and protect
a user from ill-taught spying, destroying device’s resources, protect a person’s health via improving medical sensor readings is one of main challenges that ubiquitous services face with.

Fundamentally, ubiquitous computing would be utilized in different knowledge areas such as health, business, energy management, city urban plan and so on and influence on humans’ life.

Ubiquitous could be used as a technique towards achieving sustainable development through its advantages especially its impact on socio-economic context.

4.3 Ubiquitous City

These days, we have been living in urban areas that confront global scale environmental, social and economic crises such as environmental concerns, equality, social instability, poverty, slum, economic instability and so on. These challenges would influence on the world and human’s life like increasing natural disasters, destruction of natural environment, reducing biodiversity, depletion of natural resources, socio-economic inequity and etc. So, these crises are significant threats not only for livability of the cities and world, but also for sustainable development and humanities.

Rapid and unplanned urbanization, growing population, new citizens’ demands, expansion of resource-consumption, industrialization, mobilization, agricultural intensification and excessive are realized as main reasons of these global crisis.

It is vital to tackle these reasons in order to reduce global crisis and maintain the world for upcoming generations as well as improving livability and quality of life for present. Sustainable and smart cities could be a tool to deal with global challenges. Therefore, a new concept of urban area could be applied as a path to create livable cities with high quality of life and achieving sustainable development. Ubiquitous city is novel concept founded on digitalization, smartness, sustainability and ubiquitous computing.

U-city could be realized as a near concept of digital city introduced in Europe. This concept has been introduced since 1994 in The European Digital Cities Conference. Digital city is based on three pillars: social interaction, virtual space, and connecting virtual and real spaces. Digital city has two main aspects: technological and social aspect. Basically, digital city could create self-monitoring and self-response context to be able to solve social challenges containing scarcity of resource, inadequate infrastructure, energy shortages and price instability, economic instability, insecurity, global environment, and human health. Fundamentally, U-city is about city where citizens could gain any services at anywhere and any time through ICT devices. U-city is an evaluation of E-city via innovation and intelligent context.

Amsterdam, Kyoto and Helsinki are three famous projects related to digital city.
The below figure presents these three cities features and their differences:

<table>
<thead>
<tr>
<th></th>
<th>Amsterdam</th>
<th>Helsinki</th>
<th>Kyoto</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal</strong></td>
<td>Public communication space</td>
<td>Next generation metropoli-</td>
<td>Social information infra-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tan network</td>
<td>structure for everyday life</td>
</tr>
<tr>
<td><strong>Architec-</strong></td>
<td>Loosely coupled with the</td>
<td>High speed network</td>
<td>Tightly coupled with the</td>
</tr>
<tr>
<td></td>
<td>physical city</td>
<td>Tightly coupled with physi-</td>
<td>physical city</td>
</tr>
<tr>
<td></td>
<td>Platform for community</td>
<td>cal city</td>
<td>Multi-layer architecture:</td>
</tr>
<tr>
<td></td>
<td>network</td>
<td></td>
<td>information layer, interface</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>layer and interaction layer</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>City metaphor for public</td>
<td>3D virtual city</td>
<td>3D virtual city</td>
</tr>
<tr>
<td></td>
<td>participation</td>
<td>Network technology</td>
<td>Information integration</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Social agent</td>
</tr>
<tr>
<td><strong>Organiza-</strong></td>
<td>Non-profit organization</td>
<td>Digital city consortium</td>
<td>Digital city forum (compa-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>initiated by Helsinki</td>
<td>nies, universities and local</td>
</tr>
<tr>
<td></td>
<td></td>
<td>telephone company</td>
<td>government)</td>
</tr>
</tbody>
</table>

Table 7: Comparison of Digital City (Ishida, 2000)

Digital city or Ubiquitous city could be creating an environment that is able to tackle global crisis and make urban areas with high quality of livability and life. The below figure shows the goals of digital cities and ubiquitous cities founded on smart city’s features:

Ubiquitous city concept was introduced by the Republic of Korea (ROK) for the first time. This concept has been developed through national strategies for knowledge based urban development (KBUD) via the agenda of Cyber Korea, E-Korea and eventually U-Korea. U-Korea is based on ubiquitous computing and ICTs to achieve u-infrastructure and services to create livable urban settings.

In particular, Ubiquitous city has evolved from traditional city to E-city and eventually U-city. U-city makes an environment that any citizen can gain and apply any service anywhere and anytime through ICT infrastructure, U-services and innovative strategies. For the first time, in 2004 the term “U-City” emerged in the political and the progress of Ubiquitous City Construction has developed since 2008. A number of Ubiquitous City Projects in Korea were completed, and now almost 40 cities and communities of Korea are carrying out ‘Ubiquitous City Projects’.

U-city could create sustainable, livable, intelligent and smart city through physical, spatial urban development with ubiquitous technologies. Korea SW Industry Promotion Agency has introduced the main pillars required for developing U-city. The below figure presents main body required to achieve ubiquitous city:
Services based on ICT technologies including construction, management, urban management, intelligent transportation, financing, banking, education and so on, are required to design U-city. The below figure shows city planning system needed to design U-city:

Fundamentally, ubiquitous city founded on ubiquitous infrastructure and services could create city with specific features such as:

- Settings well equipped with information and communication
- City concerned on functionally well operating public service
• Settings with amenity, amiable life and high quality of health
• City founded on environmentally friendly policies
• City concerned on zero emission, zero car, waste and water are recycled, sustained eco-
  system, energy efficiency and proper usage of natural resources
• City concerned on security with effective complex operating system
• Setting based on social sustainability, sustainable socio-cultural and economic interactions
• City focused on new markets for participatory urban regeneration projects applying u-City
  technologies
• City concerned on educational and technical sustainability
• Smart and intelligent settings concerned on sustainable development
• Smart, intelligent and sustainable city with high quality of livability and life
Although, ubiquitous city could create an urban setting with high quality of life and proper ser-
  vices, design such cities through ICT and ubiquitous services confront challenges. The main
  challenges concerned on designing ubiquitous city are:
• Cost development
• Digital security and smart mobs
• Retrofitting
• Specific education to improve high technologies
• Developing and applying high technologies in different services towards ubiquitous ser-
  vices
• Skillful, knowledgeable and expert capital to able to apply ubiquitous services
• Modern technical tools to apply high technologies
• Too transparency
• High usage of energy
• Specific urban plan and master plan to apply ubiquitous services to create ubiquitous infra-
  structure and city
Urban planning and management of U-cities are founded on physical, socio-cultural, economic
  and technological aspects of the setting and society.
Besides of master plan and urban plan, various technologies and concept such as Broadband
  Convergence Network, High Speed Downlink Packet Access, Ubiquitous Sensor Network, Fi-
  ber to the Premise, Radio Frequency Identification, Internet Protocol, Context Awareness
  Computing, Augmented Reality, System-on-a-Chip, Geographic Information System, Global
  Positioning System, Telematics, Middleware in Simulation Technology and etc.; are required
  to develop ubiquitous city services. To achieve ubiquitous city, ubiquitous infrastructure is
  needed to improve effectiveness of city through sustainability, transparent, adequate and sat-
  isfactory services for citizens.
4.4 Ubiquitous Infrastructure

Ubiquitous infrastructure is one of main pillars of U-city. High technologies like ICT play important roles in city infrastructure through planning, management, transport systems, logistics, power supply, energy management, waste and water management and so on.

U-infrastructure applies sensors and sensor networks in order to communicate with and/or wireless computer devices utilized in personal devices, buildings, infrastructure, and any feature or object of the urban space towards enhancing effectiveness and sustainability of urban infrastructure.

In particular, U-infrastructure is utilized in different urban services including transport, health services, firefighting services, security, urban amenities, urban management and ICT portals for monitoring environmental protection, sewerage and waste treatment and etc., to create sustainable, livable, smart and intelligence ubiquitous infrastructure. In addition, such urban infrastructure will be environmentally friendly and reduced environmental concerns.

To create ubiquitous infrastructure and intelligent infrastructure towards intelligent environment, specific pillars are required such as interconnected wireless network, distributed systems, mobility, heterogeneity, interoperability integration, and scalability dynamicity based on infrastructure pervasive.

Ubiquitous infrastructure could create a context that simultaneously communicate with each other via bringing information and communication technologies and other high technologies into the real world. Ubiquitous urban infrastructure equips planners and developers with much flexible design and development options by providing mobile and built infrastructure to the public as the urban system is now becoming more dynamic and programmable.

Ubiquitous infrastructure could make changes in urban form, plan and land use patterns through ubiquitous computing environment. In addition, such infrastructure designs a programmable environment that is based on flexible and changeable spaces in requiring issues. Eventually, programmable land use planning could achieve sustainable development and create cities founded on sustainability.

Fundamentally, ubiquitous infrastructure can provide information on urban utilities and realtime monitoring of the environment while this real-time planning and management in turn can contribute to conservation of urban natural resources, urban growth management and sustainable urban development.

Although ubiquitous infrastructure makes privileges like sustainable development, high quality of life, effectiveness and so on for cities, there are challenges to gain such infrastructure. High cost, requiring high technologies and technical tool, knowledgeable and expert capitals, political transparency, government transparency and smart citizens are the main issues that make achieving ubiquitous infrastructure challengeable and hard.

Ubiquitous infrastructure includes different ubiquitous services ranging from U-government to U-citizens that are declared in following context:
U-Business:

Applying ubiquitous computing would impact on business and change different aspects of it such as finance, employment, management and so on. In other words, ubiquitous computing in businesses, will create new way businesses and consumers are able to access each other. Ubiquitous computing in business helps businesses to be able not only to compete in global and international markets, but also to survive in different markets.

Ubiquitous business is defined as a kind of business process that is location-independent and it is able to turn business environment into data or targets' sources with the lowest rate of human participation. Ubiquitous business focuses on achieving the most desirable outcomes with high productivity and effectiveness.

U-business is a novel proceeding path of E-business created solutions and paths to solve challenges such as media breaks, human errors, and delayed information that E-business and traditional businesses couldn’t tackle with.

Mobile device technologies, sensor technology, context aware, protocol, wireless technology, security, connectivity, mobility, infrastructure, smart space and intelligent context are the main pillars required for ubiquitous business environment.

The main indicators for U-business are:

- Network Infrastructure: Novel and modern network environment based on technology like ICT, IoT and etc., that are as powerful as human interaction are required to design successful U-business.
- Mobility: Mobile and agile vision are needed to able to apply ubiquitous computing in business and access to information anywhere.
- Intelligent Environment: In such environment, people, citizens and their surroundings are focused to be able to supply their needs and perform their tasks. An intelligent environment is invisible, being always in used, and available.
Natural Interface: It is tried to move from human-computer interaction to human computing environment interaction and human-human interaction mediated by a federation of embedded computing devices. Natural interfaces deal with the vision of user-computer interaction, which is as natural and powerful as human interaction.

Ubiquitous business makes businesses to gain their targets, high productivity and efficiency, be able to participate in global markets, supply what their customers want and be kept up with rapid and growing consumers’ needs. In addition, ubiquitous business redefines the key aspects of their customer relationships to fill the gap existed among consumers and businesses. Fundamentally, U-businesses are one of main component of U-city.

**U-Commerce:**

In 2000, Watson ubiquitous commerce based on extending and combination of two kinds of commerce; E-commerce (electronic commerce) and M-commerce (mobile commerce). E-commerce is a kind of commerce based on applying Internet Technology for communication and transaction between firms and its stakeholders and M-commerce is a new phase of E-commerce concerned on mobile, wireless channels and unique features such as portability, accessibility, localization and identification.

Applying ubiquitous computing in commerce and combination of E-commerce and M-commerce have developed new phase of commerce named ubiquitous commerce. It defined as “The use of ubiquitous networks to support personalized and uninterrupted communications and transactions between a firm and its various stakeholders to provide a level of value, above and beyond traditional commerce” by Zhang and his coworkers. mobile applications, mobile networks, mobile devices, and data synchronization are introduced as main factors that make U-commerce derived from E-commerce and M-commerce

U-commerce is about utilizing ubiquitous computing and ubiquitous networks to improve relation between organization and its stakeholders such as customers, suppliers, governments, financial institutions, managers, employees and citizens, even to support continuous communications in order to make interactions and transaction be available anywhere and at any time.

Watson introduced four specific characters for U-commerce: ubiquitous, universal, unique and unison.

The main components of U-commerce are:

- **Electronic Commerce:** Development of global information technology influences on commerce and create new phase of it named E-commerce. It is a huge transformation of traditional commerce that is able to improve the relation between firm and its stakeholders.

- **Mobile Commerce:** M-commerce makes possibility and availability of communication between people, business and objects to occur at any time and anywhere.

- **Voice Commerce:** V-commerce founded on listening and speaking makes businesses to reduce call-center operating costs and promote costumer services.

- **Television Commerce:** T-commerce is about commerce founded on providing audio visual and the diversity of choice through non-stop broadcasting the products information in TV channels.

- **Silent Commerce:** S-commerce is based on applying advanced tagging, sensor technologies and mobile communication to achieve intelligent and interactive objects and create
new information and values. In addition, communication and commerce are happened without humans’ interactions.

- **Wireless Commerce:** It is an extending version of E-commerce with features such as reachability, accessibility, localization, identification, and portability that make communication between people, business and objects be available at anywhere and anytime.

Fundamentally, U-commerce influences every aspects of business and improve it through enhancing customer services, operating efficiency, supply chain connectivity, productivity and so on. In addition, it makes economy flexible, fluid, interconnected, efficient and resilient.

**U-Healthcare:**

These days that hectic lives, growing population, chronic diseases, aging and so on threaten the humans’ life and society; health becomes as one of the main phenomena needed to be improved through health management in order not only to survive humanities, but also to achieve better health care services, high quality of livability and life.

Evaluation of E-health to M-health and eventually U-health could improve health management and health situation towards better efficiency, accuracy and availability of medical treatment. U-healthcare enables patient to access to services at anywhere and anytime. In other words, ubiquitous healthcare solutions provide healthcare services at any time anywhere. In other words, advances in information and communication technologies make E-healthcare and M-healthcare to create new phase of healthcare introduced as U-healthcare.

Ubiquitous healthcare is concerned on emerging field of technology which applying environmental and patients’ sensors and actuators to control, monitor and enhance patients’ physical and mental conditions in daily life. Based on U-healthcare, tiny sensors that are be worn or placed and installed in patients’ homes and workplaces are being used to gather patients’ data about their conditions such as heart rate, blood pressure and etc.

The main benefits of U-healthcare ranging from an individual level to whole society, are:

- Creating comfortable context for patient at anywhere (home, workplace and etc.) and anytime
- Accessing to comprehensive healthcare services without considering time and at geographical location
- Availability of healthcare services at every region like underserved rural and urban areas
- Creating proper context for new and alternative medical treatment
- Decreasing usage of traditional medical procedures
- Enhancement of non-emergency services
- Reducing Cost
- Increasing service process efficiency
- Improvement in patient relationship management
- Improving quality of life

Obtaining the right information at the right time, patient privacy, time and location independency, accessing of U-healthcare services for all (not only rich citizens), decision making at
proper time, medical errors, interaction of insurance and U-healthcare are the main challenges that ubiquitous healthcare confronted with.

Fundamentally, U-healthcare is one of the main pillars to design U-infrastructure towards creating U-city.

**U-Learning:**

Ubiquitous learning or U-learning founded on ubiquitous computing and technology makes an environment learning where anyone is able to learn at anyplace at any time. U-learning is about learning with U-computing technology. U-learning could change traditional culture and norms of learning that surround and absorb us.

U-learning is the evaluation of traditional learning to electronic learning (E-learning) and moving from E-learning to mobile learning (M-learning) and eventually U-learning.

The main features of U-learning are:

- **Permanency:** Information and data would be remained until the learner intentionally remove it.
- **Accessibility:** The information is always available whenever user needs it through ubiquitous computing and technologies.
- **Immediacy:** Learners are able to get information immediately.
- **Interactivity:** Interaction with teachers, colleagues, experts and learners could be done through the interfaces of u-learning systems.
- **Context Awareness:** The system can understand the learner’s environment via database and sensing the learner’s location, personal and environmental situations.

Fundamentally, U-learning is a tool to create context that everyone could study at anywhere and anytime, even it would improve education sustainability and help societies to grow up knowledgeable and expert citizens who are able to develop sustainable and livable urban aeras.

**U-Library:**

Ubiquitous technology, computing and innovation make new field in library named ubiquitous library. U-library is founded on digitalized contents, a wireless network, a smart tag, ubiquitous computing, ubiquitous and smart environment. Government supports and industry-leading IT are the other tools required to achieve U-library.

Although information and communication technologies influence on libraries and create new paradigm introduced as U-library, traditional libraries wouldn’t be omitted and disappeared. The main reason of this fact is concerned on humans’ being and their tendency to participate in social. In addition, book values and book as a historical object are the other main reasons of remaining convenient libraries. In particular, U-libraries besides of convenient libraries are vital to make environment that global users are able to access, locate, transform and disseminate information through U-technologies and computing.

Dynamic and flexible engines to enhance knowledge and information society, would be developed through U-libraries.

The main benefits of U-library are:
Global accessibility

- Maintenance of printed material in order to reduce environmental concerns
- Improvement of information retrieval
- Reducing physical boundary
- Availability of information at anywhere and anytime
- Accessing to more information with lower cost
- Reducing energy consumption
- Improving knowledge and researches through accessing global information without boundry.

Copyright issues, data security, technology management and cost are the main challenges that U-libraries faced with. These challenges could directly and indirectly impact on future of U-library. Therefore, it is needed to find out strategies and solutions to tackle these challenges in order to expand U-libraries towards more knowledgeable and expert capitals.

Fundamentally, in a world where information has become ubiquitous, new phase of libraries with reinvent and modern role and function in the new ecosystem are required. So, U-library is one of the services needed to create ubiquitous infrastructure and city.

**U-Banking:**

Improving technologies and emergence of them in different services and businesses, has made financial institution change their old business models and being kept up with technologies. Therefore, new paradigm of banking named as ubiquitous banking or U-banking has developed.

In these days, banks are responsible to provide better, speedy, and ubiquitous service to the customers in order not only to be aligned with growing technology, but also to gain costumer satisfaction.

U-banking is a new phase of banking concerned on combination of electronic banking (E-banking) and mobile banking (M-banking) through applying ubiquitous technologies and computing.

The aim of U-banking service is to design a context where users are always able to be on-the-go and carry information and have power to solve their problems without being bound by the location via particular technological devices. Such banking provides retail banking and business banking to all costumers without considering age, gender, previous qualification and country of origin.

Global reachability, inelastic demand, ubiquitous service to every customer, affordable to everybody, Minimum requirement of employees, low investments, portability, satisfying intellectual needs of stakeholders, lower cost, reducing time consumption, accessibility at anywhere and anytime are the main benefits of U-banking.

The main challenges related to U-banking are:

- **Technology Challenges:** such as knowledgeable and expert labors be aware of U-banking, accessing to technologies, IT and Telecommunication issues, creating proper ubiquitous environment
- Management Challenges: like information management, regularity issues, security, data protection, proper organizational structure and resistance, acceptance issues, ethical phenomena, trust issues and outsourcing problems

- Agility and intelligence structure

Business globalization and improving technologies make traditional banking activity shift to U-banking that provides clients' accesses to bank accounts and services at anywhere and anytime.

**U-Transport System:**

Fundamentally, global risks including environmental challenges, depletion of natural resources, economy risks, social instability and so on, rapid urbanization needs new phase of transportation that is able to deal with these challenges. In other words, transportation and mobility are indicators that influence on city infrastructure. Improving technologies, automation, innovation, achieving cleaner fuels and so on make situation to develop transportation system not only ease humans' life, but also reduce global risks and improve sustainability. This transportation system is introduced as Ubiquitous transportation (U-transportation) founded on ubiquitous technology and computing, smartness and intelligence are required to achieve ubiquitous city infrastructure.

U-transportation is about safe, efficient and smart transport service environment through intelligence, smart transportation, omnipresent services and ubiquitous technologies. In addition, such transportation could keep up with growing population and new demands of citizens, even to be align with developing sustainability. U-transport could create an environment founded on existing networks everywhere with consumer durable devices, dispersion of intelligence and information, being always accessible and smart services. It is able to make global networks will be accessible and available anytime, anywhere with high quality services for anyone. In particular, U-transport system could solve and tackle traditional transport system challenges such as: clean, affordable and sustainable propulsion, proper and sustainable infrastructure for smart personal mobility and logistics, secure and safety connected, cooperative and automated mobility and transportation, proper and smart interaction among users and vehicles.

Besides of these challenges, U-transport as utilizing clean energy like hybrid energy, electric energy and so on, would reduce environmental challenges.

Main features of U-transportation are:

- Anything: It could concern on anybody like any traveler, any pedestrian, any driver, etc., and any entities such as any-in-vehicle, any road side-entity and so on.

- Anytime: In transportation system anytime refers to any travel time and any transportation related working time.

- Anywhere: Anywhere in transportation system focus on any location in any road, any space related to transportation like terminals, rest palaces and so on.

- Transcendent Transportation Intelligence (TTI): It is concerned on humanly recognizable and unrecognizable transportation environment.

- Transparency: It means that object U-in transport system should be consciousness or recognition. In addition, subject like travelers, pedestrian and etc., could useful and correct information and data in such U-transport environment.
Trustworthy: Trustworthy includes features like security, reliability, safety, integrity. In addition, trustworthy focuses on trustable interaction between human and U-transport environment.

U-transport system has many privileges not only for societies and countries, but also for the World. The main benefits of U-transportation are:

- Social Equity through improving safety and security, privacy, improving health and well-being and so on.
- Transport system based on clean energy
- Better and more efficient traffic management
- Accessing to services at anywhere and anytime for everyone
- Safer, greener and cleaner mobility
- More sustainable and smart transportation
- Further clean logistics
- Achieving sustainable and smart urban planning
- Reducing environmental challenges through utilizing clean energy, decreasing green gas emissions, noise pollution, air contamination and so on.
- Improving economic sustainability through promoting productivity, attracting investment and creating job, improving export transportation and so on.
- Impact on creating smart, sustainable and ubiquitous infrastructure towards smart and ubiquitous city
- Enhancing sustainability in urban areas

Fundamentally, U-transport could create smart and sustainable urban settings with high quality of life and livability that could create sustainable and livable world based on sustainable development.

**Intelligence and Smart Buildings:**

New concept of building concerned on developing sustainability is vital not only to create smart and ubiquitous infrastructure, but also to improve well-being of inhabitants. In particular, new phase of building is required to extend ubiquitous services in living areas towards creating ubiquitous and smart cities. Therefore, smart and intelligence building could be applied as a new phase of building that is needed for ubiquitous and smart city.

Intelligent and smart buildings are automated buildings with flexibility, cost efficiency, energy efficiency, environmental benefits, integrated technical performances and ubiquitous technologies. Eventually, smart and intelligent building create safer, livable and more productive environment for inhabitants and operationally efficient for owners through technology, smartness and ubiquitous technologies. These buildings are founded on automation, life safety, telecommunications, sensors, user systems, ubiquitous technologies, and facility management systems. The below figure shows the element that intelligent building based on:
Reducing energy cost, energy efficiency, reducing CO₂ emission, enhancing environmental sustainability, greener environment, improving building safety and security, more productive and efficient work environment, time saving, inhabitants' comfort, flexibility, assistive demotics and improving quality of life are the main privileges of smart and intelligence buildings. These benefits could achieve sustainable, smart infrastructure as well as creating ubiquitous and smart cities.

Fundamentally, intelligent and smart buildings would be applied as tools to create smart and ubiquitous infrastructure.

**U-Government:**

Government as a component of society could play role in developing ubiquitous services and designing ubiquitous infrastructure. Therefore, ubiquitous government aligned with ubiquitous computing and concept is needed.

Ubiquitous government is a new phase of E-government that is concerned new form of interaction and transaction that are available any time anywhere on different devices through networks, application, ubiquitous technologies and services.

The main features of Governance network are: formalized coordination pattern, organized network understanding, regulated rules to improve the ability of decision-making process, bind agreements and building informal relationships.

U-government isn’t existed in comprehensive definition and E-government and smart government has been declared. So, it is important to evaluate smart and E-government towards U-government.
U-government founded on smartness, digitalization and applying ubiquitous technologies could achieve e-governance towards better decision making and planning.

**Smart Citizens:**

Smart citizens are fundamental component of smart and ubiquitous city. Human capital, human actions and education play important role in developing such urban areas. Citizens as a member of community would influence on future of countries. Therefore, smart cities need smart citizens who are intellectual, knowledgeable, aware of role of ubiquitous technologies, computing and networks in creating new phase of cities and able to apply them in their different aspects of their lives.

Smart people are aware of their community, their society, their people and their needs. They know how they could respond and supply their needs and set them in their plan. Generally, smart citizen thinks, plans and utilize information technology and ubiquitous technology to supply needs, increase productivity, efficiency and quality, save time and so on.

The below table declares characteristic of Smart Citizen:

<table>
<thead>
<tr>
<th>Smart Citizen</th>
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<tbody>
<tr>
<td>Smart Cities</td>
</tr>
<tr>
<td>IoT</td>
</tr>
<tr>
<td>Cloud Computing</td>
</tr>
<tr>
<td>Big Data</td>
</tr>
<tr>
<td>Sensors</td>
</tr>
<tr>
<td>Open Data</td>
</tr>
<tr>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>UIS-MIS</td>
</tr>
<tr>
<td>Telecommunication Infrastructure</td>
</tr>
<tr>
<td>Spatial Data Infrastructure</td>
</tr>
<tr>
<td>E-Government</td>
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<tr>
<td>GIS</td>
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</tbody>
</table>

![Figure 6: Smart Citizens (Bayar, 2017)](image)

**U-Energy Management:**

Environmental concerns are fundamental threats for future of the World and humanities. Proper energy management could not only reduce environmental challenges, but also control cost towards economic sustainability. In these days, ubiquitous energy management could be used as a sustainable and smart technique to monitor and reduce environmental challenges as well creating ubiquitous city.

Ubiquitous energy was introduced by Könnölä et al., who declared ‘the existence of a well-developed and ubiquitous energy system’ for the first time. In particular, proper energy infrastructure is needed to develop and utilize renewable and sustainable energy. In energy discussion, the word ubiquitous focuses on energy management, information systems or energy services as well as renewable and high quality of energy.

U-energy is about being present and accessible high quality of energy everywhere and at any moment of time. Ubiquitous technology and concept in both management and manufacturing
renewable and sustainable energy will impact on developing U-energy. In other words, high
technologies like IoT and so on, influences on management and developing clean and renew-
able energy including solar energy, wind energy, hybrid energy, waste as new resource of
energy and etc., towards U-energy. U-energy could influence in various businesses, manufac-
turing, construction, urban planning and so on; therefore, it is a fundamental component of
Ubiquitous and smart city.

Based on two categories (scope and decentralization), U-energy could be clarified:

<table>
<thead>
<tr>
<th>Scope</th>
<th>Global</th>
<th>Local</th>
<th>Individual</th>
</tr>
</thead>
</table>
| Global              | Global energy supply based on large-scale installations both in the    | Energy supply for neighborhoods, districts or towns relying on off-site| Charging of mobile appliances [e.g. cell phones]
|                     | outer space (e.g. solar power plant installation in the Earth’s orbit) | energy sources                                                      | from mains.                                     |
|                     | and on the surface (e.g. harvesting super volcanoes for power          |                                                                     |                                                 |
|                     | generation)                                                            |                                                                     |                                                 |
|                     | Global energy supply based on Installations representing various       | Energy supply for neighborhoods, districts or towns using mainly on- | Wearable solar power generation and integrated |
|                     | scales and degree of integration(e.g. solar power installations in     | site and nearby energy sources.                                      | battery storage with external charging options  |
|                     | deserts, a network of nuclear power plants.                             |                                                                     | (e.g. smart clothes)                            |
|                     | Global energy supply based on Simultaneous coordination and management | Building: Integrated renewable energy                                 | Internal energy harvester using the movements   |
|                     | of mainly medium and small-scale energy resources through virtual      | Vehicle-integrated renewable energy                                  | and/or heat of human body to energize bio-implants|
|                     | power plant (VPP).                                                      |                                                                     | Mitochondrial energy generation in human cells. |

**Figure 7: Classification of Energy Supply Options with Examples**
(Alanne, 2019)

In general, energy management could be utilized as technique to develop U-energy concept.
Energy management is concerned on energy efficiency, utilizing renewable energy, waste as
new source of energy, being environmentally friendly and cost efficiency. It could gain its tar-
ggets through Ubiquitous technologies and services. Therefore, Ubiquitous energy manage-
ment is included in the discussion of U-energy.

Ubiquitous energy and management are about transition to more efficiency, affordable and
sustainable energy usage towards carbon free areas through decreasing the amount of using
energy, increasing the efficiency of the applications, applying renewable and clean energy
instead of fossil fuels, utilizing waste as new source of energy and reducing the cost by know-
ing the energy. In particular, U-energy, smart and ubiquitous management are path to reduce
humans’ impacts on environment and develop environmental sustainability to preserve the
world and nature for future generations. Reducing cost of energy is the other advantage of
using smart management.

Fundamentally, U-energy management, clean, renewable and sustainable energies could be
achieved U-energy concept in reality. U-energy not only improve economic sustainability, but
also reduce environmental challenges through reducing greenhouse gases emission, maintain
natural resources, utilizing clean energy and so on. So, it is needed to create smart and ubiq-
uitous city, even to develop livable world without sustainable challenges especially environ-
mental concerns. In this book, proper energy management based on U-technologies and ser-
dives will be declared as a fundamental solution to not only improve quality of human life, but
also maintain the world for upcoming generation.
4.5 Challenges and Solutions

High technologies, ubiquitous services and digitalization are fundamental techniques that could change humans’ lifestyle and businesses’ processes to create new concept of urban areas named ubiquitous smart city with high quality of life and livability. Such areas are able to deal with global challenges and achieve sustainable development. Although ubiquitous services and digitalization are needed to tackle global challenges, maintain the world and nature for future, there are challenges that make applying of such technology be challengeable. The main challenges concerned on manipulating ubiquitous computing are presented in below figure:

**Figure 8: Digitalization and Ubiquitous challenges**

It is needed to find out solutions and strategies to reduce such risks in order to be able to utilize digital and ubiquitous services to develop sustainability. The fundamental solutions realized by authors are:

- **Training Knowledgeable and Expert Capitals:**
  Knowledgeable and expert managers, leaders and labors who are aware of using high technologies are required to make businesses working with such technologies. ubiquitous computing and digitalization play significant roles to improve efficiency and productivity of businesses and organizations. Therefore, education is one the tool required to deal with digitalization and ubiquitous barriers.
  As it was mentioned in previous books, when we talk about education it is concerned on vocational and applied science training as well as education.

- **Smart Citizens:**
  Smart citizens who are aware of ubiquitous services usage would influence on applying ubiquitous services and computing in cities. Therefore, it is needed to grow smart citizens to tackle ubiquitous challenges. Training smart citizens are fundamental solutions that make it as a one of component of U-city.
- **Technology Development:**

  Many challenges including security phenomena, proper infrastructure, new and modern tools adapted to high technology and so on, are related to technical issues. In other words, modern instruments and tools are needed to be able to apply ubiquitous computing in various businesses and urban planning. Therefore, technology enhancement and technical sustainability are required to make digitalization and ubiquitous services being usable. In addition, technology development could deal with security issues and reduce such risks that are one main challenges of ubiquitous services.

  Fundamentally, ubiquitous and digital services are reasons of technology, but it is needed to improve technology more in order to able to deal with its challenges and be able to apply such services in all aspects of life to create better areas for living. Besides of technology enhancement, people and citizens in different categories (experts, public citizens and government) could influence on tackling barriers. In particular, challenges and barriers of ubiquitous technology and digitalization have to be solved in order to be able to utilize them, deal with global challenges and reduce them, achieve sustainable development and maintain the world for future generation.

  We are facing with tomorrow shock that ubiquitous and digital services are paths that make us deal with tomorrow shock.

### 4.6 Future Scenario (5th Wave)

Nowadays, we had passed the 1st, 2nd, 3rd and 4th waves (ages). Before 1970 fossil energies and various businesses could affect and improve technologies, economy and IT. Since we reached the 70ies the technologies and IT became able to change and improve the various energies, business, and even impact our lives. Besides this, they can change the global policy from fossil energy and coal to sustainable renewable energies. IT based economy (business) make the business procedure faster, safer with higher productivity. Artificial Intelligence (AI), Machine Learning, Computer Vision, Neural Network, Fuzzy Logic and other new technologies as well as knowledge in combination of reality and virtually build a new concept named Ubiquitous. Digitalization changes the paradigm from traditional to modern with huge effectiveness in different aspects of life including various businesses, urban planning, governance and etc.

These technologies would create ubiquitous and smart city; however, barriers cause challenges to apply these technologies and create modern areas like U-city. It is required to indicate these barriers and find out solutions to apply them and change humans’ life in order to maintain the world.

Based on Alvin Toffler’s book (1970), Future Shock, he discussed that in our world of that technology development and rapid growing made ever-quickingen change, the human mind is threatened by shattering. In particular, proper solutions and policies could make people to deal with future shocks.

Fundamentally, we are settling in edge of future that confronts future shocks including tomorrow’s family life challenges, new businesses’ barriers, modern life-styles risks, and human relationships challenges and so on. The below figure presents the point that we are perched on:
As in previous section was declared, solutions are required to deal with ubiquitous and digitalization challenges in order to be able to apply them in different businesses and services towards creating modern areas. The 5th theory could be a strategy to find out solutions to deal with such challenges, even to tackle future shocks.

The fifth theory is about proceeding of future of 14.0, Society 5.0 and edge of tomorrow that has presented by Prof Dr. Hamid Doost Mohammadian for the first time in 2010 and had been evaluated since 2017. This theory focuses on evaluation of ages and solutions to deal with future shocks through ubiquitous, smart, digital and innovative solutions. The below figure presents the evaluation of 5th wave:

**Figure 9. The 5th wave Theory, Ages and Technologies (Hamid Doost Mohammadian, 2010-17)**

SMEs in Energy Sector – Volume 1 Foundation
Based on this theory, modern businesses that are concerned on business and marketing, social responsibility like CSR strategies, being environmentally friendly could improve quality of livability and life. Generally, the 5th theory is a tool to achieve Blue-Green sustainability introduced by authors; that is a path to deal with urbanization challenges as well as maintain the
world for future. Blue-Green sustainability is a kind of sustainability with seven pillars including economic, environmental, social, cultural, technical, education and political sustainability based on being environmentally friendly, green strategies and water management. This kind of sustainability was introduced completely in previous book and in following chapters a brief introduction about Blue-Green sustainability is mentioned. Sustainability could create livable urban areas with high quality of life that are tools to make the word as a better place for living.

The 5th theory could be a technique that is required to be ready for the edge of tomorrow, future challenges and tomorrow shocks. In addition, this theory makes society founded on high technologies, appropriate HR, strategies concerned on sustainability which is able to create situation tackled with future concerns and ready for future shocks. According to this theory, education plays vital roles in successful businesses.
References


Aithal, S. Suresh, K. Concept of Ideal Banking and Realization of it using Ubiquitous Banking. Published by MPRA


Artificial Intelligence in Society. 2019. Published by OECD.

Artificial Intelligence and Big Data: Innovation Landscape Brief. 2019. Published by International Renewable Energy Agency (IRENA).

Artificial Intelligence and Machine Learning 101. 2019. Published by Micro Focus.


Digital Sustainability: Global Sustainability as a Driver of Innovation and Growth. Published by Cybercom Group. Stockholm, Sweden.


Dutzler, H. Schmaus, B. Schrauf, S. Nitschke, A. Hochrainer, P. 2016. Industry 4.0: Opportunities and challenges for consumer product and retail companies. Published by Service Mark of PwC Strategy& LLC. The United States.


Greco, I. Cresta, A. a Smart Planning for Smart City: The Concept of Smart City as an Opportunity to Re-think the Planning Models of the Contemporary City. In the Proceeding of 15th International Conference on Computational Science and Its Applications (ICCSA). Banff, Canada.


How Robots Change the World. 2019. Published by Oxford Economics.


Internet of Energy Education and Qualification. 2017. IoE-EQ partnership


Ishida, T. 2017. Digital City, Smart City and Beyond. In the Proceeding of the 26th International Conference on World Wide Web Companion. 3 April. Perth, Australia.


Okamoto, M. 2019. Standardization Activities on “Society 5.0” in Japan. Society 5.0 In the Proceeding of Standardization in a living Concept “Society 5.0”, BSN seminar supported by METI. Jakarta, Indonesia.


O’Reilly, T. Doctorow, C. 2015. Opportunities and Challenges in the IoT. Published by O’Reilly Media, Inc. The United States.


Perez, J. Deligianni, F. Ravi, D. Yung, J. Artificial Intelligence and Robotics. Published by UK-RAS Network.


Rifkin, J. Digital Europe: The Rise of the Internet of Things and the Economic Transformation of the EU. Available at: https://www.europarl.europa.eu/

Robots and the Workplace of the Future. 2018. Published by International Federation of Robotics (IFR). Frankfurt, Germany.


Rose, K. Eldridge, S. Chapin, L. 2015. The Internet of Things: an Overview. Published by Internet Society.


Sinopoli, J. 2010. Smart Building Systems for Architects, Owners, and Builders. Published by Elsevier.

Smart Cities/ Seoul: A Case Study. 2013. Published by ITU.


South Korea: Busan Green u-City Smart City Builds on Cloud Services Delivered by Public-Private-Partnership. 2012. Published by gmsa. Available at: http://www.gsma.com


Sustainable and Intelligent Building Services. 2018. Published by International Telecommunication Union (ITU).


Transforming Health Care Overview and System Summary. Published by University of Utah.


Ubiquitous City in Korea: Services and Enabling Technologies. 2011. Published by TEKES-Finnnode-Finpro.


Williams, A. Applying Machine Learning to Robotics. Available at: http://roboticsbusinessreview.com


Yıldırım Bayar, D. 2017. Smart Citizens: Smart Cities from a Different Point of View. In the Proceeding of INSPIRE Conference. 4-5 September 2017 Kehl Germany/ 6-8 September 2017 Strasbourg France


Towards Ubiquitous Energy

Content

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References
1. Fossil Fuels

Fossil fuels including coal, natural gas, petroleum, shale oil, and bitumen are used as the main sources of heat and electricity. Although fossil fuels have played significant roles in industrial age (200-300) years ago, causing environmental challenges like depletion of natural resources, air pollution, greenhouse gases emissions and so on; make applying of such energies be reduced in these days.

1.1 Coal

Coal is the most abundant kind of fossil fuels that is existed in various forms including hard, black, shiny and rock-like with a high-energy content. Its abundancy and cost-competitiveness are main Coal strengths.

It has been applied in different industries as main energy resources like steamships, railroad engines, homes, transportation, industries and heat of steel producing since the 1800.

Currently, 30% energy of the world is supplied by Coal. The main consumers of Coal are Asian countries. According to statistics in 2018, Asia accounted for 74% of global coal consumption with China and India as the largest consumption.

Environmental challenges like greenhouse gases emission including sulfur dioxide, nitrogen oxides, percolate ma2er, carbon dioxide and mercury, climate change, air pollution and so on, supply of energy and energy security are the main challenges related to Coal. In particular, Coal has the most impact of energy sources on environment. As these challenges are significant threat for environment and economic, it is tried to reduce utilizing of Coal and developing clean Coal technologies in order to deal with challenges and use Coal in more efficiency with lower risk.

1.2 Oil

The other fossil fuels used a lot is oil. Oil also known as 'petroleum or crude oil', is a thick black liquid madding up mainly of hydrogen and carbon. Petroleum is the leading source of energy in the World.

The main strength of oil is about liquid form of it. This fact makes economically efficiency of oil to transport, easily control and handle.

Transportation is the main consuming sector of oil. In addition, in plastic industry and many other household products; plays as a key ingredient. Fundamentally, oil is an important resource of energy and more than 30% of energy consumed are based on oil derivative such as gasoline, diesel fuel, propane gas, and domestic cooking and heating fuels.

Like coil, Asia is declared as the largest consumer of oil. China and India are the main consumers of Asia.

The main challenge of oil like the other kinds of fossil fuels is environmental risks like greenhouse gases emissions. Producing of oil also, influences on environment and cause environmental challenges like land-disturbance. Generally, oil and petroleum make environmental
concerns during extraction, transportation and use. Depletion of resources are the other important challenge.

It is required to reduce oil usage to save its resources for future and deal with environmental concerns created through oil. Renewable energies could be proper alternatives for oil in different usage sectors.

1.3 Natural Gases

The other fossil fuel is natural gas. Natural gas can be existed where petroleum is extracted. Natural gas is primarily made up methane and other hydrocarbons like ethane, propane, and butane.

Abundant resources of natural gases, being as non-conventional gases, stability of supply and be the cleanest environmental fossil fuels are the main strengths of natural gases. Based on its features, natural gas is mentioned as growing source of energy in the World. It is expected that it could surpass coal in global energy production and electricity usage in upcoming years.

Despite of coal and oil, the main producer and consumer of gas is The United States. In many large cities of U.S natural gas is used for large car fleets, city trash trucks and municipal transportation buses to reduce air pollution and other environmental challenges.

Fundamentally, the future of the coal is related to price, affordability, availability and privileges of other kind of energy resources. In addition, improving supply flexibility, achieving more flexible and deeper international market of natural gases could influence on future usage of natural gas.

1.4 Challenges of Fossil Fuels

Fossil fuels are the predominant primary energy at present in commercial energy and power generation in the World.

Today, fossil fuels are the most mature and economic source for power generation. However, they also account for most local conventional pollution and global carbon dioxide emissions.

The main challenges related to fossil fuels are:

- Increased Efficiency:

  Increasing efficiency of fossil fuels is required in order to be able use them in future. In contrast with renewable energies, fossil fuels have less efficiency that is a fundamental challenge for fossil fuels.

- Economic Challenges:

  Cost of production and processes to develop fossil fuels with more efficiency and less environmental impact are high. These high costs prone societies to be applied to apply renewable energies like wind, solar and so on that have more advantages in contrast of fossil fuels.

- Environmental Concerns:
Most of environmental concerns including climate change, greenhouse gases emissions, air pollution, water pollution, soil degradation, depletion of natural resources are depended on fossil fuels.

The most important environment concerns are climate change. The Earth is rapidly getting warmer. This change in the climate threatens serious risks and challenges for societies and the natural environment that are significant threats for future of the world and humanities. Climate change is defined as a change in the “average weather” of a given region experiences. The main reason of this issue is greenhouses gas that are released by human activities, especially the burning of fossil fuels (coal, oil and gas), deforestation and certain types of agriculture. Besides of greenhouses gas, other factors are realized for climate change such as variations in the Earth’s orbital characteristics, atmospheric carbon dioxide variations, volcanic eruptions, variation in solar output, and plate tectonics, thermohaline circulation. In other words, fossil fuels are the main reason of climate change that could influence on economic, social and environment and make them be worsen. In addition, social welfare and equity in an unprecedented manner are the other consequences of climate change. Fundamentally, climate change is a significant threat for the future economic wellbeing of large numbers of human beings as well as environment and nature.

Environmental risks including air quality, water pollution, climate change, greenhouse gases emissions, resources and species depletion, land degradation, accessibility and so on; security, health problems, accidents and risks, incentivized, unsustainable and global warning are the main disadvantages and consequences of fossil fuels.

These challenges are significant threats for the countries, humanities and eventually the future of the world. So, it is vital to find out solutions such as alternatives for fossil fuels, improving efficiency of fossil fuels, reducing greenhouse gases emissions by fossil fuels via technology and so on, to deal with fossil fuels challenges in order to maintain the world for upcoming generations and improve quality of human life.

1.5 Future of Fossil Fuels

Generally future of fossil fuels as well as energy system is complicated, vague and not transparent. Although there is demand of fossil fuels, an amount of this demand relies on fossil fuels’ consequences like reduction in carbon dioxide emissions, growth of renewable energies and so on.

Using of oil as main source of transportation energy would be decreased through applying of renewable energies like hybrid energy, electric energy and so on; however, its usage in the Middle East, India, China, and South-East Asia is increased. Environmental challenges and carbon footprint of transportation systems on environment, are the main reason to switch new resources instead of oil.

Coal as the dirtiest fossil fuels, is usually applied for electric power generations. Emissions of greenhouse gases towards environmental impacts and pollution and climate change challenges make countries especially developed countries like Denmark, Russia and etc., reduce coal environmental impacts through high efficiency, greenhouse gases emissions control, independency of coal and applying alternatives instead of coal. Although developed countries
reduce using of coal, coal production and consumption has grown in China, Indonesia and developing countries.

Natural gas is poised to become the dominant fossil fuel across the world for power generation and transport, and for domestic and industrial use. The future of the natural gas depends on not only renewable energy, but also technology of gas like proper gas turbines. New generations of high-efficiency gas turbines are tools to increase usage of natural gas as one of prominent energy resources.

Fundamentally, there are some factors that the future of fossil fuels is related to:

- **Consequences of Fossil Fuels:**
  Challenges of fossil fuels like environmental concerns, climate change, greenhouse gases emissions and economic challenges are the main barriers to reduce using of fossil fuels.

- **High technologies:**
  It is concerned on if technologies are able to completely replace new phase of fuels like renewable energies instead of fossil fuels. In particular, new phase of energies need infrastructure be changed that requires high cost, time, technical demands and expert capitals. Therefore, it takes times to make alternatives for fossil fuels.

- **Fluctuations in Economic Condition:**
  Economic situation directly and indirectly influences on demands of fossil fuels. In addition, it could impact on developing of alternative resources of fossil fuels.

- **Political Issues:**
  Political situation of countries, political sustainability, geopolitical, war, sanctions and so on would influence on kinds of energy resources applied in the country. For instance, sanction is a barrier for countries to be able to use renewable energies or high quality of fossil fuels.

- **New Regulations:**
  New regulations and laws including public opposition, accidents, environmental concerns, climate change, government fiscal policies, political strategies and so on could impact on production and demands of fossil fuels.

- **Government Policies:**
  Government policies, governance and supports will impacts on future of energy resources in countries.

- **Future of Renewable Energies:**
  Future of alternatives for fossil fuels like renewable energies, technologies required to develop modern and renewable energies, their advantages, disadvantages and their cost could influence on future of fossil fuels.

These factors could impact on future of fossil fuels usage.
2. Renewable Energy

We have used fossil fuels as main source of energy to meet our needs for many years. Basically, we are using them much more rapidly than they are made and they will run out in near future. In addition, fossil fuels cause environmental challenges that threaten future of the world. Therefore, it is vital to apply other kinds of energy instead of fossil fuels to reduce environmental challenges as well as maintain the fossil fuel resources for upcoming generations.

Using renewable energies also introduced as clean or green energies could be environmentally friendly, even be unlimited resources for energy supply. Renewable energy uses energy sources that are continually replenished by nature—the sun, the wind, water, the Earth’s heat, and plants.

There are fundamental reasons to utilize renewable energies such as requiring sustainable energy system to reduce CO2 ang greenhouse gases emission, preserving natural resources and environment, enhancing energy efficiency, better quality of life and livability and sustainable world.

2.1 Solar Energy

Solar energy was introduced in 1953 through an article named “Why Don't We Have ..Sun Power” with a statement “Every hour, it floods the earth with a deluge of thermal energy equal to 21 billion tons of coal” in a magazine. However ancient Greece and Romans built their houses with solar heating and sunlight advantages.

Solar power is about transformation of sunlight into electricity through using photovoltaics or concentrated solar power.

Solar energy is produced through deep nuclear fusion reactions. In a fusion process, two atomic nuclei collide at very high speed and create a new form of nucleus. It can be done due to the extremely high temperature and high density in the sun’s core. Although the positive charges tend to repel each other, they stay together due to the high temperature and density of the sun's core.

The main benefits of solar energy are:

- No negative environment impacts, no greenhouse gases emissions and no pollution
- Low cost of maintenance
- Reducing usage of fossil fuels and making indecency of fossil energies
- Making job opportunities and source of income through employing solar panel manufacturers, solar installers, etc.
- Improving economy through job opportunities and being a source of income
- Value added property
- Being installed virtually anywhere; in a field to on a building (no wasting space)
- Safer source of energy especially than traditional electric current
Although solar energy has many privileges, there are some challenges and disadvantages concerned on solar energy. The most important ones are:

- High initial cost for material as well as installation
- Low efficiency
- Dependency on sun latitude and geographical location
- Low production and efficiency in winter, cloudy days and so on

Technology plays important role in developing and enhancing of this energy. Technology would improve efficiency, improving processes, productivity and reduce installation cost. In other word, technology is a tool to deal with solar energy challenges and make them be resolved. Besides of technology, other policies would enable solar energy be applied more:

- Industrial policies including promoting R&D strategies, making competitive environments, promoting costumer awareness, Strengthen value creation
- Financial policies such as use revenue, mobilize revenue streams by carbon pricing and other measures like green bands, recycling schemes and so on
- Education policies including technical and vocational education, training skillful experts and labors, facilitating reskilling of the work force from the fossil fuel industry to renewables

Fundamentally, solar energy is a proper renewable energy that could use instead of fossil fuels and countries benefit from its advantages to create low carbon and greener environment, even more economic sustainable countries.

### 2.2 Wind Energy

Wind energy is one of the most economical renewable and clean energy. It was used 5000 years ago by ancient Egyptians to sail their ships. Wind is the other source of clean energy that had been used since ancient Greece. In 1980s, the United State and Denmark were the pioneers of using Wind energy and at the end of 21st century, Germany has been introduced as the main leader of applying wind energy in the World by producing about a third of the world’s wind presented electricity until 2008.

Wind could be proper source of renewable energy for windy areas like Europe and Asia some countries. It is introduced as one of the cleanest sources of energy by not producing direct gaseous emissions into the environment and reducing impacts on climate change as well as one of the most economical energy resources.

Different types of turbine machine are used in developing the wind energy. horizontal-axis wind turbine is the most popular ones. The different types of wind turbines are:

- Horizontal Axis Convertor
- Vertical Axis Convertor
- Up-Steam Power Station
Wind energy as a source of clean energy without any footprint of carbon and greenhouse gases footprints, as a source to improve economic situation by taxes, utilizing as main resources of energy in local communities, boosting economic sustainability of countries through generating electricity via wind turbines, and employment opportunities are the main advantages of wind energy.

Although wind energy has many advantages, some challenges like its dependency on the region and its wind speed make challenges to apply this clean and renewable energy in high amount. Besides of this challenge, wind turbine machinery construction and operation make other challenges for wind energy to be applied. The main challenges that wind energy faced with are:

- **Design Issues:**
  Proper design of turbines with focus on blade loading and aerodynamically stability is required. Models for the estimating of material and structural stresses the horizontal axis and vertical axis wind turbines and appropriate aerofoiled shape for turbines are challenges that turbine designer faced with.

- **Locations Issues:**
  Proper area where high speed of wind is available is needed to be able to produce wind energy. Basically, rural areas that obstacles like high buildings aren't existed are realized as main locations. In addition, areas where high amount of wind is available, is the other location feature needed for proper position of wind turbines.

- **Grid Infrastructure and Connection Issues:**
  Areas with high speed of wind and with availability of land without obstacles such as high buildings; like rural areas are appropriate locations for wind turbines; However, such areas face with grid infrastructure challenges and grid stability; that these make most of energy generated be wasted. New phase of design, operation issues of power systems like energy storage techniques, energy management, grid infrastructure issues like reinforcement and upgrade of networks are needed to improve grid infrastructure and processes towards better efficiency of wind turbines.

- **Environmental Consequences:**
  Although wind energy is a clean and green energy, it could make some kind of environmental challenges like wildlife impacts, noise and visual impacts. A life cycle assessment (LCA) process is used to find out environmental impacts and reduce them in order to apply wind energy with higher efficiency and less environmental consequences.

  Proper design and planning could reduce birds killing made by wind turbines. Fundamentally, noise pollution by wind turbines is divided in two groups: aerodynamic and mechanical types. Aerodynamic noise is concerned on the speed of the rotor and could be reduced through proper design. Mechanical noise is generated by moving components such as gearbox, generator, bearings etc. proper design, selection, maintenance could reduce mechanical noise. Shape, color and layout of winds are the main features of wind turbines that could influence on visual impacts of areas.

- **Cost Challenges:**
Production cost including power produced, fixed costs such as interest, land rate, insurance, variable costs like maintenance, repair, miscellaneous and turbine costs make high investment be needed to develop wind energy. Therefore, new phases of wind turbine to be able to reduce their overall costs are required.

Fundamentally, improving technology and innovation would impact on design, militance and repair of turbines in order to reduce these challenges an increase usage of wind energy as a source of clean energy that countries are able to benefit from its advantages.

2.3 Hydropower Energy

Hydropower energy is the largest source of renewable energy to generate electricity. Hydropower energy is founded on energy derived from moving water. It is a source of energy for producing mechanical and electrical energy.

Hydropower has been used since ancient Greeks by using water wheels to grind wheat into flour. Then American and European factories used water wheel to power machines in 1800s. In late 19th century the force of falling water was used to generate electricity as a hydropower energy and eventually, the best sites for big dams had been developed in late 1940s as main resource of hydropower energy.

The main advantages of hydropower energy are:

- **Clean, Affordable and Reliable Energy:**
  
  Hydropower is the lowest cost source of electricity generation as well as clean energy without greenhouse gases footprints in many markets. It is low carbon, greenhouse emissions and pollution technology.

- **Improving environmental sustainability:**
  
  The hydro power is able to deal with environmental challenges such as waste and noise pollution, water quality and so on towards environmental sustainability.

- **Improving Economic Situation and Creating new Opportunities for Employment:**
  
  The hydropower industry is able to employ many workers worldwide, and achieve many more connected in supply chains. In addition, it could improve investment in local communities, including education, healthcare and other services.

- **Improving city Infrastructure:**
  
  Hydropower development make greater regional connectivity in distribution and transport networks towards enhancing infrastructure. Furthermore, it could influence on city infrastructure through providing safely management of freshwater, providing water supply for homes, businesses and agriculture.

- **Enhancing cooperation between countries:**
  
  Long distance electricity transmission across national boundaries promotes strong inter-governmental cooperation.

Hydropower energy is a large scale, cost efficient and clean storage technology that could improve sustainable development through its privileges and advantages.
2.4 Biomass Energy

Biomass is the oldest source of energy after sun. It has been used since the cave-men discovered fire. Around 1975, this kind of energy had been named officially “biomass energy”. In the 1980’s, Office of Technology Assessment estimated that over 1/4 of the U.S. needs to be fulfilled using biomass material. Although this will not happen until people stop using fossil fuels.

Biomass energy is concerned on generating and producing through living or one-living organism like wood, crops, seaweed, animal wastes. In particular, biomass energy is concerned on all organic matter existing in the biosphere, whether of plant or animal origin, and materials obtained through their natural or artificial transformation. Biomass is available in all three basic forms of matter: Solid, Liquid, and Gas, which themselves can be sub-divided into primary (produced by direct use of solar energy through photosynthesis) and secondary (generated by the decomposition or conversion of organic substances) products.

Biomass can be converted to thermal energy, liquid, solid or gaseous fuels and other chemical products through a variety of conversion processes.

Biomass as a renewable energy has advantages such as:

- Being accessible and available widely by generating through everyday human and animal wastes, vegetable and agriculture left-over etc.
- Reducing diseases by recycling of waste
- More effective and reliable, less expensive in contrast of fossil fuels
- Proper resource to produce biogas energy
- Producing oxygen and using up carbon dioxide by growing biomass
- Carbon neutral resource of energy

Although biomass has many advantages, it has disadvantages. Not being a completely clean energy, high cost in contrast of alternative resources, deforestation, requirement of large amount of space and water, not be as efficient as processed fossil fuels, like petroleum and gasoline are the main disadvantages of this kind of energy.

Fundamentally, it is needed to reduce disadvantages of biomass fuels and increase its efficiency in order to develop this energy and utilize it in larger amount.

2.5 Ocean Energy

Oceans are renewable energy including different types such as waves, tides, marine currents, Ocean thermal energy conversion (OTEC). Thermal energy could be harvested by oceans. In addition, potential and kinetic energy would be gained through the temperature difference of warm surface water and the cool deeper water as well as mechanical energy by tides, waves and currents.

Technology and development of ocean’s energy were made between 1800 and the late 1960’s and the largest tidal power station in the world was built in St. Malo, France in 1966.
Generally, tidal and wave are the main types of ocean energy utilized to provide reliable and sustainable energy.

The main advantages of ocean energy are:

- Be as clean and renewable resource of energy
- Neutral greenhouse gases emissions and products
- Not requirement of any fuels to create
- Proper alternative of fossil fuels
- Low cost after building technology
- No requirement of maintenance
- No footprint of huge environmental impact

Although ocean energy has many advantages, it has disadvantages that make challenges to utilize ocean energy as clean energy in large amount with high efficiency. High cost of related machines and technologies, damaging technologies by intense waves, low efficiency concerned on pattern of the tides, restriction of locations such as frozen oceans or places where tidal barrages could be built, design consensus especially for wave energy and requirement of specific technology are the main disadvantages and challenges related to ocean energy.

Oceans make energy that is an amazing advance for the human race and a great environmental help for the earth and humans being. continued technology push support mechanisms, large-scale deployment and market-pull support schemes are needed to tackle ocean energy challenges and apply this source of energy in larger amount with better efficiency.

2.6 Geothermal Energy

Geothermal energy is one of the renewable energy using the heat contained in the ground to generate electricity and direct use of heat with producing very low levels of greenhouse gas emissions. Geothermal energy is the thermal energy stored in the underground, including any contained fluid, which is available for extraction and conversion into energy products.

Geothermal energy had been used during Paleolithic times and eventually, in 1892 geothermal energy was applied directly by American. In 1943, Steam and hot water from geysers were used to heat homes in Iceland. In the 20th century, increasing demand of electricity made geothermal energy as one of main resource to generate energy and eventually in these days, geothermal energy is becoming one of clean, renewable and sustainable energy.

Based on factors such as soil conditions, climate, local installation costs on site and available land, there are different types of geothermal systems. Closed geothermal loop system including horizontal, vertical and pond, open geothermal loop consisting of pond and standing well are two basic types of ground loop systems.

Geothermal energy as renewable and clean energy has many advantages increasing the usage of this sustainable energy. The main benefits are:

- Being environmentally friendly
• Low cost of maintenance
• High efficiency and sustainability
• Proper alternative for non-renewable and fossil fuels energy
• Be reliable energy and not be dependent on the weather conditions

High cost of installation, rising earthquake, requirement of specific sites, releasing and expanding harmful, poisonous gases escaping during construction, land requirement to install geothermal system are the main challenges that geothermal systems confronted with. It is required to improve technologies and apply strategies to tackle these challenges and use geothermal energy in larger amount with more efficiency.

Fundamentally, geothermal technologies play significant role in energy security, economic development and mitigating climate change as well as reducing greenhouse gases emissions.

2.7 Waste Energy

Waste could be used as a renewable source of energy. In particular, waste to energy (WTE) is based on converting waste to different types of energy such as electricity, heat, fuel and so on through treatment technologies.

If waste does exist, it is proper to reuse it in possible condition or recycle it if isn’t possible to reuse it. Waste should be prevented, reduced, reused and recycled and unrecycled waste could be converted to energy.

In 1980s, first ideas about applying waste to generate energy instead of using natural resources had been created. In addition, shortage of landfill capacity was the other reason to manipulate waste for producing energy. The first indicator to burn waste and convert its products to energy was developed in 1874. In effect, Albert Fryer’s design and patent of the incinerator has made it possible to make tangible use out of waste products for over 140 years. Generally, the usage of this energy has increased since 1874. For instance, 61% rise has happened between 1960 to 2016 for American usage.

Solid waste, water waste and gas waste are three main types of waste that could be applied as a resource of energy. The below table presents types, sources and environmental impacts of waste:

<table>
<thead>
<tr>
<th>Physical State</th>
<th>Solid Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Liquid Waste</td>
</tr>
<tr>
<td></td>
<td>Gasous Waste</td>
</tr>
<tr>
<td>Source</td>
<td>Household/ Domestic Waste</td>
</tr>
<tr>
<td></td>
<td>Industrial Waste</td>
</tr>
<tr>
<td></td>
<td>Agricultural Waste</td>
</tr>
<tr>
<td></td>
<td>Commercial Waste</td>
</tr>
<tr>
<td></td>
<td>Demolition and Construction Waste</td>
</tr>
<tr>
<td></td>
<td>Mining Waste</td>
</tr>
<tr>
<td>Environmental Impact</td>
<td>Hazardous Waste</td>
</tr>
<tr>
<td></td>
<td>Non-hazardous Waste</td>
</tr>
</tbody>
</table>

Table 3.1: Waste Types, Sources and Impacts
Applying waste energy has many advantages including:

- Reducing pollution through reducing untreated waste
- Environmental and health benefits
- Decreasing quantity of waste
- Indirect energy saving
- Reducing depletion of natural and non-renewable sources of energy
- Economic benefit and employment opportunities

High cost, transmission of diseases, polluting of environment through producing smoke, long-term problems such as environmental damages concerned on not recycling some wastes, producing more waste and so on, harming humans and environment through ash wasting are the main challenges of waste energy.

Fundamentally, low cost technologies with lower environmental impacts are needed to reduce waste energy challenges. One of the main disadvantages related to waste to energy is dioxin emission that sophisticated filters could control them. Between 1990 and 2000 dioxin emissions of Waste-to-Energy plants in Germany dropped from 400 g to less than 0.5 g per year while the amount of thermally treated waste had more than doubled in the same period. In addition, ashes and fly ashes are the other main challenges of waste to energy resource. Burning under controlled condition, filtration process and recycling of ashes could reduce consequences of ashes of burning waste. In particular, air emissions regulations, solid waste regulations, storage tank regulations, special waste regulations, land use regulations, water use regulations are required to confront with waste energy challenges to be able to apply it in higher amount with more efficiency.

For more than four decades energy has been created by waste through leading of waste management. Generally, waste management and wastewater management are the main topics related to waste energy in order to improve its efficiency and deal with its challenges towards applying waste energy in higher amount. In other words, waste management is the solution to reduce environmental impacts of waste and waste energy. Therefore, waste management is fundamental issue in future of waste as renewable and clean source of energy.

**Waste Management:**

Waste management policy is based on three “R”: Reduce, Reuse and Recycle. It is required to recognize the optimal level of these three R with optimally each category of relevant stakeholders such as:

- Individual Households, who benefit from clean environment and gain renewable energy as consumers
- Individuals, who benefit from reusing or recycling discard materials directly
- Companies, that profit from recycling and reusing wastes as well as generated renewable energy

There are five categories of waste: liquid waste, solid rubbish, organic waste, recyclable waste and hazardous waste, that ordinary garbage, household trash as well as business and indus-
trial nonhazardous waste are applied as the main resources of solid waste to generate renewable energy. Solid waste management means the methods used for collecting, processing, transformation, recycling or disposal of solid waste, controlling landfill disposal facilities, transfer stations, resource recovery facilities, incinerators and other similar facilities. According to Tchobanoglous et al. (1993), waste management is the effective way to handle, keep, collect, convey, treat and dispose waste to be safe for environment and society. Demirbas (2011) declared waste management as a process to gather, transport and do process on waste before of any remaining residues. Fundamentally, waste management is a tool to reduce consequences of waste, ensure about safe environment and improve sustainability. There are different types of waste treatment including composting and biodegrading; incineration; reduce, reuse, recycle and recovery (energy region) and landfill that reuse, recycling, composting and energy generation are often preferred to landfills. The below figure presents hierarchy of waste management:

**Figure 1: Waste Management Hierarchy**
(https://baxcompany.com/)
Waste management has stages in order to gain best results that is shown in below figure:

Figure 2: Initial Steps in Solid Waste Management  
(Pakistan Environmental Protection Agency, 2005)

Wastewater Management:

We are living in an era that needed to be environmentally friendly. To be environmentally friendly, it is to focus on water as well as nature and environment. Therefore, wastewater management could be applied to improve environment sustainability and human’s health.

When water is used, water is contaminated by pollutant and it is needed to treat water to reduce negative impacts of water on environment. There are different sources of water contamination such as households, industry, mines and infiltration and eventually four main types of wastewater are declared:

- Domestic wastewater, storm water and urban runoff
- Industrial wastewater
- Agricultural wastewater
- Rainwater

Wastewater management is an old concept that it was used in 1500 B.C in Mohenjo-Daro near the river Indus (Pakistan), and in 1930s and 1940s civilizations was discovered as new path to reuse water by specific technologies.
Wastewater management is able to reduce environmental risks of wastewater to maintain the environment for future, develop sustainability and improve quality of life. Strong governance, financial aspects including financing investments, cost recovery, equity, economic benefits, technological cost, innovation challenges, human resource issues such as knowledgeable and expert capitals, applying high technologies and so on, data needs, technical barriers and optimizing the re-use of wastewater are the main challenges related to wastewater management.

Fundamentally, wastewater management could be a path to preserve the energy by improving water treatments based on using lower energy and solving challenges related to water shortage, water pollutions and health. In addition, wastewater management could be used as a tool to make wastewater as different sources such as:

- Drought-resistant source of water (especially for agriculture or industry)
- Source of nutrients for agriculture
- Soil conditioner
- Source of energy and heat

In particular, anaerobic digestion as a water treatment stabilizes organic wastes and generate a mixture of methane and carbon dioxide named biogas through bacterial decomposition process. Basically, biogas is a proper energy source that will be generated through wastewater Anaerobic digestion is usually carried out in a specially built digester and is common at some wastewater treatment works. The use of faecal sludge as a fuel has also been investigated in developing countries. Muspratt et al. (in press), for example, collected sludge samples from pit latrines, septic tanks, drying beds and stabilization ponds from Ghana, Uganda and Senegal for the determination of calorific value. The average calorific value of the sludge was 17.3 MJ/kg total solids which compares well with other biomass fuels, although partial drying of the sludge was required.

Wastewater management will not only improve environmental sustainability and health, but also influence on energy sector in two aspects: reducing energy consumption in water treatment and producing biogas as a renewable source of energy. Fundamentally, wastewater management is a tool to develop sustainability and improve quality of humans’ life.

2.8 Challenges of Renewable Energy

Low carbon and greenhouse emissions, free of direct pollution and maintaining natural resources are the main reasons to apply renewable energy more than traditional sources of energy. In particular, renewable energies are sustainable ones that could develop sustainability, better quality of life and livability. However renewable energies have many advantages that society, humans and the world could benefit from, there are challenges and limits that make applying of such energies controversial and challengeable. The main challenges that renewable energies confronted with, are:

- High Cost Issues:

  Proper technology to set up renewable energy tools, designing technical tools, applying high technologies, equipment maintenance cost, training technically skilled human resources, sustainable energy management, energy security and other issues to develop high efficiency,
productivity and sustainable energies are dependent on high cost. Therefore, reducing cost is one of the main challenges that renewable energies confronted with.

- **Technological Challenges:**

Most of renewable energies are based on high technology and modern technics. For instance, turbines for wind energy or equipment for waste energy are dependent on technology that needs not only high cost, but also research, knowledgeable and expert capitals, proper designing and so on. It means that such energies require technology and have to deal with technological challenges.

- **Structural Restrictions:**

Location dependency (wind energy), requiring appropriate locations (solar cells), limited radius of transportation (biomass energy), low efficiency related to appropriate design (wind energy) and other restrictions make applying of renewable energies challengeable.

### 2.9 Future of Renewable Energy

Energy plays significant roles not only in economic activity, but also in sustainability, livability and development of countries. In other words, energy could be a key driver for agriculture, industries, service sectors and all other sectors of the economy, such as food, health, the environment, water, and so onto achieve economic sustainability as well as environmental and social sustainability. In addition, quality of life and livability of humans like health, education, security and so on, are related to energy sector. Energy security, sustainable development and wellbeing are the energy policy that are required to develop sustainability. Therefore, renewable energy will gain these policies towards sustainability and humans well-being.

As sustainable development is the path to deal with global challenges, improve quality of life, livability and eventually make the world as a better place for living; renewable energies are solutions to gain sustainable development.

Renewable and clean energy resources could be applied as alternative of fossil fuels to develop sustainability.

Besides of applying renewable and clean energies, sustainable energy management is required to gain high efficiency and productivity of renewable energy with the lowest amount of consequences.

In particular, sustainable interaction of three feedback loops including intelligent infrastructure and grid reliability loop; a consumer loop; and a fragility loop plays significant roles in efficacy and productivity of renewable energies.

Generally, future of renewable energies is dependent on its efficiency, productivity and solving its challenges that energy management and proper interaction among declaring loops could influence on these parameters and applying them as main resources of energies instead of fossil fuels.

Fundamentally, future scenario for modern energy which are renewable, sustainable and clean could not only develop sustainability but also make the world as a better place for living. New energy solutions introduced as ubiquitous energy in this book are required to maintain the world and humanities through sustainability. In other words, future of renewable energies is
related future scenario. Appropriate and sustainable scenario based on different indicators such as ubiquitous concept, smartness, digitalization, innovation and sustainable energy management. In this book, appropriate and sustainable scenario for future is introduced as ubiquitous energy that is declared in future sections.

2.10 Clean and Inclusive Energy

Clean and inclusive energies introduced as ubiquitous energies is based on renewable resources of energy and energy management that is aligned with sustainability and sustainable development. In particular, such energies are vital to reduce environmental concerns related to energies towards sustainability. In addition, they are able to preserve the nature and environment for future as well as improving livability of the world at present.

The below figure illustrates ubiquitous energy:

![Figure 3: Main Qualities of Ubiquitous Energy](Alanne and Cao, 2019)

Environmental sustainability, reducing climate change, maintaining resources, materials and species, efficiency, productivity, accessibility, security, improving health conditions, supplying humans’ needs, economic sustainability, social sustainability, sustainable development and high quality of life are main advantages of clean and inclusive energies. Therefore, it is vital to increase usage of such kind of energies to reduce negative impacts of energies towards creating better places for living.
References


Energy: The Next Fifty Years. 1999. Published by OECD.


Hydropower Status Report: Sector Trends and Insight. 2019. Published by International Hydropower Association (IHA).


http://www.ianswer4u.com/2012/02/biomass-energy-advantages-and.html
Ubiquitous Blue-Green Energy Management

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1. Blue-Green Energy Management

Energy management as well as renewable energy resources are the tool to make sustainable future of energy that could influence on developing sustainability.

In this section energy management, sustainable energy management and new idea about energy management introduced by authors are mentioned.

1.1 Energy Management

The world is moving towards a sustainable energy future with focus on energy efficiency, using of renewable energy sources and applying proper energy management.

Energy is a fundamental key for sustainable development. Sustainable energy could be applied as tool towards sustainable development. Energy issue confronts a lot of challenges besides of renewable and fossil fuels such as: energy consumption, waste of energy, energy costs, technological and technical concerns, environmental risks, human society, culture challenges and so on, that influence on energy sector. So, it is vital to find out solution and path to reduce these challenges to achieve sustainable energy. Energy management could be a tool to be able to face with these energy challenges.

Energy management is about using of management and technology to improve energy performance and energy efficiency.

The energy crises happened in 1973 made the world to find out new solution for alternative arrangement of ensuring energy sufficiency. This new concept focused on more efficiency, more productivity and reduced production cost named energy management.

Based on ISO 50001, energy management system (EnMS) process is founded on Plan-Do-Check-Act Framework:

Plan: This step is concerned on conducting energy review, establishing the base line, developing resources and action plan.

Do: This step is about implementing action plan.

Check: Monitoring and measuring processes to determine energy efficiency against energy policy are done in this step.

Act: The last step is concerned on taking the action to enhance energy performance and EnMS

Energy management has three main players that is shown in below figure:
Energy management is a solution for organizations to produce services and products not only with the least costs, but also with the least greenhouse gases emissions and environmental risks. Basically, reducing costs has two aspects: price and quantity. Reducing greenhouse gases emissions could improve environment quality that is one of the main concerns of recent decades. In addition, energy saving could influence on environmental challenges as well as cost, so, cost-effective decision making, cost reduction, environmentally friendly and sustainability towards better quality of life are the main benefits of energy management.

Energy management has advantages for businesses, their process as well as society and a country. In other words, the country could benefit from privileges of energy management used by businesses. The most important advantages of energy management are:

- Reducing energy costs affected on the company profitability, efficiency and competitiveness of businesses in the world market
- Improving productivity and quality of businesses
- Improve staff well-being and business performances
- Demand balance
- Increasing the investment to the renewable energy
- Providing widely use of advance energy technologies,
- Improving economic sustainability by improving energy efficiency and reducing costs
- Occupational safety and health
- Reducing businesses' risks
- Waste disposal reduction
- Reducing environmental concerns and improving environmental protection
- Improving usage of wastewater as resource of energy
- Enhancing sustainability factors like social, environmental and economic sustainability
- Making opportunities for businesses to participate in global and international markets

Different tools and techniques like applying high technologies such as ICT, IoT, IoE and so on, innovation, education to train knowledgeable, expert and intellectual capitals, using different
Fundamentally, energy management is concerned on energy efficiency, utilizing renewable energy, and waste as new source of energy, being environmentally friendly and cost efficiency to improve efficiency and productivity of business with lower cost and environmental effects. It is important to apply energy management to improve economic development, sustainability and progress of countries.

1.2 Sustainable Energy Management

Energy management is a tool to gain sustainable energy towards sustainable development. Therefore, proper type of energy management that is aligned with sustainability strategies and policies is needed.

Sustainable energy management could be a key to develop sustainability.

Sustainable energy management is based not only on energy management, but also environmental, economical and social sustainable policies.

Sustainable energy management could reduce environmental concerns, reduce cost, improve investment situation, enhance economic sustainability, decrease business risks, improve social sustainability and so on towards sustainable development. In particular, clean, efficient, affordable and reliable energy services achieved by sustainable energy management are indispensable for global prosperity and facing with global challenges.

Such energy management would manage energy consumption and process cost to promote sustainable and successful business as well as develop sustainability in countries.

Different tools and techniques like applying high technologies such as ICT, IoT, IoE, digitalization, smartness and innovation play significant roles in developing sustainable energy management. In addition, education, applied science and vocational training are important means to train knowledgeable, expert and intellectual capitals are needed for sustainable energy management. For instance, IoE-EQ is a project to enhance awareness and knowledge of European Companies and Professionals about IoE, its benefits and impotence to make businesses be able to benefit from IoE privileges. The other factor introduced is smartness and digitalization. Applying smart grids instead of traditional grids would make sustainable energy management. The below figure shows smart grid challenges and benefits:
Fundamentally, sustainable energy management could be a path to achieve sustainable energy to develop not only sustainable and successful businesses, but also improve sustainability.

1.3 Blue-Green Strategies

Blue-Green city is a new concept for modern areas that is able to tackle global challenges and make the world a better place for living through developing sustainability and better quality of life. Such city is based on Blue-Green infrastructure and polices with mitigating flooding, reducing water sacristy, enhancing ecosystems, designing a platform for stakeholder engagement, improving sustainable developing and making better quality of livability as main goals.

In particular, Blue-Green strategies are based on environmentally friendly and water management policies like stormwater management, water security, flood management, tree health, recreation needs, reducing greenhouse gases, creating renewable energy resources, decreasing environmental concerns and climate change. In specific, Blue-Green strategies are related to two indicators landscape planning concerned on open space strategy, urban forest strategy, biodiversity and environmental policy and water planning including sustainable water use plan, integrated water management strategy, flood studies and stormwater management plan.
Blue-Green policies are based on two principles that are shown in below figure:

![Blue-Green Infrastructure Planning](E2Designlab, 2017)

Fundamentally, Blue-Green policies make situation to develop Blue-Green infrastructure that countries could benefit from its privileges. The main advantages of Blue-Green infrastructure are shown in below figure:

![Advantages of Blue-Green Infrastructure](Hamid Doost Mohammadian and Rezaie,2017)

Water supply, biodiversity, flood reduction, pollution control, natural hazards, water quality, natural resources maintainace, reducing environmetal concerns, climate change and recreational are main achievement of applying Blue-Green strategies.

Blue-Green strategies could be realized as principles of healthy urban living, multifunctional green infrastructure, key factors of healthy urban water, strategies of maintaining nature and environment in order to create healthy urban living based on healthy urban environment and healthy lifestyle towards obtaining high liviability and quality of life for citizens. Blue-Green
policies play an essential part in the physical and mental health and well-being of the urban population.

1.4 Blue-Green Energy Management

Blue-Green Energy management is about modern concept of energy management that is both sustainable and smart. Such energy management is based on sustainability pillars as well as renewable technologies. Furthermore, it is founded on Blue-Green strategies.

In particular, there are three main indicators that have influenced on evolving debate of sustainability. Economic development, social development and environmental protection are component that are created sustainable development; but authors believe that sustainability has seven pillars: environmental, economic, social, cultural, educational, political and technical sustainability are main component of modern sustainability introduced by authors. The below figure presents this theory:

![Figure 5: 7PS Model (Hamid Doost Mohammadian, 2017)](image)

This model was introduced in 6th International Conference on Civil, Architectural and Environmental Sciences in Stockholm in June 2019 in article named „An applied comparative study about the countries with low sustainability and high CO2-emission and advanced sustainability knowledge in Europe and giving practical models to improve and implement sustainability solutions“. These pillars are required to create Blue-Green energy management and such management is able to improve these pillars of sustainability in a business, a country and eventually in the world. Therefore, there is a bilateral relation among sustainability and Blue-Green energy management that is illustrated in below figure:
Fundamentally, Blue-Green energy management is founded on environmentally friendly strategies, sustainable water management, seven pillars of sustainability, renewable energies and smartness. Generally, energy management aligned with sustainable water management, environment and nature preserving and sustainability policies as well as smartness paths, smart and sustainable infrastructure would be introduced as Blue-Green energy management. In particular, technology is not only a component of such energy management, it is a fundamental tool to develop it. In other words, Blue-Green energy management is based on two main indicators: sustainability and technology. The below figure presents Blue-Green energy management Cycle:
This energy management would make opportunities and benefits for businesses such as:

- Energy efficiency
- Improving energy quality
- Increasing energy security
- Preserving natural resources
- Creating new paths and resources as renewable energies such as waste and water-waste
- Reducing environmental concerns
- Being accessible at anytime and anywhere
- Cost reducing
- Improving CSR strategies
- Creating friendly working environment
- Improving productivity and efficiency of a business
- Controlling and managing business processes towards reducing risks
- Making successful business with high efficiency, productivity
- Achieving sustainable development
Technology barriers, inexpert and not knowledgeable capitals, security risks are main challenges that Blue-Green energy management confront with. Basically, improving technology, applying innovative and creative solutions, risk management, resource management could reduce these challenges. In addition, education and training capitals who are expert, knowledgeable and intellectual play fundamental roles in developing Blue-Green energy management.

Blue-Green energy management is required to not only develop environmental sustainability to preserve resources and the world for future, but also make modern and sustainable business such as hybrid SMEs or SME 4.0 that are components of sustainable and smart countries which are able to make better world for living focused on sustainability, high quality of livability and quality of life. In particular, it is able to make environmental sustainability as well as sustainable countries that improve all aspects of sustainability towards more sustainable and livable world.

Generally, 7 P.S is a tool to achieve Blue-Green energy management that the below figure presents impacts of this theory on energy management towards developing Blue-Green energy management:

![Figure 8: Sustainable Energy Management based on Seven Pillars of Sustainability](image)

Fundamentally, Blue-Green energy management plays significant and fundamental roles in creating sustainable businesses and countries towards more sustainable and livable world. So, it is required to be applied in businesses to benefit from its privileges and developing sustainability. Different tools and techniques are required to create Blue-Green energy management that are declared in following context.
2. Towards Blue-Green Energy Management

Different tools and techniques are required to apply Blue-Green strategies to develop Blue-Green energy management. Techniques required for Blue-Green energy management by authors' point of view are declared in this section.

2.1 Risk Management as a tool to achieve Blue-Green Energy Management

Risk management is one of main tool that is required to develop Blue-Green energy management.

Although the concept of risk, risk management and risk assessments have a long history; More than 2400 years when the Athenians applied their capacity to assess risk before making decisions; risk assessment and risk management as a scientific field is novel and young. At the beginning of the twentieth century, the first significant studies in business risk management were developed by Willet (1901), Leitner (1915), Knight (1921), Oberparletier (1930), Stadler (1932), and Sassi (1940).

Risk assessment and management are two main tools to identify, treat and reduce risks threaten each business.

Risk is defined as uncertain events that could have positive or negative impact on the project objectives. Risks include circumstances or situations, the existence or occurrence of which, in all reasonable foresight, results in an adverse impact on any aspect of the implementation of the project. Social risks, technical risks, environmental risks, economic risks, political risks, commercial risks, organization risks, legal risks, humans’ risks and risks concerned on high technologies like IT risks are the main types of risks that threaten future of each business.

Although risks make failure, unsuccess or loss in projects, companies like to take risks to achieve income and profits by benefits of risks. So, path or solution would be applied to help companies to do risk to gain income and profits with the lowest failure rate. Risk assessment and management are the tool applied by companies to reduce risks. They could work together to mitigate and control risks towards business targets and success.

Risk assessment is a process to determine the nature and extent of risk, and is critical for laying the foundations for developing effective policies and strategies for disaster risk management. In particular, risk assessment is about risk identification, risk analysis and risk evaluation. The below figure presents risk assessment processes:
Risk Management is about process to make balance between realizing opportunities and minimizing vulnerabilities, losses and negative impacts of risks. The below figure present risk management processes:

Fundamentally, risk assessment and risk management are tools to find out risks, treat them and reduce them towards success. There are several models and standards for risk management such as ISO 31000, PM Book and so on. Furthermore, two models were designed by authors that are illustrated in following figure:
There are different types of risk management including:

- **Project Risk Management (PRM):**

  Project risk management is the process to find out, analyze and respond of proper risks in cycle of each project in order to manage risks and help businesses to gain their goals and targets. Main aim of PRM is to find out level of project risks, minimize its negative impacts and maximize positive happenings of project outcome. Fundamentally, PRM is an element to achieve business success and sustainability.

  PRM has four main stages:
  
  - **Risk Identification** to find out proper risks and their features for each project.
  - **Risk Quantification** to evaluate risks and risk interactions to assess the range of possible project outcomes.
  - **Risk Response Development** to declare opportunities and responses of proper risks.
  - **Risk Response Control** to manage and respond to risks and their changes in project.

- **Financial Risk Management (FRM):**

  Financial risk management is the processes concerned on economic value of business to decrease and minimize financial failure. FRM measures could make strategies and policies to help departmental traders, operating divisions and the firm to keep within the acceptable, predetermined limits and reducing risks related to financial sector.

  Financial risk management strategies, financial risk management policies, financial risk management methodologies are the main components of FRM.
• **Govern Mentality Risk Management (GRM):**

Govern Mentality risk management (GRM) is concerned on managing and controlling the risk of a city or a country and putting it down.

In particular, developing a comprehensive risk management program that identifies, reduces or minimizes risks to its property, interests, and employees by governments is required to reduce risks threaten future of the country. In addition, costs and consequences of harmful or damaging incidents arising from those risks should be contained and analyzed by GRM.

• **Enterprise Risk Management (ERM):**

COSO defined ERM as “a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risks to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives”.

COSO believes that the ERM Framework provides a clearly defined interrelationship between an organization’s risk management components and objectives that will fill the need to meet new laws, regulations, and listing standards and expects it will become widely accepted by companies and other organizations and interested parties.

Fundamentally, ERM as a kind of risk management is able to support value creation by enabling management to deal effectively with potential future events that create uncertainty and respond in a manner that reduces the likelihood of downside outcomes and increases the upside. Furthermore, ERM considers objectives in all level of organizations such as enterprise level, division or subsidiary and business unit processes. So, ERM considers how individual risks interrelate and develops portfolio views in business unit level and entity level perspectives.

### 2.2 Resource Management a tool to achieve Blue-Green Energy Management

Resource management as a part of project management is a fundamental tool to achieve Blue-Green energy management.

Resource management is the process to plan, schedule and allocate resources in the best path with the highest resource efficiency. In other words, resource management is about planning, leadership and controlling of resources. Not only does resource management ensures that all labor and time information is recorded, it enables managers to easily access, assess, and analyze this invaluable data.

It would develop optimization, efficiency and success for businesses. It has steps that are shown in below figure:
Resource management plan finds out the issues, opportunities, and constraints that could influence on land management and resource development to develop goals and aims of projects in a path concerned on higher efficiency and productivity.

Sustainable resource management (SRM) is required to guarantee the materials and energy supply for future. In other words, it is a tool to develop sustainability and maintain the nature and the world for future. Sustainable resource management means managing resources in a path not to be depleted that future generations are able to benefit from it. By SRM, a renewable resource would be used again and again, so is more sustainable, and non-renewable resource will be running out, although it is not be sustainable in the long run, it will be remained more.

Fundamentally, sustainable resource management has advantages such as:

- Reducing costs
- Making management process more transparent
- Making project controlling easier
- Maximizing resource efficiency
- Increasing profitably
- Better working environment
- Proper resource allocation to preserve non-renewable resources
Creating sustainable businesses with better efficiency and productivity

Resource management as a fundamental tool to create successful, sustainable, efficient and effective businesses has different types that the common categories are:

- **Human Resources Management:**
  Human resource management (HRM) is about employing people, training them, compensating them, developing policies relating to them, and developing strategies to train employees and make opportunities towards successful and sustainable businesses with high productivity and efficiency. HRM strives to achieve organizational and individual goals through most effective use of people. Fundamentally, the main aim of HRM is to improve business efficiency, productivity and output of employees in strategic, social and ethical responsible path. In addition, HRM is a tool to tackle organizational challenges in order to achieve productive improvement, enhancing quality of working life, improving safety and health, providing equal employment opportunity towards successful business with high efficiency and productivity.

- **Natural Resources Management:**
  Natural resource management (NRM) is about management of natural resources like land, water, soil, plants and animals, fossil fuels such as gas, oil and so on; with a focus on how management could improve the livability of the world, quality of life for present and future generations. In particular, natural resource management is concerned on sustainable utilizing natural resources to maintain them for future as well as make sustainable development. Avoiding degradation and destruction, solving the water balance challenges, improving the conditions of the resources, maintenance of non-renewable, fossil fuels for future, reducing environmental concerns and preserve it for future are the main benefits of NRM.

- **Project Resources Management:**
  Project resource management (PRM) is about processes to identify, acquire and manage the resources to make successful and sustainable business. Resource estimation, data collection, resource plan, schedule development, checking of resource allocation and negotiation for resources are the main steps of PRM.

- **Financial Management:**
  Financial management as an integral part of overall management is concerned on managing financial assets and liabilities. It is about planning, organizing, directing and controlling the financial activities including procurement and utilization of funds of the businesses. Profit maximization and wealth maximization are the main targets of financial management by main benefits such as: Providing guidance in financial planning, assisting in acquiring funds from different sources, increasing organizational efficiency, reducing delay production, cutting down financial costs, reducing cost of fund, ensuring proper use of fund, helping business firm to take financial decisions, increasing shareholder’s wealth, controlling the financial aspects of the business, providing information through financial reporting and making the employees aware of saving funds.

Applying strategies, tools and techniques for sustainable financial management in order to create sustainable and successful business with focus on sustainable development are required.
• **Infrastructure Management:**

Infrastructure management (IM) is about management processes to operate essential components such as policies, processes, equipment, data, human resources, and external contacts towards effectiveness. In other words, IM is concerned on the planning, design, delivery and control of the foundational back-end support structure for applications and data. Based on the other definition, Infrastructure Management is to manage foundational structures like bridges or electrical grids including deployment, operation and maintenance.

Backup and disaster recovery, network and storage, servers and operating systems, database management and applications are the main pillars of IM. In particular, cost effectiveness solutions, better costumer services, round the clock monitoring, data security, improving productivity, scheduled maintenance, sustainable business and sustainable development are the main advantages of IM.

• **Facility Management:**

Facility management (FM) focuses on managing a facility like office building or data center. FM is an interdisciplinary field concerned on the coordination of space, infrastructure, people and organization, associated with the administration of office blocks, arenas, schools, sporting complexes, convention centers, shopping complexes, hospitals, hotels, manufacturing, shipping, and so on. Reducing costs and adding value to the core business of both the public and private sectors client organization are the main aims of FM. In particular, facility management is required to make successful and sustainable business towards improving sustainable development.

• **Enterprise Asset Management:**

Enterprise asset management (EAM) is about managing capital assets of organization. In other words, EAM is a process to manage the lifecycle of physical assets and equipment to maximize lifetime, reduce costs, improve quality and efficiency, health of assets and environmental safety of businesses.

Reducing maintenance cost, reducing inventory cost, reducing procurement cost, increasing project return on investment, improving cash flow, improving productivity and efficiency, improving costumer experience and sustainability are the main benefits of EAM.

• **Asset Management:**

Asset management is a tool for both private and public sectors to define and establish more sustainable, efficient and effective organizations. Asset management in concerned on growing a client's portfolio while mitigating risk of businesses.

Reducing total costs, reducing capital costs, improving operating performances, reducing health impacts, decreasing environmental impacts, reducing risks especially safety risks, improving and maintaining reputation of businesses, reducing legal risks, improving effectiveness, productivity of businesses and sustainability are the main benefits of applying asset management for not only businesses, but also country as a public sector.

• **Digital Asset Management:**
Digital asset management (DAS) is about managing digital assets such as documents and media. It is associated processes applied by companies to manage digital data and to catalog, search, and retrieve digital assets. Fundamentally, organizations and businesses apply DAM to manage their digital assets efficiently, quickly and sustainable.

Making efficient production cycle, cost savings, increasing standardization, achieving efficient redistribution of intellectual property, optimizing organization, improving organizational processes and performances.

- **Inventory Management:**

Inventory management is the process of monitoring and controlling inventory level and making adequate condition to meet and supply customer demand.

Improving efficiency and productivity of businesses, minimizing costs and maximizing sales and profits, making manual tasks automated, integration of entire businesses, improving customers’ willingness and eventually developing sustainability are the main advantages of inventory management.

- **IT Service Management:**

Information technology and internet play significant roles in business processes and functions. Therefore, it is required to apply these technologies to gain targets and success of each business. IT service management based on managing information technology assets as a kind of service declared by service level agreements is a fundamental resource management tool to help businesses towards success and sustainability. In other words, IT service management is a concept to enable organizations and businesses to maximize business value, profitability, effectiveness and productivity through applying information technology.

Fundamentally, resource management could be declared as a tool to develop Blue-Green energy management.

### 2.3 Technologies to achieve Blue-Green Energy Management

Technology is able to change and improve the energies especially renewable energies and energy management, business, and even impact our lives. In particular, technology has a strong impact on economic growth, environmental sustainability, water management and eventually sustainable development. Therefore, applying high technologies, digitalization and smartness play significant and strong role in creating Blue-Green Energy management. In particular, high technologies, smartness and digitalization and their roles in modern era were declared in previous chapters.

Technological changes in renewable energy technologies play an important role in developing Blue-Green Energy management in order to reduce impacts on climate change, being environmentally friendly, applying sustainable water management policies, improving energy quality, energy efficiency, reducing costs, improving work environment, improving market penetration and participating in different markets towards sustainable development. In other words, technology is a tool to develop all features and indicators that are required for Blue-Green energy management.
High technologies such as ICT, IoE, smartness and so on; are technological transformation influence on energy management through changing the global policy from fossil energy and coal to sustainable renewable energies, improving energy management, energy efficiency and energy quality as well as other benefits such as reducing cost, creating better environment and so on. Such technologies like IoE, IoT, digitalization and smartness are able to make smart environment.

In particular, high technologies could be applied in different processes and levels of energy management like risk management, human resource management and so on; and influence energy management performances and processes towards developing modern concept of energy management like smart energy management.

The below figure illustrate how high technologies and digitalization could influence on energy management:

![Figure 13: Digitalization and Energy Management](Hamid Doost Mohammadian, 2017-20)
Fundamentally, such technologies are able to create Blue-Green energy management through its benefits and privileges such as energy efficiency, high energy quality, environmentally friendly, sustainable water management, improving renewable energy technologies, energy security, flexibility, improving market operation and market design, reducing cost, smart and sustainable infrastructure, participating in different markets especially global ones and high working environment quality. The below figure presents impacts of digitalization index on energy area:

![Figure 14: Digitalization Index and Energy Area (Hamid Doost Mohammadian, 2017-20)](image-url)
Not only digitalization, but also other modern technologies like IoE, IoT, IT, ICT and so on; would influence on energy area and energy management. The below figure designed by authors illustrates smart and sustainable energy management through applying of modern technologies and digitalization:

**Figure 15: Sustainable and Smart Energy Management based on technologies like IoT (Hamid Doost Mohammadian, 2017-20)**

Although digitalization and high technologies could influence on sustainable and smart energy management, they could make security challenges in energy sector. Therefore cyber security is required to reduce security risks. The below figure presents cybersecurity:

**Figure 16: Cyber Security (Hamid Doost Mohammadian, Dario Assante, 2016-20)**
Sustainable energy structure will be developed as well as opportunities and solutions for challenges that traditional energy management faced with; through the help of high technologies, digitalization and smartness in energy management and their advantages. In other word, such technologies, smartness and digitalization are important tools to make Blue-Green Energy management.

2.4 Innovation as a tool to achieve Blue-Green Energy Management

Innovation is an important tool and technique to create solutions and apply strategies, policies towards sustainable and Blue-Green Energy management.

In particular, innovation is about introduction of something new and useful. Innovation is the embodiment, combination, or synthesis of knowledge in original, relevant, valued new products, processes, or services. Innovation also encompasses new processes, new business systems and new management methods that could influence on productivity and hence growth. Innovation is defined as the successful implementation of creative ideas within an organization. Innovation could be utilized as a tool to change or improve old processes in order to enhance business and organization function.

It is vital to improve business and make the economic situation profitable. In specific, it is a fundamental tool for Blue-Green energy management.

Different innovation models are introduced that could be used to apply sustainability strategies, environmentally friendly policies and water management techniques towards Blue-Green Energy management. According to the period of development, resources, and the novelty of the innovation portfolio, different categories for innovation are declared.

Besides of these models, IMP³rove and TRIZ are two innovation management techniques that are proper to gain sustainability in not only energy management sectors, but also all businesses and organizations.

**IMP³rove:**

IMP³rove was introduced in 2006 by the European Commission, DG Enterprise and Industry for developing and testing better services in support of innovation management. The main aim of IMP³rove academy is to find out path to gain growth of people, organizations, regions and counties sustainable via innovative management. In particular, it is utilized to apply innovation management capabilities for developing better services in management towards achieving businesses’ goals, business productivity and efficiency. Furthermore, it could be used as a tool to make businesses be aligned with sustainable approach.

IMP³rove founded on innovation management, has five main management dimensions: innovation strategy, innovation organization and culture, innovation life-cycle processes and enabling factors such as human resources management, knowledge management, project and program management, controlling and IT.

**Innovation Strategy:** It declares as the most promising areas where the businesses are able to gain profit growth rates with new products/services or existing products/service in new markets and environment. Generally, it could help businesses towards direction and paths focused on all innovation management activities for maximum impact.
Organization and Culture: Organization and culture must support innovation's strategy to gain profit growth. In particular, businesses must follow specific structures, for instance, to integrate external partners in their development processes or to seamlessly manage the development processes. Their culture should be aligned with new ideas no matter where they come from to be able to participate in different markets with different features. The organization has to translate the innovation strategy to pursue those ideas that are most promising for their focus areas.

Innovation Life-Cycle Management: It covers the integration and management of innovation life cycle processes such as idea management, product/service and process development, launch, continuous improvement and the discontinuation of e.g. products and services of firms.

Enabling factors: Enabling factors including knowledge management or capabilities in specific technologies or expertise in new market development have an impact on growth through innovation management. They must be aligned with the organization innovation strategy, allocated in the right manner in the organization and leveraged for successful innovation management to exploit the growth potential of the innovation.

These four dimensions of innovation management could increase the innovation and business performance to make businesses and organization profitable growth as well as developing sustainable energy management for businesses. It means that it is a fundamental tool to develop sustainability.

TRIZ Algorithm:

TRIZ based on Russian word “TEORIVA RESHENIVA IZOBRETA TELSKIKH ZADATCH” which means theory of Inventive Problem Solving; is a Russian innovative problem solving theory. It was invented and developed by Genrich, S. Altshuller and his associates in a private section in the former Soviet Union in 1940s.

Genrich, S. Altshuller found out three main findings through his inventions and researches:
1. Problems and solutions are repeated across industries and sciences
2. Patterns of technical evolution are also repeated across industries and sciences
3. The innovations used scientific effects outside the field in which they were developed

TRIZ is a philosophy in technology, a methodology for reorganizing science and technology from the technology side, a technique for innovation, and a huge system of knowledge base of technology reorganized in such a perspective, altogether at the same time. Fundamentally, TRIZ provides excellent principles (or models) and concrete tools for ‘creative thinking’ in the whole range of technology.

The TRIZ matrix as a systematic way to think about issues could develop and create alternative solutions. Based on TRIZ method, every specific challenge that an organization confronts with, could be controlled and reduced to a general problem that has been faced with before. This general problem with a general solution founded on one of the 40 inventive principles that TRIZ matrix contains such as: segmentation, extraction, local quality, asymmetry, merging, universality, nested doll, counterweight, preliminary counteraction, preliminary action, cushion in advance, equipotentiality, the other way round, spheroidality, dynamics, partial or excessive actions, partial or excessive actions, transition into another dimension, mechanical vibrations,
periodic action, continuity, rushing through, blessing in disguise, feedback, intermediary, self-service, copying, cheap objects, replace mechanical system, pneumatics and hydraulics, flexible shell, porous materials, color changes, homogeneity, discarding and recovering, parameters changes, phase transitions, thermal expansion, strong oxidants, inert atmosphere, composite materials.

TRIZ has six main steps: identifying contradiction, determine improvement and degradation, design parameters, examine proposed principle, select best principle, apply inventive principle. Innovation as an internal factor could influence on developing renewable energy as well as applying sustainability policies, environmentally friendly strategies and sustainable water management paths towards Blue-Green energy management. In particular, technological changes are the tools in increasing roles of innovation on Blue-Green Energy management.

Innovation is one of the main accelerators for energy transmutation and creating sustainable and smart energy management. Innovation models could influence on energy sectors in different paths and processes like linear and systematic model.

Technical challenges, cost, economic barriers, environmental challenges and concerns, climate change, proper infrastructure, capitals, participating in global market and so on, are the main challenges for developing Blue-Green energy management that innovation processes could confront with them and find out solutions and strategies towards Blue-Green energy management. For instance, i- Sustainability plus theory based on innovation, technology and sustainability is a tool to create Blue-Green Energy Management. This theory is introduced in following context. Fundamentally, innovation is required to deal with energy management challenges, applying technology in energy management to make Blue-Green energy management.

3. Ubiquitous Blue-Green Energy Management and Sustainable Development

Ubiquitous Blue-Green energy management could be applied as a path to create successful businesses founded on sustainability, environmentally friendly, water management, energy quality and efficiency and renewable resources towards sustainable and livable countries. These modern countries are able to deal with global challenges and improve livability in order to make the world as a better place for living. Therefore, it is important to focus more on such energy management not only as a tool to improve renewable energies, but also as a path towards sustainability and making better world for living.

3.1 Sustainable Development

Nowadays, sustainability and sustainable development are remarkable, controversial and timely phenomena at not only local level, but also global one.

The concept of sustainability is not new and it has long story. For the first time in 1713 sustainability as a new concept was introduced by Carlowitz. Then in the first half of the 18th century, the idea of sustainable revenue was published by Denmark, Norway, Russia and France; and in 1970’s concept of sustainability was officially stated. After that, several researches and studies were explored, and different agendas were held about sustainability. Eventually, in 1995
in Agenda 21 was mentioned that: "Sustainable Development is a multidimensional phenomenon that could make a higher quality of life for all people. The United Nations (UN) has declared sustainability as a tool to struggle with urbanization problems such as social conflict, environmental degradation and the collapse of basic services which threaten the cities, human's beings and the world.

Fundamentally, sustainable development is declared as a path to maintain the world for upcoming generations as well as improving livability of the world for present generation. Sustainable development makes society stable and to improve human situation and life. High quality of life, health and prosperity with social justice and maintaining the earth’s capacity to support life in all its diversity are the main aims of sustainable development.

The main aims of sustainable development are:

- End poverty in all its forms everywhere
- End hunger, promote food security, improve nutrition and enhance sustainable agriculture
- Ensure healthy lives and promote wellbeing for all at all ages
- Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- Achieve gender equality
- Ensure availability and sustainable management of water and sanitation for all
- Ensure access to affordable reliable sustainable and modern energy for all
- Achieve sustained, inclusive and sustainable economic growth, full and productive employment
- Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
- Make cities and human settlements inclusive, safe, resilient, and sustainable
- Reduce inequality within and among countries
- Ensure sustainable consumption and production patterns
- Take urgent action to combat climate change and its impacts
- Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.
- Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
- Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
- Strengthen the means of implementation and revitalize the global partnership for sustainable development

In particular, sustainability and sustainable development are needed to not only maintain the world but also improve human well-being in the long term through management of the human
environmental system and dealing with global challenges like poverty, security, social instability, health challenges, diseases, economic problems, environmental concerns, climate change, social challenges, cultural barriers and so on.

3.2 Ubiquitous Blue-Green Energy Management

Ubiquitous concept is about everything, always, everywhere that is a path to be aligned with rapid growing population towards supplying citizens needs and sustainability.

Artificial intelligence, virtual reality, robotic and digitalization founded on high technologies play significant roles on developing and growing of ubiquitous services. In addition, innovation is a strong tool to make ubiquitous services, even ubiquitous is derived from innovative concept. Innovation and technology are required to create ubiquitous services. In particular, ubiquitous is founded on five main pillars reality, virtual-reality, smartness, ICT infrastructure and high technologies. The below figure presents ubiquitous pillars and sustainable smart energy management based on authors’ point of view:

Ubiquitous and digitalization based on technology and innovation are modern idea in western and non-western countries to create modern and sustainable cities in order to supply humans' needs, improve quality of life and livability, deal with global challenges and developing sustainability. Therefore, ubiquitous is a technique to apply Blue-Green strategies towards Blue-Green energy management.

As ubiquitous is a fundamental tool and technique to find out solutions and paths towards Blue-Green energy management, it could be introduced as component of such energy management. Therefore, Ubiquitous Blue-Green energy management could be stronger tool instead
of Blue-Green energy management to focus on roles of technologies especially ubiquitous in modern concept of sustainable and smart energy management.

Ubiquitous Blue-Green energy management has two main aspects: ubiquitous services and sustainability strategies. So, it is an energy management system that is able to keep up with rapid growing population in order to supply citizens need as well as align with sustainable development aims. The main benefits of Ubiquitous Blue-Green energy management are:

- Being kept up with growing population and supplying humans’ needs
- Maintaining natural resources and nature for future
- Creating new opportunities for renewable resources
- Improving waste and waste water management systems as renewable resources
- Reducing environmental concerns and developing environment sustainability
- Better working environment through CSR strategies, knowledgeable, expert and intellectual capitals and resource management
- Creating new contexts for ubiquitous and clean energy
- Increasing transparency and security
- Decreasing barriers like time, place and so on.
- Social sustainability
- Reducing cost
- Making successful and sustainable businesses
- Economic sustainability
- Reducing risks threaten business success
- Increasing efficiency and productivity of businesses
- Making opportunities for businesses to participate in global market
- Making context to train smart citizens
- Making sustainable city infrastructure
- Creating opportunities for developing Blue-Green City
- Developing smartness and digitalization
- Improving seven pillars of sustainability
- Reducing global challenges
- Sustainable development aims
- Creating environment and areas with higher quality of life and livability

Generally, technological barriers, ubiquitous concept and not intelligent, knowledgeable and expert capitals are main barriers to achieve Ubiquitous Blue-Green energy management. In
addition, smart citizens who are aware of ubiquitous services is the other main barriers of applying Ubiquitous Blue-Green energy management.

In particular, all tools and techniques including training intelligent, expert and knowledgeable capitals through education, vocational training and applied science; all types of resource management including natural resource management, human resource management, project resource management, financial management, infrastructure management, facility management, enterprise asset management, asset management, digital asset management, inventory management and IT service management; digitalization, high technologies and smartness; innovation; smart citizens, smart and ubiquitous context to make businesses concerned on Ubiquitous Blue-Green energy management are the main tools required to face with these challenges in order to develop Ubiquitous Blue-Green energy management.

Fundamentally, Ubiquitous Blue-Green energy management could be a path to make modern and sustainable businesses and SMEs that are able to achieve sustainable development in countries and eventually the world. Therefore, it plays significant role in future of the world as well as the countries.

3.3 Ubiquitous Blue-Green Energy Management and Sustainable Development

Ubiquitous Blue-Green energy management could both make successful and sustainable businesses and SMEs (small and medium enterprise) as backbone of country and reduce environmental challenges.

In particular, sustainable and successful businesses would make economic sustainability in a country, even other pillars of sustainability like social sustainability and environmental sustainability. Therefore, Ubiquitous Blue-Green energy management as a tool to develop sustainable and successful businesses plays significant and fundamental role in improving sustainable development. Furthermore, Ubiquitous Blue-Green energy management founded on environmentally friendly strategies, sustainable water management and sustainability pillars could reduce environmental challenges like air pollution, water contamination, water shortage, climate change, resource preservation, environment maintenance and so on; towards improving environmental sustainability that is a necessary indicator for sustainable development and existing of livability in this world in future.

Ubiquitous Blue-Green energy management could make proper infrastructure to create modern urban areas like Ubiquitous Blue-Green city with high quality of life and livability. Fundamentally, Ubiquitous Blue-Green city could gain sustainable development through two main aspects:

- **Seven pillars of sustainability and sustainable development:**
  Ubiquitous Blue-Green city is able to develop seven pillars of sustainability including environmental, social, political, educational, technical, cultural and economic sustainability towards sustainable development.

- **Quality of life and livability:**
  Ubiquitous Blue-Green city makes city infrastructure that could deal with urbanization challenges like poverty, unemployment, security challenges, environmental concern, economic
problems, health diseases and so on as well as supply citizen's needs. Therefore, high quality of livability and life could be achieved in such urban areas. Fundamentally, Ubiquitous Blue-Green cities through their privileges could achieve sustainability and make high quality of life and livability towards making the world as a better place for living. In particular, such areas are based on indicators that are shown in below figure:

Ubiquitous Blue-Green energy management is one the main components of modern urban areas like Ubiquitous Blue-Green city that is required to be known and applied in different businesses as a tool towards sustainable development. Generally, there is a relation among energy management, urban infrastructure, sustainable development and quality of life. Sustainable and proper energy management is required to design sustainable city infrastructure towards sustainability and better quality of life.

Fundamentally, Ubiquitous Blue-Green energy management would create Ubiquitous Blue-Green city in order to gain sustainable development that is required to maintain the world for future as well as improve quality of human life at present. Therefore, such energy management plays critical role in future of the world for living and quality of life for citizens at present. In specific, Ubiquitous Blue-Green energy management could achieve sustainable development as the tool to improve quality of human life at present and maintain the world for upcoming generations through its advantages and making proper context for modern and sustainable urban areas concept. In addition, sustainable development would deal with global challenges
and supply humans’ needs towards high quality of life. The below figure declares this relation among Ubiquitous Blue-Green energy management, sustainable development and quality of life:

![Figure 19: Sustainable Ubiquitous Energy Management Cycle (Hamid Doost Mohammadian, 2017-20)](image)

Fundamentally, Ubiquitous Blue-Green energy management would make the world as a better place for living and maintain it for future generations.

### 3.4 i-Sustainability Plus towards Ubiquitous Blue-Green Energy Management

i-Sustainability plus as the theory concerned on working of high sustainability, innovation and digitalization together; could be applied as a tool to gain Ubiquitous Blue-Green Energy Management.

This model was introduced in article named” Giving three Practical Innovative Models based on IMP³rove and TRIZ in Smart and Sustainable Mobility: Keys towards Blue-Green, Sustainable Livable Urban Area" for the first time and then it was revised in the later article named” Blue-Green and Inclusive Mobility: A Key to Make the World a Better Place for Living” in International Congress on Engineering, technology and Innovation held in Darmstadt in August 2019. Eventually, in previous book of authors were explained comprehensively.

In this theory, innovative management is about innovation in business, marketing and technology systems of an organization to gain successfullness and the best result. Business model innovation is about rethinking and reforming current businesses to preserve in marketing environment through improving current and existing business model or utilizing new path to provide and increase values. Besides of business model innovation, marketing innovation is needed as a tool to evaluate profits of an organization. Marketing innovation focuses on finding
new channels and tactics to enhance businesses' efforts, finding new markets, creating new markets, realizing new services and offers that other businesses couldn’t provide. Technological innovation is a technique to create new ideas through applying technology or utilizing knowledge to find out innovative and new solutions to improve processes and situation of organization.

The other component of this theory is seven pillars of sustainability that was declared by authors such as environmental, educational, social, cultural, political, technical and economic sustainability. In other words, this theory is based on seven pillars of sustainability and strategies aligned with sustainability in order to develop sustainability through these pillars. Further, innovation is a tool to find paths to gain high sustainability. It means that innovative management not only influences on processes of an organization, but also it is able to improve high sustainability. So, innovation has significant role in this theory.

In addition, technologies, high technologies like digitalization and ubiquitous would play significant role in this theory. Digitalization and ubiquitous concept could be used as tools to improve high sustainability and innovative management. In general, high technologies are changing the processes and their results in these days. So, it is vital to be utilized in new policies, strategies and theories as fundamental techniques. Therefore, in this theory authors use digitalization and ubiquitous concept as one of the main pillars.

i-Sustainability plus is integration of high sustainability, innovative management and digitalization in order to gain the best results, effectiveness and profits. The below figures present this theory:

![Figure 20: i-Sustainability Plus](Hamid Doost Mohammadian, 2017)

Fundamentally, businesses, firms and governments could design models and make solutions based on this theory to develop Ubiquitous Blue-Green energy management. i-Sustainability plus theory is based on indicators that are required for Ubiquitous Blue-Green energy management towards sustainable development. So, it is a strong tool to gain such energy management. In addition, i-Sustainability plus is able to develop sustainability by itself. Therefore, this theory could be declared as a path to develop Ubiquitous Blue-Green energy management, even sustainable development.
The below figure illustrates role of i-Sustainability Plus in developing sustainable and smart energy management like Ubiquitous Blue-Green energy management:

Figure 21: Impacts of i-Sustainability Plus in Developing Sustainable and Smart Energy Management like Ubiquitous Blue-Green Energy Management
(Hamid Doost Mohammadian, 2017-20)
4. Case Studies

In this section, two countries are selected to be explored and declared in order to find out how these countries find out solutions, strategies and policies towards developing sustainable and smart energy management. In addition, roles of improving technology, digitalization and smartness in designing smart and sustainable energy management are mentioned. Eventually, the role of proper energy management on quality of life and livability through dealing with urbanization challenges and developing sustainability are mentioned.

In particular, South Korea as a non-western country is chosen to declare how ubiquitous concept helps this country to tackle challenges and risks that threaten the future of the country. The impact of ubiquitous services in supplying citizens needs, developing sustainability, improving livability and quality of life are mentioned. In addition, smart and sustainable energy management systems applied in South Korea is explored.

Spain as a western country is selected to remark how digitalization and high technologies influence on every aspects of life, developing sustainable infrastructure and improving quality of citizens’ life. Furthermore, role of technology in energy management and how energy management could impact on sustainability of the country.

4.1 South Korea

South Korea is as a pioneer of designing and creating U-city. This country has confronted challenges and concerns related to rapid and unplanned urbanization, supplying citizens' needs, environmental challenges, contamination and so on.; that threaten future of the country and livability of it. Therefore, it tries to find out solutions, strategies and paths to create new concept for urban areas that are able to deal with urbanization challenges, improve sustainability, supply citizens' needs and improve quality of citizens life. In particular, U-city is a new concept that help this country to deal with challenges and create modern, sustainable and livable urban areas. Generally, different Ubiquitous City Project were completed about 40 cities in Korea. Seoul and Songdo are main projects of Ubiquitous cities that create new sustainable and livable urban areas.

U-city could be realized as a near concept of digital city introduced in Europe. This concept has been introduced since 1994 in The European Digital Cities Conference. Eventually, U-City emerged in the political arena first in 2004 and then as the second step toward the realization of ubiquitous society enactment of the ‘Act on Ubiquitous City Construction’ has occurred since 2008 in Korea. Physical, spatial urban development with ubiquitous technologies are combined in U-city. So, the limitation on physical distance and time could be overcome and a new urban model for a sustainable, intelligent city will be developed.

As it was mentioned, reasons like high population density and environmental problems such as high carbon emission, low sustainability, citizens' needs, security, economic challenges and etc. make South Korea to apply U-city concept. Seoul and Songdo are two main ubiquitous city projects in South Korea that are mentioned in following context:

Seoul as the capital of South Korea and the largest metropolis with over 10 million citizens has confronted urbanization challenges that are significant threats of sustainability and quality of citizens'life.
After 1953, Seoul has developed quickly and it caused environmental problems. Since 1990s, urbanization has grown more rapidly that has caused a lot of problems such as air and water pollution, environmental challenges and etc. Seoul should struggle with these problems. So, it is required to deal with these challenges through new strategies, policies and solutions focused on sustainability. Ubiquitous services and smart city were declared as the best solution for Seoul to struggle with its problems. Therefore, Seoul became to a ubiquitous city through ICT infrastructure, ubiquitous and smart services. In particular, Seoul has passed stages to become ubiquitous and smart city: digitalization (1999), intelligent city Seoul (2003), U-Seoul (2006), smart Seoul (2011) and eventually Global Digital Seoul (2016).

The main pillars of Seoul as U-city are:

**ICT infrastructure:** ICT infrastructure is vital to achieve U-city services. Efforts to develop ICT infrastructure must anticipate future service demands, rather than respond only to those most apparent.

**Integrated City-management Framework:** Management framework is vital to gain U-services in cities. The many integrated subsystems, meta-systems and individual, building-block systems of U-city could work through standards.

**Smart users:** Although ICT are used as a tool in U-cities, citizens who could use smart tech to interact with smart services are vital to achieve U-life in cities.

**Open government:** Government that focus on communication, participation and sharing influences on creating proper infrastructure towards making Seoul as global digital and U-city.

**Smart services:** Developing smart and ubiquitous services through applying bigdata, IoT, IoE, GIS, Cloud and so on; play fundamental role in U-city.

Generally, U-Life services such as U-culture and U-life, U-education, U-business and finance, U-environment, U-health, U-transportation, and U-government, intelligent buildings, smart citizen, and ICT infrastructure are main component of Seoul. In particular, sustainable and smart energy management applied in Seoul influence on developing ubiquitous life in Seoul. The main features of Seoul Energy management are:

- Decreasing in usage and increasing in production of renewable energy
- Energy self-sufficient
- Using renewable energies
- Reducing fossil fuels usage
- Energy public participation
- Suppling heating and hot water to residential and commercial buildings through themselves
- Reducing energy consumption of buildings
- Waste water as a source of renewable energy especially for heating
- Converting trash and waste to energy or recycling them
- Applying technology trends in use of sewage energy
Fundamentally, ubiquitous infrastructure and services make Seoul to be able to deal with its challenges and create more sustainable and livable urban areas where citizens needs are supplied and high quality of life are available. In addition, such areas could reduce environmental concerns and climate change towards sustainable development, maintain the world and nature for future.

Songdo located on an island about 40 miles from Seoul is another U-city in South Korea. Songdo is a ubiquitous and smart city from scratch that is also introduced as ubiquitous ecocity towards Green Korea. The main aim of this city is to make greener and more sustainable Korea. In addition, it is nominated as business hub in northeast Asia based on its features like strategic location, advanced infrastructure, and business-friendly environment. Besides of all these facts, innovation and technologies used in urban system make Songdo as one of important and famous samle of U-city.

This city target is to make an urban area where high quality of citizens' life and sustainability by a vital public realm rich in cultural and recreational attractions are existed. Improving global economic environment, energy efficiency, the future viability and health of the city, reducing environmental challenges and climate change, security, dealing with health challenges, diseases and social instability are the sub goals of New Songdo.

The master plan applied in Songdo and certificated by LEED, has six categories to create sustainable and ubiquitous infrastructure:

- **Open and green space**: access to nature, sunlight, healthful recreation, public gathering spaces
- **Transportation**: multi-modal transportation including walking and biking, clean energy; sustainable and smart transportation
- **Water consumption, storage, and reuse**: reduced water use, stormwater and grey-water recycling, green roofs to reduce runoff, mitigate heat island effect and provide native species habitat
- **Carbon emissions and energy use**: ASHRAE standards, co-generation, solar energy generation, renewable energy, reduced energy use, pneumatic waste collection
- **Material flows and recycling**: construction waste recycling, local materials
- **Sustainable city operation**

U-Life services such as U-culture and U-life, U-education, U-business and finance, U-environment, U-health, U-transportation, and U-government, intelligent buildings, smart citizen, aren’t all existed in Songdo. Some of these u-services are already in use and some u-services that are introduced haven’t been yet ready and available.

Fundamentally, every aspect of public life in Songdo founded on technology ranging from integrated public transport system to the government’s emergency warning system make Songdo as an ubiquitous city. One of the main services special in Songdo and plays fundamental roles in creating ubiquitous city are energy management systems and trash systems related to energy. Through trash systems, all trash is transported by underground pneumatic pipe to plant and eventually it recycled, reused or converted to clean and renewable energy.

In particular, there are several paths and strategies applied in Songdo to develop ubiquitous energy management. The most important ones are:
• Using renewable and clean energy
• Converting trashes to energy
• Reducing energy consumption
• Energy usage in every building
• Waste water as resource of energy (heat energy)
• Recycle water use
• Infrastructure required less energy than traditional city
• Capturing stormwater on green roofs and using in parks

Fundamentally, ubiquitous infrastructure and services make Songdo as a city where sustainability, livability and high quality of life are existed. Songdo as a ubiquitous city is able to not only make high quality of citizens life and sustainability for a country, but also reduce environmental concerns and climate change in the world. Therefore, ubiquitous cities could develop sustainability in the world and make it as a better place for living.

4.2 Germany

Digitalization and digital city are about western concept to create modern and sustainable urban areas to deal with global challenges and improve citizens’ quality of life. In particular, digital city is similar to ubiquitous concept in non-western countries.

Several western countries like Sweden, Denmark, Finland, Germany, the Netherland and so on, apply digital transformation and digitalization to create more livable and sustainable countries that are aligned with environmental and nature maintenance as well as sustainable development.

Germany is one of the western pioneers of digitalization. Germany is among the European leaders to improve social, environmental and economic factors through digitalization development. Generally, digitalization is required to sustain productivity growth and efficiency as well as enhancing living standards in Germany.

Digital infrastructure based on digital, cultural and social infrastructures are required for Germany to design sustainable and livable areas where citizens prefer to live, work and satisfy about their lives.

Germany is tried to create digital infrastructure that is based on specific services like: digital health-care system, E-government, digital human capital, smart citizens, internet usage, integration of digital technologies in the economy, E-businesses, smart transportation, E-education and other digital services. Government, policy makers, regulations and owner play fundamental roles in achieving digital infrastructure. In particular, digital infrastructure influence on all aspects of a society especially Economy. Improving businesses through digitalization could influence on economy of a country that plays fundamental role in future and sustainability of a country.

The main benefits of digital infrastructure for Germany are:
• Availability and accessibility of all services for anybody at anyplace
Fundamentally, digital infrastructure and services help Germany to be sustainable country with high quality of life. In addition, digital economy makes Germany able to participate in Global market in order to gain better economic condition. Therefore, digitalization is a proper and fundamental tool for Germany to be sustainable and successful.

Generally, some federal states like Hesse, have digital strategies that to have the Internet access network and also address the importance of data centers in order to make digital infrastructure. Many cities of Germany including Berlin, Frankfurt, Hamburg, Hannover, Dusseldorf, Bochum and so on apply digital services and digital infrastructure in order to create better areas for living as well as help country to be more sustainable and livable.

Industry 4.0 is one solution created and applied by Germany to able to develop digital country. Industry 4.0 (I 4.0) is a kind of service based on technology and digitalization introduced by Germany to be applied in order to improve efficiency, productivity and sustainability of businesses towards sustainable development. Industry 4 is related to intelligent networking of machines and processes for industry through the help of information and communication technology.

The cause of Industry 4.0 has been taken up by the German government and is a favourite theme of Chancellor Angela Merkel. The government has invested 200 million euros in Industry 4.0 research. With this policy, the government seeks to create test beds for new ideas in industry and to convince the smaller Mittelstand firms to take up the cause of digitization.

The main benefits of Industry 4 are:

- To develop core ideas in groups to deal with challenges
- To create and provide recommendation for companies, academics and politicians
- To support SMEs through services like online map of use cases, the compass for Industry 4.0 orientation (only in German), the online library and etc.
- Help businesses to participate in different markets especially global ones
- Improving national and international exchanges through bilateral and multilateral cooperation
- Increasing efficiency and productivity
- Developing sustainability in a country to create more liveable areas
One of the main sectors influences on Germany condition is energy section. In particular, digital energy management and proper system applied by Germany have a significant role in sustainability of a country. Applying digitalization, IoT, IoE and the other technologies on energy management besides of using renewable energies make sustainable energy management that is aligned with environmental sustainability and sustainable development. The main policies founded on high technology and used by Germany in energy management are:

- Smart and affordable access to green electricity
- Applying renewable energies like wind energy, solar thermal energies and so on.
- Reducing fossil fuels usage
- Smart and innovative energy management
- More sustainability thanks to a flexible energy concept
- Green investment that is great for investors and users
- Sustainable and smart water management and waste water management
- Reducing energy cost
- Increasing energy efficiency and productivity through applying digitalization and I 4.0
- Transportation working with clean and renewable energies
- Green businesses based on sustainable and smart energy management

Fundamentally, digitalization and high technologies play significant and fundamental role in sustainability and livability of Germany. Germany has set itself the target of becoming one of country applied digitalization in high level in order to gain digital growth. This fact could help Germany to be more sustainable and livable where high quality of life is existed.
References


Analysis of Selected Concepts on Resource Management: A Study to Support the Development of a Thematic Community Strategy on the Sustainable Use of Resources. 2002. Published by European Commission - DG Environment

A Practical Guide to Enterprise Risk Management: Creating Value through Effective Risk Management. 2015. Published by Investors in Risk Management (iirm).


Blue-Green Cities: Demonstrating the Multiple Benefits of Blue-Green Infrastructure. Published by Newcastle University.


Davila, T. Cooper, R. 2010. Basic Concepts of Innovation and Innovation Management Student Material-. Ericson.

Davis, R. An Introduction to Asset Management: A Simple but Informative Introduction to the Management of Physical Assets. Published by blah d blah design ltd Subsidiary of EA Technology Ltd Capenhurst Technology Park Capenhurst.


Energy Solutions made in Germany. 2019. Published by Federal Ministry for Economic Affairs and Energy (BMWi). Berlin, Germany.

Enterprise Risk Management: Tools and Techniques for Effective Implementation. 2007. Published by Institute of Management Accountants


Hasbi, H. Bambang, T. Connie, S. 2010. Elements of Public Asset Management Framework for Local Governments in Developing Countries. In the Proceeding of 8th International Conference on Construction and Real Estate Management (ICCREM 2010), 1-3 December. Royal on the Park Hotel, Brisbane.

Hazard Identification, Risk Assessment and Control Procedure. 2011. Published by Western Sydney University (WSN).

Iyengar, S. Infrastructure Management Whitepaper. Published by Manage Engine.
Kaswamila, A. 2011. Sustainable Natural Resources Management. Published by InTech. Rijeka, Croatia
Leading People Resource Management. 2008. Published by Charles Sturt University.


Planning a Green-Blue City: A how-to guide for planning urban greening and enhanced storm-water management in Victoria. 2017. Produced with assistance from E2Designlab


Risk Management. 2011. Published by SMFG.


Strengthening Blue-Green Infrastructure in Our Cities. Published by Ramboll. Available at: www.ramboll.com


Steyn, J. 2018. Introduction to Project Risk Management. Published by Owner Team Consultation (OTC).


Ubiquitous City in Korea Services and Enabling Technologies. 2011. Published by TEKES-Finnnode-Finpro.


Woo, Sh. 2016. Smart Seoul Status and Strategies. Published by Seoul Metropolitan Government.


Yu-Min, J. 2019. Smart City Seoul. EAI Background Brief No. 1442.


www.bluegreencities.ac.uk
https://emergeapp.net/sales/benefits-inventory-management-software/
www.hyperconverged.org/5-pillars-infrastructure-management/
https://simplicable.com/new/resource-management
https://www.workamajig.com/blog/implementing-resource-management-software
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1. Summery

In this section, summary and overlook of previous chapters are concluded.

1.1 Towards Ubiquitous Concept

- **High Technologies:**

  We are living in an era that 1st, 2nd, 3rd and 4th waves (ages) were passed and now we are locating in an era that technologies play fundamental roles in future of countries, humanities and even the World. Since 70’s, the technologies and IT became able to change and improve the various energies, business, and even impact our lives. Now we are in in the 5th wave that high technologies, smartness, IT based energies, digitalization and eventually ubiquitous are main component. Artificial Intelligence (AI), Machine Learning, Computer Vision, Neural Network, Fuzzy Logic and other new technologies as well as knowledge in combination of reality and virtually build a new concept named Ubiquitous. Digitalization changes the paradigm from traditional to modern with huge effectiveness in different aspects of life including various businesses, urban planning, governance and etc. These technologies would create ubiquitous and smart city that are able to deal with challenges the world confronted with. In the other hands, these technologies could make challenges and barriers named future shocks that are significant threat for the humanities and the world. Smart citizens who are aware of these technologies through education and cultural norms could reduce future shocks and negative impacts of high technologies.

  In particular, the main high technologies play significant role in this era are: *Artificial Intelligence (AI), Machine Learning (ML) and Robotic themselves.*

- **Towards Ubiquitous:**

  Techniques and tools including virtual reality, IT and IT based technologies, smartness, digitalization and ubiquitous founded on development of technology and high technologies are required to develop Ubiquitous energy.

  **Virtual Reality:**

  Virtual Reality (VR) is now existed everywhere and utilized by everyone. It about technology that allows a user to collaborate in computer-simulated environment based on real world or imaginary world.

  Although VR are applied in several industries, services such as car design, robot design, medicine, chemistry, biology, education, building design, construction and so on, it faces challenges that make barriers in applying VR. In particular, challenges concerned on VR could be categorized in two groups: technical challenges and cultural challenges.

  **Digitalization:**

  Digitalization is about applying of connectivity and networking of digital technologies to improve businesses, services, manufacturing, trade between people and eventually life. Digitalization has emerged since end of the 20th century and it has become as one of main tools that could influence on changing society, life and businesses in present and near future. It is able to be
used as technique not only would make changes in way that we live, but also could develop sustainability.

Improving technologies, innovation, enabling digital infrastructure, online services, digital services to increase efficiency of resource use, productivity and sustainability, processes and services based on digital infrastructure and analytical packages for exploration and monitoring are main principals of digital transformation. Although digitalization makes privileges, there are challenges related to enhancing and applying digitalization such as cost, security challenges, competitive threats, time, technology barriers, education and so on. It is vital to find out strategies, policies and solutions to deal with these challenges in order to benefit from digitalization privileges towards sustainable development.

**Smartness:**

Smart is defined to being intelligent or have potential to think quickly in difficult different situation especially difficult ones.

Smartness as a technique towards being intelligence could make proper condition in different aspects of lives and fields of businesses towards living smart. In particular, smartness is about changing traditional networks and services more flexible, efficient and sustainable through applying high technologies especially information and telecommunication technologies and digitalization in order to improve processes, functions and operation for benefit of its inhabitants.

Smart infrastructure, less environmental concerns, cost reduction, social stability, security, developing sustainability and etc., are the main advantages of being smartness. Fundamentally, smartness could be applied in different services like transportation, buildings, urban plan, government and so on, as a path to design smart cities towards sustainable and livable world.

**Technologies based on Internet and Information Technology:**

Technologies based on internet and information including IT (Information Technology), ICT (Information and Communication Technology), IoT (Internet of Things) and IoE (Internet of Energy) play significant roles in developing new concept like ubiquitous and even digitalization.

IT is a technology which applies computers to gather, process, store, protect, and transfer information. In specific, the Information Technology Association of America defined information technology as "the study, design, development, application, implementation, support or management of computer-based information systems". Information and Communication Technology (ICT) is an extended context of IT that is based on providing accesses to information via telecommunication. ICT is about all computer-based advanced technologies to control, manage, communicate and transfer information. ICT includes all communication devices and applications like radio, television, cellular phones, computer and network hardware and software, and satellite systems, even the various services and applications associated with them, such as videoconferencing and distance learning. Internet of Thing is a new version of ICT founded on interrelating embedded systems through sensors and electronic applications. In particular, enabling things to be connected anytime, at anywhere; with anything and anyone through any path/network and any service is the main target of IoT that could influence on various businesses and services. Eventually, Internet of Energy (IoE) has emerged in order to improve energy issues concerned on energy consumption to energy challenges including reducing greenhouse gas emissions, waste energy, depletion of natural resources, usage of fossil fuels,
sustainable energy management, utilizing renewable and clean energy, making renewable resources, environmental changes and etc. IoE is about utilizing electricity infrastructure, making energy production cleaner and more efficient, causing more power in the hands of the consumer. IoE is founded on dynamic network connecting the energy network to internet in order to improve energy efficiency and being environmentally friendly.

Fundamentally, all these technologies are new and novel technologies emerged since 1970 that have been applied in several city and life services like energy management to make them not only more efficient and productive, but also smarter and more sustainable. Fundamentally, they are able to make smart and intelligent services like smart building, smart transportation, smart infrastructure, smart businesses, smart life and so on towards designing smart city that could improve sustainability and quality of human’s life. Although these technologies have many advantages especially developing sustainability and dealing with global challenges, the face with challenges and barriers. The most important challenges are cost; expert, knowledgeable and intelligent capitals, human resources, technical challenges, privacy and security challenges, legal issues, smart citizens, proper infrastructure and context to develop such technologies. It is required to deal with these barriers in order to be able to apply IT based technologies in different services like energy management to benefit from their advantages.

Ubiquitous:

Developing technologies makes a context and proper environment to achieve ubiquitous concept.

Ubiquitous is derived from the noun ubiquity, meaning omnipresent or being presence everywhere or in many places at the same time. For the first time in late 16th century, ubiquitous emerged in print and in 1830 it officially appeared. In addition, iniquitousness appeared around 1874. Eventually in early 1990s, Mark Weiser introduced the concept of Ubiquitous Computing that make the world as a place where computing devices could be available in objects, environment and humans being by themselves. His concept is about that world could be disappeared into the context and be hidden for users through applying technologies. At the next decade, Mahadev Satyanarayanan wrote an article named Pervasive computing: vision and challenges in the following of Weiser concept. Fundamentally, improvement of technologies and integration of them make ubiquitous services be developed, improved and grown.

In particular, ubiquitous computing is about “everything, always, everywhere” for data processing and transmission via the ubiquity of ICT systems.

Fundamentally, ubiquitous computing would be utilized in different knowledge areas such as health, business, energy management, city urban plan and so on. It could deal with global challenges to develop sustainability and high quality of life. Therefore, ubiquitous and sustainable cities are able to achieve sustainable development and create livable urban areas with high quality of life through its advantages especially its impact on socio-economic context.

U-city could be realized as a near concept of digital city introduced in Europe. This concept has been introduced since 1994 in The European Digital Cities Conference. Digital city is based on three pillars: social interaction, virtual space, and connecting virtual and real spaces. Digital city has two main aspects: technological and social aspect. Ubiquitous city concept was introduced by the Republic of Korea (ROK) for the first time. For the first time, in 2004 the term “U-City” emerged in the political and the progress of Ubiquitous City Construction has developed since 2008.
U-city makes an environment that any citizen can gain and apply any service anywhere and anytime through ICT infrastructure, U-services and innovative strategies. The main services of U-city are: U-infrastructure, U-business, U-commerce, U-healthcare, U-learning, U-library, U-banking, U-transport system, U-government, intelligent and smart building, smart citizens, U-energy management and U-life. These features create U-city ubiquitous city through its benefits. The main benefits of such city are:

- Settings well equipped with information and communication
- City concerned on functionally well operating public service
- Settings with amenity, amiable life and high quality of health
- City founded on environmentally friendly policies
- City concerned on zero emission, zero car, waste and water are recycled, sustained ecosystem, energy efficiency and proper usage of natural resources
- City concerned on security with effective complex operating system
- Setting based on social sustainability, sustainable socio-cultural and economic interactions
- City focused on new markets for participatory urban regeneration projects applying u-City technologies
- City concerned on educational and technical sustainability
- Smart and intelligent settings concerned on sustainable development
- Smart, intelligent and sustainable city with high quality of livability and life

Fundamentally, U-cities are able to make world as a better place for living through achieving sustainable development.

A new concept of Ubiquitous cities introduced as ubiquitous Blue-Green city would be a tool to create sustainable. Livable urban areas with high quality of life that are able to struggle with global challenges and supply humans’ needs. One of the components of such city is Ubiquitous Energy management that is explored in this book.

1.2 Ubiquitous Energy

These days, renewable energies are used and applied more than fossil fuels in order to reduce environmental concerns and maintain resources for future. Generally, renewable energies are tools to preserve the nature, environment and resources for upcoming generations. In other words, renewable energies are required to maintain the world and humanities. Therefore, new concept of renewable energy like ubiquitous energy based on renewable energy, sustainable and smart energy management are required. In other words, clean and inclusive energy as well as ubiquitous, smart and sustainable energy management are vital to achieve sustainable development towards more sustainable and livable world.

- **Fossil Energies:**

  Fossil fuels including coal, natural gas, petroleum, shale oil, and bitumen are used as the main sources of heat and electricity. Although, fossil fuels have played significant roles in industrial
age (200-300) years ago, they cause challenges like environmental concerns, climate change and so on., that make applying of these fuels be reduced. Environmental concerns, climate change, greenhouse gases emissions, economic challenges, inefficiency, depletion of natural resources and material, destroying nature, and so on are the main consequences of fossil fuels that make challenges to apply these kinds of energies. So, it is vital to find out solutions such as alternatives for fossil fuels, improving efficiency of fossil fuels, reducing greenhouse gases emissions by fossil fuels via technology and so on, to deal with fossil fuels challenges in order to maintain the world for upcoming generations and improve quality of human life. Renewable energies and sustainable energy management are two main solutions for reducing negative impacts of fossil fuels.

- **Renewable Energies:**
  
  Using renewable energies also introduced as clean or green energies could be environmentally friendly, even be unlimited resources for energy supply.

  Solar energy, wind energy, hydropower energy, biomass energy, ocean energy, geothermal energy and waste energy are the main categories of renewable energies.

  Renewable energies have many advantages such as requiring sustainable energy system to reduce CO2 and greenhouse gases emission, preserving natural resources and environment, enhancing energy efficiency, better quality of life and livability and sustainable world. In particular, renewable energies are sustainable ones that could develop sustainability, better quality of life and livability. However renewable energies have many advantages that society, humans and the world could benefit from, there are challenges and limits like high cost, technological challenges and structural challenges that make applying of such energies controversial and challengeable. Fundamentally, future of renewable energies is dependent on its efficiency, productivity and solving its challenges that energy management and proper interaction among declaring loops could influence on these parameters and applying them as main resources of energies instead of fossil fuels.

- **Clean and Inclusive Energies:**
  
  Clean and inclusive energies introduced as ubiquitous energies is based on renewable resources of energy that is aligned with sustainability and sustainable development.

  Clean and inclusive energies would influence on livability of the world through their advantages such as environmental sustainability, reducing climate change, maintaining resources, materials and species, efficiency, productivity, accessibility, security, improving health conditions, supplying humans’ needs, economic sustainability, social sustainability, and sustainable development.

  Proper energy management could be a tool to gain sustainable development that is required to improve quality of life and maintain the world for future. Energy management is about using of management and technology to improve energy performance and energy efficiency. Generally, energy management is a solution for organizations to produce services and products not only with the least costs, but also with the least greenhouse gases emissions and environmental risks. Basically, reducing costs has two aspects: price and quantity. In particular, Ubiquitous Blue-Green Energy Management is introduced by authors as a to achieve sustainable development towards making the world as a better place for living.
Different tools are required to be able to achieve ubiquitous Blue-Green energy management towards more sustainable and livable world. The main tools are:

**Risk Management:**

Risk management is one of main tool that is required to develop Blue-Green energy management. Risk assessment and management are two main tools to identify, treat and reduce risks threaten each business. Although risks make failure, unsuccess or loss in projects, companies like to take risks to achieve income and profits by benefits of risks. So, path or solution would be applied to help companies to do risk to gain income and profits with the lowest failure rate. Risk assessment and management are the tool applied by companies to reduce risks. They could work together to mitigate and control risks towards business targets and success.

Project Risk Management (PRM), Financial Risk Management (FRM), Govern Risk Management (GRM) and Enterprise Risk Management (ERM) are main types of risk management that could be used.

**Resource Management:**

Resource management as a part of project management is a fundamental tool to achieve Blue-Green energy management. Resource management is the process to plan, schedule and allocate resources in the best path with the highest resource efficiency. In other words, resource management is about planning, leadership and controlling of resources. Resource management plan finds out the issues, opportunities, and constraints that could influence on land management and resource development to develop goals and aims of projects in a path concerned on higher efficiency and productivity.

Fundamentally, resource management as a fundamental tool to create successful, sustainable, efficient and effective businesses has different types that the common categories are: human resource management, natural resource management, project resource management, financial management, infrastructure management, facility management, enterprise assets management, assets management, digital assets management, inventory management, IT service management.

The main advantages of resource management that businesses could benefit from are: reducing cost, making management processes more transparent, making project controlling easier, maximizing resource efficiency, increasing profitably, better working environment, proper resource allocation to preserve non-renewable resources, creating sustainable businesses with better efficiency and productivity, and sustainable development.

**Digitalization, High Technologies and Smartness:**

Technology is able to change and improve the energies especially renewable energies and energy management, business, and even impact our lives. In particular, technology has a strong impact on economic growth, environmental sustainability, water management and eventually sustainable development. Therefore, applying high technologies, digitalization and smartness play significant and strong role in creating Blue-Green Energy management.

High technologies such as ICT, IoE, smartness and so on; are technological transformation influence on energy management through changing the global policy from fossil energy and coal to sustainable renewable energies, improving energy management, energy efficiency and energy quality as well as other benefits such as reducing cost, creating better environment and
so on. Such technologies like IoE, IoT, digitalization and smartness are able to make smart environment.

Fundamentally, such technologies are able to create Blue-Green energy management through its benefits and privileges such as energy efficiency, high energy quality, environmentally friendly, sustainable water management, improving renewable energy technologies, energy security, flexibility, improving market operation and market design, reducing cost, smart and sustainable infrastructure, participating in different markets especially global ones and high working environment quality.

**Innovation:**

Innovation is an important tool and technique to create solutions and apply strategies, policies towards sustainable and Blue-Green Energy management. Innovation also encompasses new processes, new business systems and new management methods that could influence on productivity and hence growth. Innovation is defined as the successful implementation of creative ideas within an organization. Innovation could be utilized as a tool to change or improve old processes in order to enhance business and organization function.

Innovation is vital to improve business and make the economic situation profitable. In specific, it is a fundamental tool for Blue-Green energy management.

### 1.3 Ubiquitous Blue-Green Energy Management and Sustainable Development

Ubiquitous Blue-Green energy management founded on environmentally friendly strategies, sustainable water management and sustainability pillars could reduce environmental challenges like air pollution, water contamination, water shortage, climate change, resource preservation, environment maintenance and so on; towards improving environmental sustainability that is a necessary indicator for sustainable development and existing of livability in this world in future.

Fundamentally, Ubiquitous Blue Green Energy Management could develop sustainability through its advantages such as:

- Energy efficiency
- Improving energy quality
- Increasing energy security
- Preserving natural resources
- Being accessible at anytime and anywhere
- Creating new paths and resources as renewable energies such as waste and water-waste
- Reducing environmental concerns
- Cost reducing
- Improving CSR strategies
- Creating friendly working environment
- Improving productivity and efficiency of a business
• Controlling and managing business processes towards reducing risks
• Making successful business with high efficiency, productivity
• Achieving sustainable development

Ubiquitous Blue-Green energy management as a component of urban infrastructure is able to create Ubiquitous Blue-Green city where sustainability, high quality of life and livability are existed. Such urban areas could supply humans’ needs and make high quality of life as well as sustainable development.

Fundamentally, Ubiquitous Blue-Green Energy Management is required to deal with global challenges and achieve Sustainable Development.

2. Conclusion and Future Scenario

In this section, discussion about importance of sustainable and smart Energy management like Ubiquitous Blue-Green Energy Management introduced by authors is declared. In addition, challenges related to design such energy management and solutions are mentioned.

2.1 Discussion

We are living in an era that global challenges like poverty, slum, climate change, environmental concerns, economic challenges, instability, security, health challenges and so on that are significant threat to the humanities and the world. Environmental challenges and climate change are fundamental threats for livability of the World. Sustainable development is the solution and path to not only deal with these challenges and maintain the world for future, but also to improve livability and quality of life at present. Ubiquitous Blue-Green energy management could be applied as a path to achieve sustainable development. Therefore, it is vital to deal with these challenges in order to maintain the world for future and improve quality of life at present.

In particular, different strategies and policies are needed to achieve sustainable development. New concept for urban areas is a path to tackle global challenges and achieve sustainable development. Ubiquitous Blue-Green cities are realized as a proper concept of urban areas by authors to develop sustainability. These cities are founded on two aspects: ubiquitous-smartness and Blue-Green strategies. City infrastructure based on these two aspects, ubiquitous and intelligent services could develop such urban areas. Such city is based on Blue-Green infrastructure and polices with mitigating flooding, reducing water scarcity, enhancing ecosystems, designing a platform for stakeholder engagement, improving sustainable developing and making better quality of livability as main goals. Blue-Green strategies are based on environmentally friendly and water management policies like stormwater management, water security, flood management, tree health, recreation needs, reducing greenhouse gases, creating renewable energy resources, decreasing environmental concerns and climate change.

In addition, ubiquitous and intelligent services like ubiquitous transportation and mobility, intelligent buildings and constructions, ubiquitous learning, smart government, smart citizens and so on could not only develop Blue-Green strategies, but also create areas that are able to
supply growing humans’ needs. Ubiquitous services are required to establish services for all at anyplace at anytime that is able to align with growing citizens needs.

In particular, energy plays significant roles in future of the world as well as countries. The below figure presents energy hierarchy:  

![Energy Hierarchy Diagram](image)

**Figure 1: Energy Hierarchy**
*(Hamid Doost Mohammadian, 2017-20)*

Therefore, one of the main services that could directly and indirectly influence on developing Ubiquitous Blue-Green city is proper energy management. In particular, there is a relation among sustainability and energy that is shown in below figure:  

![Sustainability and Energy Management Diagram](image)

**Figure 2: Sustainability and Energy Management**
*(Hamid Doost Mohammadian, 2017-20)*
Ubiquitous Blue-Green energy management is one of the tools to design Ubiquitous Blue-Green infrastructure and city. Ubiquitous Blue-Green energy management is founded on environmentally friendly strategies, sustainable water management, sustainability pillars, ubiquitous and smartness. Such energy management is able to reduce environmental challenges like air pollution, water contamination, water shortage, climate change, resource preservation, environment maintenance and so on; towards improving environmental sustainability that is a necessary indicator for sustainable development and existing of livability in this world in future. So, it plays significant roles in future of the world and humanities through its privileges and developing sustainability.

Different tools and techniques like resource management, risk management, innovation, ubiquitous computing and technology could be applied to make Ubiquitous Blue-Green energy management.

Ubiquitous Blue-Green energy management could reduce environmental concerns, develop sustainability through creating sustainable and smart urban settings. Fundamentally, Ubiquitous Blue-Green energy management is a tool to achieve sustainable development to create more sustainable, livable and smarter urban areas towards making the world as a better place for humans.

2.2 Challenges and Solutions

Ubiquitous Blue-Green energy management confronts several challenges that make barriers for developing and achieving it. The most significant challenges are shown below figure:
It is vital to find out solutions to tackle these challenges in order to create Ubiquitous Blue-Green energy management. Innovation, high technology, developing and improving technologies, innovation, sustainable and smart risk management and resource management, technical enhancement, education and making smart and sustainable infrastructure including smart services, smart citizens, governments and sustainability pillars are the main tools and solutions towards such energy management. Furthermore, training knowledgeable, expert and intellectual capitals and citizens who are aware of ubiquitous services and Blue-Green policies requires to able to design Ubiquitous Blue-Green energy management.

2.3 Future Scenario

In this book, Ubiquitous Blue-Green energy management is introduced. In addition, its impacts on sustainability, supplying humans’ life and quality of life are declared. In future studies and books, roles of such energy management in city urban plan and city infrastructure could be presented.

Ubiquitous Blue-Green energy management is one of the techniques required to create new urban areas based on sustainability, smartness and ubiquitous services. Fundamentally, it could be a path to create Ubiquitous Blue-Green infrastructure towards Ubiquitous Blue-Green cities, more sustainable and livable world.

Mobility as one of main city components plays significant role in city infrastructure. Therefore, in future book impacts of Ubiquitous Blue-Green energy management on mobility system and role of mobility of a city on city infrastructure are illustrated. In second volume of the book; smart, Blue-Green mobility via Ubiquitous Blue-Green energy management is explored in order to find out how such energy management could influence on developing sustainable and smart mobility. In addition, roles of sustainable and smart mobility systems like Smart Blue-Green Mobility in creating and designing smart and sustainable city.
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