CHAPTER 2

REVIEW ON IDEAL SYSTEMS & TECHNOLOGY

P. S. Aithal
Professor, College of Management & Commerce, Srinivas University, India
OrcidID: 0000-0002-4691-8736; E-mail: psaithal@gmail.com

ABSTRACT :
This chapter contains an elaborate review of various ideal system models used to improve the characteristics of practical systems, anticipated breakthrough technologies of 21st century, and nanotechnology innovations & business opportunities : a review on how technology has affected society and its surroundings in a number of ways. In many societies, technology has helped to develop more advanced economies (including today's global economy) and has supported the rise of leisure class people. The concept of the ideal engine, ideal switch, ideal semiconductor devices like ideal diodes, transistors, etc. have been defined and taken as standards to improve the quality and performance of such practical devices or systems. It is found that, by keeping such a hypothetical device or systems in mind, researchers have to continuously improve the characteristics/properties of practical devices/systems to upgrade their performances. Hence, ideal properties of a device or a system can be used to upgrade or improve its properties toward reaching 100% efficiency. By comparing the properties/characteristics of a practical device/system with its ideal counterpart, one can find out the possible modifications in that device/system toward reaching the objective of achieving such an ideal device. In this chapter, we have also developed the concept of Ideal technology by creating a model and identified its important characteristics. These characteristics are grouped into four categories namely input conditions, output conditions, system conditions and environmental conditions/social expectations. These characteristics are further discussed, analyzed and compared with present technologies. Based on the discussion, it is realized that many of the characteristics of the ideal technology are achievable through discoveries and innovations in Nanotechnology. Finally, the characteristics of this ideal technology model are compared with nanotechnology developments and the possible way of realizing nanotechnology as ideal technology is discussed.

2.1 INTRODUCTION :

A system model is a conceptual model used to describe and represent a system. A system comprises of various processes used to convert some form of input into the required form of output based on its objectives. A system will have its own control mechanism to convert the input into output. The performance of the system depends on two factors as the objective of the system and the environment of the system. Further, a system is a set of interrelated components. The systems are orderly arranged according to a design and each component has a definite function to perform in the system. The components forming a system are called subsystems. Each such subsystem can further be divided into lower level subsystems. This

process of dividing a system into lower level subsystems is called factoring of a system and this can be carried on until we get a unit, which is easy to manage. A system can also be defined as an organized or complex entity, combination of things or parts forming a complex entity. The system may be Physical or Abstract. The physical system is a set of elements which operate together to accomplish an objective. Physical systems are made up of objects such as land, building, machines, people and other tangible objects. An abstract system is an orderly arrangement of ideas, concepts, or constructs. The physical systems produce some outputs which may help to achieve its defined objective. Organization systems are more meaningfully defined as an array of components designed to accomplish a particular objective according to a plan. The general model of a physical system is a collection of related elements. These elements take the form of input, process, and output. The objective of the system decides the system, subsystems, their functions, and the systems environment. The features which define and delineate a system form its boundary. A model is a simplified representation of an operation, or is a process, or a system in which only the basic aspects or the most important features of a typical problem under investigation are considered. The objective of a model is to identify significant factors and interrelationships. The reliability of the solution obtained from a model depends on the validity of the model representing the real system. A good model called the ideal model must have the following characteristics:

- An ideal model should be capable of taking new formulations into account without having any changes in its frame.
- Assumptions made in the model should be as small as possible.
- Variables used in the model must be less in number ensuring that it is simple and coherent.
- It should be open to the parametric type of treatment.
- It should not take much time in its construction for any problem.

The significant advantages of using a model for a system are:

- Problems under consideration become controllable through a model.
- It provides a logical and systematic approach to the problem.
- It provides the limitations and scope of an activity of the system.

It helps in finding useful tools that eliminate duplication of methods applied to solve the problems.

- It helps in finding solutions for research and improvements in a system.

- It provides an economic description and explanation of either the operation or the systems they represent.

Predictive Models predict facts and relationships among the various activities of the problem. These models do not have an objective function as a part of the model to evaluate decision alternatives. In this model, it is possible to get information as to how one or more factors change as a result of changes in other factors. An example of a predictive model is the model of an Ideal system. Descriptive Models describe facts and relationships among the various activities of the problem. These models also do not have an objective function as a part of the model to evaluate decision alternatives. In this model also, it is possible to get information as to how one or more factors change as a result of changes in other factors. An example of a descriptive model is the model of a real system.

In this paper, we have reviewed the ideal properties of various hypothetical systems which can be used to upgrade or improve their properties towards reaching 100% efficiency. By comparing the properties/characteristics of a practical device/system with its ideal counterpart, one can find out the possible modifications in that device /system towards reaching the objective of achieving such an ideal system. Even though ideal systems are hypothetical systems, which cannot be realized completely in practice, gives a broad idea on how the practical systems can be improved continuously to reach ideal system characteristics. The ideal system characteristics of technology, business, education, banking, electrical energy, software, computing and strategy, discussed in this review, under input characteristics, system characteristics, output characteristics, and external characteristics shows an opportunity to the scientists and engineers to develop such practical systems further with an objective to reach the goal. Based on the review, we have also discussed the possible characteristics of some of the future anticipated systems like ideal automobiles, ideal home, ideal human being, ideal organization, ideal city and even, ideal world.

Similarly, every rational person in this world constantly aims to improve his standard of living. Forecasting the future technologies is important for dreamers who hope to innovate better tools and techniques and through such research to achieve breakthroughs for the mainstream people who expect to benefit from such new and improved technologies. Many inventions are born in the lab and never enters into the consumer market, while others evolve beyond the expectation of putting good regulations on their use. Since the beginning of the 21st century, mankind has made tremendous strides and struggles in developing new technologies and manage them efficiently and effectively to improve the quality of life. While machines can replicate many

movements and actions of humans, the next challenge lies in teaching them to think for themselves and react to changing conditions [1]. For example, the field of artificial intelligence will one day give machines the ability to think analytically. Exploring space will also push genetic research. It is predicted that travelling to and living in other planets such as Mars with extremely cold temperatures and toxic atmosphere will require genetic changes through gene therapies. Sending humans into space without genetic modification would be impractical. However, we need breakthroughs to achieve this glowing future. Similarly, many anticipated technology breakthroughs are expected to change the lifestyle, comfort and thinking of human beings in near future [2]. Will these breakthroughs happen? Experts believe technologies will develop at lightning speeds during this century. Between 2015 and 2035, we could see more breakthroughs than in the last 200 years. From 2035-to-2050, advances might outpace all of human history; and from 2050-to-2100, massive discoveries beyond the wildest imaginings of science fiction could appear. As we trek into this future, aided by technologies we cannot even imagine today, it's easy to predict and believe that sometime during the 22nd century, more humans will live in space than on Earth. This paper discusses thirteen, the most anticipated possible technology breakthroughs of 21st century which substantially affects the lifestyle of living beings in the world provided they are managed properly by utilizing the advantages of them for human prosperity. These technologies are (1) Nanotechnology based human life comfort, (2) High speed computation through optical computers, (3) Embedded Intelligence, (4) HIV Antivirus, (5) Pseudo Senses - Sensation of existence through virtual reality, through artificial environment, (6) Off Planet Production in micro-gravity, (7) Protein Maps to know how many active genes are coding for proteins in living being, (8) Customized Kids which are used for Customization of Physical and mental ability of children, (9) Development of Chameleon Chips which are reconfigurable photonic circuits using the idea of optical solitons, (10) Flying cars through manipulation of gravitational force, (11) Immortality through nano-bio-technology & stem cell research, Fractal Models for fragmented geometry shapes, and (13) Space travel for everybody. The effect of these technology breakthroughs, their effective management, possible changes in the lifestyle of people in the society and its contribution in solving many basic & advanced problems of human beings on the earth are also discussed in this chapter.

Nanotechnology is expected as the major breakthrough technology of this century and is defined according to the National Nanotechnology Initiative (NNI), as the “understanding and control of matter at dimensions of roughly one to one hundred nanometers, where unique

phenomena enable novel applications," [3]. The U.S. Environmental Protection Agency (EPA) [4] defines nanotechnology as "research and technology development at the atomic, molecular, or macromolecular levels using a length scale of approximately one to one hundred nanometers in any dimension; the creation and use of structures, devices and systems that have novel properties and functions because of their small size; and the ability to control or manipulate matter on an atomic scale. Scientists have been studying and working with nanoparticles for centuries. But the ability to see nano-sized materials using high powered microscope has opened up a world of possibilities in a variety of industries and scientific endeavours. Since nanotechnology is a set of techniques used to manipulate the properties of matter at the microscopic scale, it can support many applications in the society especially to solve problems of living being. Nanotechnology is viewed as a group of technologies over time and is expected to support innovative new product developments. Lux Research, Inc., the New York-based nanotechnology research and advocacy firm, predicts that by 2015 products that incorporate nanotechnology will constitute 15 percent of global manufacturing output and will total $3 trillion. Products of nanotechnology are diverse and growing exponentially due to high priority research investments by many countries. According to the NNI, nanoparticles and nanoscale materials are used in many industries, including agriculture, food, energy, electronics, pharmaceuticals, chemicals, and biomedical, among others. Many areas of industries are producing greater revenue for nanoparticles are chemical-mechanical polishing, solar panel coatings, magnetic recording tapes, sunscreens, automotive catalyst supports, biolabeling, electroconductive coatings, and optical fibers. Many nano-enabled products are available in the market today, which include paints, cosmetics, stain-resistant clothing, electronics, surface coatings, sporting goods etc., among other applications [5]. According to RNCOS, the global nanotechnology market has been witnessing a growth at a compound annual growth rate (CAGR) of around 19% during 2011-2014 [6]. The future prospective growth will be largely driven by massive investment in nanotechnology R&D and commercialization by both government and corporations worldwide. In the coming years, it is expected that nanotechnology based products and services will have a huge impact on most of the industrial sectors and will enter the consumer market in large quantities. Some researchers believe nanotechnology can be used to significantly extend the human lifespan or produce replicator-like devices that can create almost anything from simple raw materials. Others see nanotechnology only as a tool to help us to do what we do now, but faster or better. The third major area of debate concerns the timeframe of nanotechnology- related advances. Will

nanotechnology has a significant impact on our day to day lives in a decade or two, or will many of these promised advances take considerably longer to become realities [7]. Based on the ability, advantages, and applications of nanotechnology in solving problems in almost all areas of the society, it can be considered as an ideal technology [8]. Only time will tell how nanotechnology will affect our lives. The applications of nanotechnology identified in different areas provides lots of business opportunities which includes Medicine, Electronics, Food, Fuel Cells, Solar Cells, Batteries, Space Travels, Fuel, Better air quality, Cleaner water, Chemical sensors, Sporting goods, Consumer goods, cosmetics, Fabrics, Cleaning products, automobiles, Energy, Environment, Health, Lifespan increase etc. These business opportunities may create new business model with a challenge of educating people in the usage of these innovative products & services safely to harness their advantages and benefits.

2.2 REVIEW ON VARIOUS IDEAL SYSTEM MODELS

2.2.1. Ideal Systems:

It is well known that we can improve the performance of any system by comparing it with a hypothetical, predicted system of that kind called "Ideal system" [9]. The word “Ideal system” refers to the system which has ideal characteristics i.e., perfect in every way. It is what the mind pictures as being perfect. The characteristics of the present system can be improved towards the characteristics of the ideal system by doing research and innovation. The concept of an ideal gas, ideal fluid, ideal engine, ideal switch, ideal voltage source, ideal current source, ideal semiconductor devices like ideal diodes, ideal transistors, ideal amplifiers etc. have been defined and taken as standards to improve the quality and performance of such practical devices or systems. Some of the ideal systems are listed table 2.1, along with their definitions. It is found that, by keeping such hypothetical devices or systems in mind, researchers have continuously been improving the characteristics/properties of practical devices / systems to upgrade their performances. Hence, ideal properties of a device or a system can be used to upgrade or improve its properties towards reaching 100% efficiency. By comparing the properties/characteristics of a practical device/system with its ideal counterpart, one can find out the possible modifications in that device /system towards reaching the objective of achieving such an ideal system [10].

Table 2.1: Some of the ideal systems in science, engineering and social sciences with their definitions

S. No.	Ideal Systems	Definition of ideal systems
1	Ideal gas	A hypothetical gas whose molecules occupy negligible space and have no interactions, and which consequently obeys the gas laws exactly.

2	Ideal fuel	It should possess high calorific value, moderate ignition temperature, burn without giving harmful gas, cheap and easily available everywhere, no risk during usage or transportation, burn completely, and burn smoothly.
	Ideal solution	An ideal solution or ideal mixture is a solution in which the enthalpy of solution is zero
3	Ideal fluid	An ideal fluid is one with constant density and has zero viscosity coefficient
4	Ideal Engine	A heat engine operating on perfect reversible cycle with 100 % efficiency.
5	Ideal switch,	An ideal switch would have no voltage drop when closed, and would have no limits on voltage or current rating. It would have zero rise time and fall time during state changes, and would change state without "bouncing" between on and off positions, with negligible power loss.
6	Ideal voltage source	It is a two-terminal device that maintains a fixed voltage drop across its terminals. It is often used as a mathematical abstraction that simplifies the analysis of real electric circuits.
7	Ideal current source	It is a current source that supplies constant current to a circuit despite the voltage dropped in the circuit. It acts as a 100% efficient source of current: it has infinite internal resistance.
8	Ideal Diode	It is a diode that acts like a perfect conductor when a voltage is applied forward biased and like a perfect insulator when a voltage is applied reverse biased. So, when a positive voltage is applied across the anode to the cathode, the diode conducts forward current instantly.
9	Ideal Transistor	The ideal transistor model the base and emitter are at the same AC voltage. They differ only by a constant DC potential. The collector current is equal to the emitter current and proportional to the base current.
10	Ideal Amplifier	Ideal amplifier has Infinite input impedance, zero output impedance, zero common-mode gain, or, infinite common-mode rejection, Infinite open-loop gain, and Infinite bandwidth.
11	Ideal Business	A business which as ideal input characteristics, ideal output characteristics, ideal system requirements and ideal marketing conditions [11-12].
12	Ideal Education System	Has ideal characteristics under Input conditions, Systems requirements, Output conditions and Environmental & social conditions [13].
13	Ideal Technology	An ideal technology system should have characteristics to fulfil its objectives to solve all problems of human beings including both basic needs and advanced gadgets to support comfort living to realize their dreams. Based on various factors which decide the ideal technology system characteristics, a model consisting of input conditions, output conditions, environmental conditions and system requirements [8].
14	Ideal Strategy	It is the mixture of Red ocean strategy, Blue ocean strategy, Green ocean strategy, and Black ocean strategy, also called white ocean mixed strategy [16].
15	Ideal Energy Source	It provides an infinite amount of energy without any constraints of the load. It has 100% energy output efficiency [17]
16	Ideal Banking	Ideal Banking has ideal input conditions, output conditions, system requirements, and social & environmental conditions [18].

17	Ideal Library	Ideal library system is a ubiquitous universal resource centre openly accessible by everybody online to get any type of information from various databases, e-books, Journals and any other type of publications free of cost electronically [19].
18	Ideal software	It is a general purpose software model which can be used for any platform, any type of system, and application automation, without making modifications in the form of structure, coding by an external person/agency [20].

2.2.2. Ideal Technology Model:

The concept of ideal technology can be predicted as a technology which can solve all basic needs of human beings and provide a luxurious comfortable life without affecting the society and environment. Ideal technology should have characteristics in order to elevate the quality of life to a unique level with perfect equality so that every human being in this universe should lead happy and comfortable life and realize the so-called concept of heaven on earth. Based on various factors which decide the ideal technology system characteristics, a model consisting of input conditions, output conditions, environmental conditions and system requirements [10]. The input properties are: (1) Manipulate the fundamental nature of matter to provide solutions to basic and advanced problems of mankind. (2) In-expensive & self-reliable in terms of resources to make it attractive to be used by people/countries of varied economical situations. (3) Ubiquitous so that the technology provides solutions and services at anytime, anywhere, any amount of time to the users. (4) Affordable to everybody so that it uses common materials available in nature and manipulate effectively to the need of human being at an affordable cost. The Output properties are (1) Solve basic needs like food, drinking water, renewable energy, clothing, shelter, health, and clean environment. (2) Provide comfort life to the users by providing solutions to their desires. (3) Equality; ideal technology provides equal opportunity and similar solutions to every user irrespective of their gender, religion, background, education, economic status, and country of origin. (4) Automation; ideal technology automates all processes in every type of industries to avoid human interference in work/control in order to provide an expected output based on programming. (5) Immortality is the ultimate goal of ideal technology so that it can create an avenue for the deathless situation or enhancement of human lifespan. The System Requirement Properties are (1) General purpose technology to support all fields and problems of human & living beings on the earth. (2) Self-directed & self-controlled & self-regulated so that the technology can control itself in order to achieve its goal. (3) Easy, simple, quick & user-friendly to solve all type of problems and to provide a quick ideal solution. (4) Scalable so that it is used for solving the small and simple problem to large and complex problems of life. (5) Omnipotent to identify and solve problems and provide

comfortability to a human being and feeling him like God. (6) Exploring new opportunities to improve and explore comfortability and further leisure in the life of people. (7) An infinite potential for the further development of life in the universe. The Environment/external Properties are (1) Maintain a clean environment through its processes and avoid the footprint of processes while achieving a specific function. (2) Infinite business opportunities by creating new products/services with ideal characteristics. (3) Adaptive to any situations to achieve the stated goal. (4) No side effects so that it should be safe for users, and the environment. Any technology which has the above properties/characteristics is considered as ideal technology and the conventional technologies have serious drawbacks/limitations in terms of the above properties [11]. Many research publications focus on solving various problems of society by utilizing nanotechnology as an ideal technology [7, 22-27].

2.2.3. Ideal Business Model:

An Ideal business system shall have characteristics which can be predicted and classified. Based on various factors which decide the ideal business system characteristics, a model consisting of the input conditions, output conditions, market conditions, and system requirements.

- The Ideal Business sells its products/services to the entire world rather than a single neighbourhood and hence it has an unlimited global market.
- The Ideal Business offers a product/service, which enjoys an inelastic demand in the market. (inelastically refers to a product that people need or desire almost at any price.)
- The Ideal Business markets a product/service that cannot be easily copied. This means that the product/service is original or, at least, it is something that can be copyrighted or patented.
- The Ideal Business has minimal labour requirements. The fewer personnel, the better is the business.
- The Ideal Business operates on a low overhead. It does not need an expensive location. It does not need large amounts of electricity, or advertising, or legal advice, or high-priced employees, or a large inventory.
- The Ideal Business does not require big cash outlays or major investments in equipment or product. In other words, it does not require huge capital.
- The Ideal Business is relatively free of all kinds of government regulations or restrictions.

- The Ideal Business is portable or easily moveable. This means one can shift his business and himself anywhere he wants to.
- The Ideal Business satisfies its owner's intellectual needs. There is nothing like being fascinated with what he does.
- The Ideal Business leaves enough free time to its owner. In other words, it doesn't require his labour and attention of 12, 16, or 18 hours a day.
- The Ideal Business is one in which the income is not limited by the personal output (Leverage). In the Ideal- Business, one can have 10,000 customers as easily as can have one."
- The ideal Business will not have any liability after sales.
- The ideal Business will not have problems like seasonality, perishability and price drop.
- In ideal Business, the demand is always very high than supply and the efficiency of production is always 100%.
- The ideal Business will be sustainable for a long time.

Any business which has the above properties is considered as an ideal business and the conventional business called brick and mortar business has serious drawbacks/limitations in terms of the above properties. Many research publications focus on improving the quality of business towards ideal nature [11-12, 28-29].

2.2.4. Ideal Education Model:

Education at its best will effectively prepare students for the working world. An ideal education system would not only prepare students for the working world but would also prepare them to become empowered to transform the working world to better suit the needs of the people. An Ideal education system shall have characteristics which can be predicted and classified. Based on various factors which decide the ideal education system characteristics, a model consisting of the input conditions, output conditions, system requirements, and social & environmental conditions [13-15].

- The Ideal Education provides education to the entire world rather than a single neighbourhood /Country and hence it has an unlimited global reachability.
- The Ideal Education offers courses of study, which enjoys an inelastic demand in the world market. (Inelastic refers to a Course that people need or desire almost at any price.)

- The Ideal Education provides all types of courses in all field of specialization and imparts knowledge, skills and experience to all people irrespective of their age, gender, previous qualification and country of origin.
- The Ideal Education system provides high-quality education to everybody irrespective of their economic, social, linguistic and cultural background.
- The Ideal Education system needs minimum instructors in identified courses and must utilize optimum service from them.
- The Ideal Education system operates on a low overhead. It does not need an expensive location, big campus and huge amount of infrastructure. Only a few Universities are required to provide quality education to the entire world.
- The Ideal Education system does not require major investments in equipment and other education & training. systems or repetition of a large number of universities in every state and every country. In other words, it does not require huge capital.
- The Ideal Education system is relatively free of all kinds of government regulations or restrictions.
- The Ideal Education system is portable or easily moveable. This means a student registered for a course should get the service wherever he moves.
- The Ideal Education system satisfies its student's intellectual needs. There are no constraints like compulsory subjects, minimum and maximum subjects.
- The Ideal Education system leaves enough free time to instructors as well as students. In other words, it doesn't require attention/study of 12, 16, or 18 hours a day.
- The Ideal Education system is one in which the income of the university does not limit by the personal output (Leverage). In the Ideal Education system, one can train 10,000 students as easily as can have one."
- The ideal Education system students can take exams anytime, any number of times and results should be declared immediately. There is nothing like losing a year due to failure in examination.
- The ideal Education system will provide services to its registered students anywhere, anytime and any amount of time. i.e., it is ubiquitous.
- In an ideal system, the technology is used in such a way that all pedagogies of the education system should be delivered effectively.
- An ideal education system provides all students with not only basic knowledge but also social skills and good behaviours.

- In ideal Education system, the demand for a variety of courses is higher than the supply and the efficiency of the system is always 100%.
- In ideal Education system, the students have a choice of alternative in terms of course/service providers.
- The ideal Education system will be sustainable for a long time.
- Any education system which has the above properties is considered as the ideal education system and the conventional education systems called brick and mortar systems have serious drawbacks/limitations in terms of the above properties [13]. Several research publications focus towards improving the quality of higher education towards ideal nature [30-32].

2.2.5. Ideal Banking Model:

Ideal Banking System model by considering various characteristics under 4 categories such as Input conditions, Systems requirements, Output conditions, and Environmental & social conditions, and analysed these characteristics with an objective to achieve the goal. An ideal banking system would not only prepare students for the working world but would also prepare them to become empowered to transform the working world to better suit the needs of the people. An Ideal banking system shall have characteristics which can be predicted and classified. Based on various factors which decide the ideal banking system characteristics, a model consisting of the input conditions, output conditions, system requirements, and social & environmental condition is developed [18].

- The Ideal Banking system provides banking services to the entire world rather than a single neighbourhood town /Country and hence, it has an unlimited global reachability.
- The Ideal banking system offers services to its customers, which enjoys an inelastic demand in the world market (inelastic means a service that people need or desire almost at any price).
- The Ideal banking system provides all types of banking services of both retail banking and business banking to all customers irrespective of their age, gender, previous qualification and country of origin.
- The Ideal Banking system provides high-quality banking services to everybody irrespective of their economic, social, linguistic and cultural background.
- The Ideal Banking system needs minimum employees in identified areas of operation and must utilize optimum service from them.

- The Ideal Banking system operates on a low overhead. It does not need an expensive location, many branches, and huge amount of infrastructure. Only a few Banks are required to provide quality service to the entire world.
- The Ideal Banking system does not require major investments in equipment and other infrastructure or repetition of a large number of branches in every state and every country. In other words, it does not require huge capital.
- The ideal banking system is relatively free of all kinds of government regulations or restrictions.
- The ideal banking system is portable or easily moveable. This means a customer registered in one bank should be able to get the services wherever he moves and in whichever city he lives.
- The ideal banking system satisfies its customers‟ intellectual needs. There are no constraints like minimum amount transaction, to be registered or avail services only in one bank, minimum and a maximum number of services availed per day.
- The ideal banking system leaves enough free time to service providers/bank employees as well as customers. In other words, it doesn't require attention/study of 12, 16, or 18 hours a day.
- The ideal banking system is one in which the income of the bank does not limit by a personal output (Leverage) of the bank workers. In the ideal banking system, a bank can provide any number of customers as easily as can have one.
- The ideal Banking system, customers can do transactions at any time, any number of times and results should be declared immediately. There is nothing like wasting time in queue, travel time to the bank etc.
- The ideal Banking system will provide services to its registered customers anywhere, anytime and any amount of time. i.e., it is ubiquitous.
- In an ideal system, the technology is used in such a way that all services of the banking system should be delivered effectively.
- An ideal banking system provides all customers with not only basic knowledge of banking but also on authenticity and security for financial transactions.
- In the ideal banking system, the demand for a variety of services is higher than supply and the efficiency of the system is always 100%.
- In the ideal banking system, the customers have a choice of alternative in terms of service providers.

- The ideal banking system will be sustainable for a long time.
- Any banking system which has the above properties is considered as ideal banking system and the conventional education systems called brick and mortar systems have serious drawbacks/limitations in terms of the above properties [33-41].

2.2.6. Ideal Energy Source:

An ideal electrical system must include the various characteristics to fulfill the objectives to solve the problems in the energy system. Based on various characteristics the model consists of three important conditions namely input conditions, system requirements and output conditions [17]. The various properties of an ideal electrical energy system are [42-43]:

The input conditions discuss the ideal characteristics of the energy system at the input side.

- Identify the fundamental nature of the input system at the production/ distribution/utilization.
- What are the differences between the practical input systems with the ideal system?
- How to reach the ideal system in the production/distribution/utilization.
- The challenges in reaching the ideal systems.
- The cost involved in improving towards the ideal system.

The output conditions have the following properties:

- The energy system should provide complete solutions to the requirements.
- The energy of should not be wasted in the form of heat or electromagnetic wave.
- The energy system should completely avoid the hazardous shocks at its output.

The system requirements concentrate on what are the system requirements to achieve the ideal output in the energy production/distribution/utility.

- The general purpose technology to support all the processes in the production/distribution/utility.
- Easy, simple, and affordable system to support the ideal technology.
- It should support the further new opportunities for the improvements.
- The further new opportunities/improvements should upgrade the existing technology without replacement of the existing technology.

The impact of the new proposed ideal system on the environment are as follows:

- Environmental cleanliness.
- The amount of unwanted by-products from the system to the environment.
- Adaptive to any environmental situations to achieve the goal.

No side effects assuring the users about safety.

2.2.7. Ideal Strategy:

An ideal strategy is a planning and execution strategy which confirms the success of the work in any situational conditions and constraints. This strategy ensures the sustainability of the organization with a huge profit. Ideal strategy always ensures winning in an organizational problem with least or zero effort. The ideal strategy is suitable for hypothetical situations to confirm winning but cannot be implemented for real situations. But we can realize the consequences of ideal strategy in practice by means of the new strategy named White Ocean Mixed (WOM) strategy, which is an optimum mixture of all existing strategies like red ocean strategy, blue ocean strategy, green ocean strategy, black ocean strategy, and white ocean strategies. Even though the characteristics of the ideal strategy cannot be implemented in reality, to develop an optimum strategy which will ensure the organizational success, one has to identify characteristics of ideal strategy. The important characteristics of an ideal strategy which will give idea to identify an optimum strategy to the organizational problems are given below:

- The strategy should be independent of types of business and type of problems.
- The strategy should identify ideal solutions to organizational problems and to fulfil organizational objectives.
- The ideal strategy provides solutions to all problems the organization is facing and gives expected output whatever may be the constraints of the business system.
- Flexible to accommodate internal and environmental changes.
- Success through ideal strategy is measurable.
- Ideal strategy will not consume any resources while implementing.
- Ideal strategy is easy to implement and supports to fulfil the objectives at zero cost and zero time without any constraints.
- Ideal strategy includes competitive strategy, monopoly strategy, sustainable strategy and survival strategy to win the organizational challenges.
- Ideal strategy translates organizational business into ideal business.
- Ideal strategy guarantees organizational success in any kind of internal and external environments.

An optimum strategy is the best strategy within organizational or business constraints to fulfil the objectives of an organization. Optimum strategies of an organization can realizable and results can be tested. Optimum strategy in an organization or in a business model supports how

to face competition, how to develop monopoly products and services, how to maintain an environment for sustainability, how to manage turbulent situations for survival, and how to get long term profit for changes in internal and external environments. By mixing various corporate strategies like red ocean competitive strategy [44], blue ocean monopoly strategy [45], green ocean sustainable strategy [46], and black ocean survival strategy [47-50], one can develop white ocean optimum strategy [16, 51] with the intention to use ideal strategy for a given situation.

2.2.8. Ideal Software:

The Quality factors of software can be determined using their input characteristics, operational characteristics, transition characteristics, revision characteristics, and output characteristics. These characteristics are obvious and essential features expected from any project during development and implementation. The prominent eight input characteristics are (1) Zero input resources, (2) Infinite selectivity, (3) Ubiquitous input acceptance, (4) Infinite input security, (5) Infinite reliability, (6) Infinite usability, (7) Infinite efficiency in data acceptance, and (8) Zero energy consumption at input.

System characteristics include operational characteristics, transitional characteristics and maintenance characteristics. The ten prominent operational characteristics are (1) Zero budget, (2) Full correctness, (3) Easy usability, (4) Perfect integrity, (5) 100% reliability, (6) 100% efficiency, (7) Infinite tolerance to security threats, (8) 100% safety against hazards, (9) Infinite functionality, (10) Perfect Robustness. The importance of any of these factors varies from application to application. In systems where human life is at stake, integrity and reliability factors must be given prime importance. In any business, related application usability and maintainability are key factors to be considered. Always remember in Software Engineering, quality of software is everything, therefore try to deliver a product which has all these characteristics and qualities. The four most prominent transaction characteristics of an ideal software are (1) Perfect interoperability, (2) 100% reusability, (3) perfect portability, and (4) 100% performance guarantee. The ten most prominent maintenance characteristics of ideal software are (1) Zero maintenance cost, (2) Perfect flexibility, (3) Perfect generality, (4) Infinite extensibility, (5) Infinite scalability, (6) Easy testability, (7) Highest modularity, (8) Best readability, (9) Easy documentation for anybody use, (10) Infinite tenant efficiency, and (11) Easy reconfigurability.

The prominent eight output characteristics are (1) 100% accuracy, (2) Perfectly correct output, (3) Perfectly reliable output, (4) Long-term sustainability, (5) Infinitely reusability, (6) 100%

output efficiency at very low input, (7) Readability to everyone, and (8) Perfect satisfied user experience. The most prominent external characteristics are (1) Inelastic demand, (2) Infinite market for ideal software, (3) Infinite ability, (4) Cannot be copied by others/competitors, and (5) High-quality service to every user [52, 53].

2.2.9. Future Ideal Systems:

Various systems which are useful in practice to human beings for improving comfortability can be also discussed based on ideal system characteristics. Some of such hypothetical systems which can have ideal characteristics are:

- Ideal Automobile – with characteristics like low procurement cost, zero maintenance cost, easy operation, zero energy consumption etc. which can be achieved using advent in nanotechnology.
- Ideal Library– with characteristics like ubiquitous access of information from any corner of the world with no cost by anybody can be achieved using concepts like universal resource centre [19, 54].
- Ideal Human Beings– with characteristics like honesty, integrity, courage, self-awareness, wholeheartedness, scientific thinking, openness etc.
- Ideal Home – with features for good air and light circulation, independence in energy & water, enough storage space, temperature control facility, low maintenance interiors, and exteriors, healthy environment etc.
- Ideal Organization – with characteristics like total automation, the opportunity for its employees to work from home [55-57], online ubiquitous services, stakeholder satisfaction, customer enlightenment etc.
- Ideal City – with all neat, wide, and clean roads, systematically designed infrastructure and facilities, educated, responsible, and disciplined citizens, independence in all life leading resources, clean potable water, nutritious food, education to everybody, systematically planned sanitary, renewable energy & total health & fitness facilities, every other facility to keep its citizen happy & comfortable.
- Ideal World – without any differentiation between human beings based on gender, religion, race, cast, and age. The ideal world can have one currency, one judiciary system, one military, one common language, and one social system. It is the world with nutritious food, enough potable drinking water, ambient temperature, clean air, renewable energy, shelter, employment, and health for everybody with a comfortable living environment.

2.3 REVIEW ON ANTICIPATED BREAKTHROUGH TECHNOLOGIES OF 21ST CENTURY

2.3.1. Some Anticipated Breakthrough Technologies of this Century

Based on various factors which solve basic needs and advanced comfortability of human life, the technology breakthrough model consisting of nanotechnology and interrelated technologies and a set of independent technologies are derived by a qualitative data collection instrument namely focus group method [58, 59]. The block diagram of such a system is shown in Fig. 2.1. The anticipated breakthrough technologies are divided into two groups and listed below :

Interrelated Technologies :

(1) Nanotechnology

(2) Optical Computation

(3) Embedded Intelligence

(4) Chameleon Chips

(5) Flying cars

(6) Immortality through nano-bio-technology

(7) Space travel

Independent Technologies :

(1) HIV Antivirus

(2) Pseudo Senses

(3) Off Planet Production

(4) Protein Maps

(5) Customized Kids

(6) Fractal Models

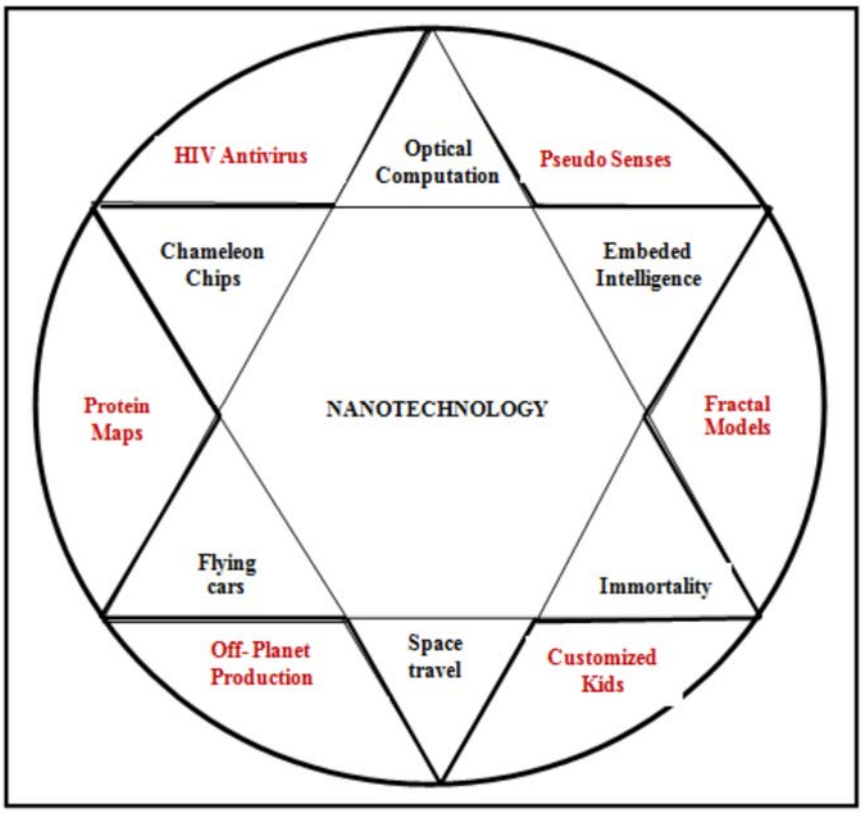

Fig. 2.1 : Block diagram to represent interrelated and independent technologies

2.3.2. Managing Breakthrough Technologies

(1) Nanotechnology :

Nanotechnology is the manipulation of matter at a scale of 1 to 100 nanometers. Using nanotechnology we can control molecules at an atomic level and create materials with unique properties. Fundamentally the properties of materials can be changed by nanotechnology. We can arrange molecules in a way that they do not normally occur in nature. The mechanical, material strength, electronic and optical properties of materials can all be altered using nanotechnology. There are different means like lithography, self-assembly, bottom-up methods to manipulate nanomaterials. Nanotechnology is the first worldwide research initiative of the 21st century.

As general purpose and enabling technologies, nanotechnologies reveal commercialization processes, from small to large firms in collaboration with public sector research, and which lead to changing patterns of industrial organization which influence public policy initiatives to foster their development [60-62]. Nanotechnologies are not only general purpose technologies but they are also technologies that enable the creation of new devices and new ways to improve the quality of life. Nanotechnologies are used in existing industries and new research areas are

developed within existing areas, transforming them from microelectronics to nano-electronics, from photonics to nano-photonics, from biotechnologies to nano-bio-technologies, and from energy to nano energy. Business firms are exploring new ways to address consumer needs, new business models based on the changes nanotechnologies could enable in existing industries. Huge amount of investments in nanotechnology to support scientific and technological researches, the creation of technological and industrial platforms and infrastructures have led to more than two million articles related to nanotechnologies being published, and over one million applications patents were lodged.

Nanotechnology has the potential to change every part of our lives. Nanotechnology affects all materials like metals, ceramics, polymers, organics and biomaterials. In the coming decade, nanotechnology will have an enormous impact in all areas of life. Future advances could change our approaches to manufacturing, electronics, IT & communications technology, space technology, agriculture & food technology, renewable energy, biotechnology and medicine, making previous technology redundant and leading to applications which could not have been developed or even thought about, without this new approach. Nanotechnology will play a major role in solving all the problems of humans like food, drinking water, energy, health, environment and many other areas including lifespan expansion.

Some of the Application areas of Nanotechnology are :

1. Medicine : This includes drug delivery, therapy techniques, diagnostic techniques, antimicrobial techniques, cell repair, cancer detection & curing, gene therapy, nanotech in regenerative medicine & tissue engineering, lifespan extension etc.

2. Electronics : This includes the development of nanotransistors, nanogates, nanodevice based integrated circuits, nanoemmissive display panels, nanomemories, nanowires, nanophotonic devices, Nano-optical computers etc.

3. Agriculture & Food : This includes contamination sensor, antimicrobial packaging, enhanced nutrient delivery, green packaging, pesticide reduction, tracking & brand protection, texture, food flavour, bacteria and virus identification & elimination etc.

4. Cleaner Air & Water : This includes pollution control, nanotech windmill blades, nanostructure membranes, water cleaning nanotechnology devices, nanoparticle catalysts, removal of carbon dioxide from industrial smoke stacks, nanotubes as the pores in reverse osmosis membranes, nanotech based water purifiers etc.

5. Batteries & Fuel Cells : This includes nanostructure fuel cells, hydrogen nanofuel cells, nanotech alternative fuel cells, long life high storage capacity fast rechargeable nanotech batteries etc.

6. Automobile & Space Technology : This includes nanomaterial based automobile parts, space elevators, weight reduction in spaceships and spacesuits, solar power satellites, bio-nano-machines for space applications, new breed of robots to explore the planets etc.

7. Sensors : This includes chemical sensors, MEMS based sensors, nano-hydrogen sensors, Nanocantilevers etc.

8. Consumer Products : Devices like sporting goods, fabrics & textiles, cosmetics, skin care products, sunscreens, flame retardants, nanocleaning products, nanopaints, and any other products based on nanotechnology.

9. Renewable Energy : This include inexpensive solar cells, devices for capturing, storage, & use of energy optimally.

10. Defense : This includes concepts like nano for the soldier, nano for defense vehicles, nano for aeronautics, nano for naval vessels, nanotechnology for weapon systems, nano for satellites, nano for logistics, nano for security, nano for military operations at land, nano for military operations in the air, nano for military operations at sea, nanotechnology for urban operations etc.

11. Civil & Mechanical Engineering Manufacturing : This includes nano-material technology, nano-processing technology, nano-assembly technology, nano-coating technology, and nano-measurement technology in mechanical manufacturing. This also includes nanorobotics, Micro-ElectroMechanical Systems (MEMS) for accelerometer chips, inkjet nozzles, pressure sensors, microphones, RF switches, gyroscope, oscillators etc.

12. Building Materials : This includes various future building materials like aerogels, nanotube mixed concrete, nanopaints, building integrated photovoltaic's, nanophotonic materials as building cooler nanotechnology on construction, and fire protection etc.

Timeline for nanotechnology innovations is predicted in various literatures is as follows :

- *Passive Nanostructures (2000-2015) : Nanomaterials, including nanotubes and nanolayers.*
- *Active Nanostructures (2015-2020) : Change their state during use, responding in predictable ways to the environment.*
- *Systems of Nanosystems (2020-2035) : Assemblies of nanotools work together to achieve a final goal.*

- *Molecular Nanosystems (2035-2050) : Involves the intelligent design of molecular and atomic devices, leading to "unprecedented understanding and control over the basic building blocks of all natural and man-made things.*
- *The Singularity (2050 and beyond) : Growth rate in NT applications become almost infinite.*

The ability to see nano-sized materials has opened up a world of possibilities in a variety of industries and scientific endeavours. Because nanotechnology is essentially a set of techniques that allow manipulation of properties at a very small scale, it can have many applications in all parts of life. Nanotechnology is viewed broadly as many technologies over time are expected to generate numerous new products and applications. Products of nanotechnology are diverse and growing exponentially. It is believed that nanotechnology can be used to significantly extend the human lifespan or produce replicator- like devices that can create almost anything from simple raw materials. The applications of nanotechnology identified in different areas provides lots of business opportunities which include health & medicine, electronics & photonics, food & food preservation, fuel cells & batteries, efficient solar cells, space travels, fuels, better air quality, cleaner drinking water, chemical sensors, sporting goods, fabric, cleaning products, energy, environment, and even lifespan increase. Management of nanotechnology research involves promotion and support of an idea to reality to make some very fine and small-scaled tools called nanotools. These tools have to be assembled at the molecular level in order to perform work at the nano level. The work of nanotechnology is so specialized that the tools need to be modelled and made specifically for each job. Handling the tools involves careful and minute planning so that those skilled in molecular nanotechnology will be in high demand in the workforce [63-64].

Anticipated breakthrough in nanotechnology will soon radically change our lives and the entire world. Researchers and policymakers from around the world believe that nanotechnology is about to radically transform world economies, improve the global environment, and provide a new understanding of what it means to be human.

(2) High speed computing through optical computers :

High performance computing through optical computing is the science of making computing work better using optics and related technologies. Optics has the ability to solve hectic problems in computing hardware. With the growth of computing technology, the need of high performance computers (HPC) has significantly increased [65]. Even though lot of research is taking place in laboratories, optical computing research has so far failed to come out of the lab in the form of a general purpose device. The construction of optical subsystems directly on-

chip, with the same lithographic tools as the surrounding electronics has been made possible by the advances in these tools, which can now create features significantly smaller than the optical wavelength [66].

The need for optical technology arrives from the fact that present day computers are limited by the time response and speed of electronic circuits. A solid transmission medium limits both the speed and volume of signals, as well as generating heat that damages components. These constraints have led scientists to seek answers in the light itself. Light does not have the time response limitations of electronics, does not need insulators, and can even send dozens or hundreds of photon signal streams simultaneously using different colour frequencies. They have low-loss transmission and provide large bandwidth. By replacing electrons and wires with photons, fiber optics, crystals, thin films and mirrors, researchers are hoping to build a new generation of computers that work several million times faster than conventional computers [67].

Some of the advantages of optical computers are listed below :

(1) High performance : The performance of an optical computer in an advanced stage should be several orders of magnitude higher than the conventional computer.

(2) High parallelism : Another key to fasten up optical computers is to compute with higher parallelism. This implies higher performance and higher bandwidth.

(3) Low energy consumption : Optical computers have the potential to be more power-saving than conventional ones.

(4) Less heat dissipation : In optical computers lasers are used as light sources. Those concentrated light beams only consist of a small spectrum of different wavelengths. Depending on the field of application lasers have different needs of energy and produce heat to a greater or lesser extent. Optical computers could be smaller because there is no need for a fan or free spaces for air circulation.

(5) Low noise : Conventional computers produce noise due to rotating fans and drives. Optical computers could be almost noiseless since no fan will be needed. Light sources (e.g. lasers) can be cooled with passive coolers and heat pipes built out of aluminium or copper. Those passive coolers evacuate heat silently.

(6) Flexibility layout : In optical components the distance of communication does not matter. Once the signal is in an optical fiber it does not matter whether the signal runs 1 meter or 1000 meters. Because of the low damping long-range communication is possible. Still the data rate

is very high and there is no crosstalk. So, the optical computer technology has the potential to change the shape and layout of computers fundamentally.

(7) Low loss in communication : The communication with optical fibers is almost lossless due to the total internal reflection. So, amplifying the signal is not or only rarely needed. Furthermore, a higher bandwidth is possible, optical communication is insensible to electromagnetic interfering fields and it is more tap-proof. For high performance communication fiber optics are used.

(8) Less wear : Wear normally occurs at mechanically moving parts. In optical computers fans will not be required. An optical processor does not heat up due to internal friction of the electrons like a conventional computer does. Additionally, new technologies for mass storages in the form of holograms or on molecular basis is possible. Those forms do not need fast rotating parts and do not wear out. It is sure that the scientists of 21st century will make a breakthrough by developing a suitable model and realize such model using suitable materials and components, and algorithms to realize both optical and quantum computers in the society.

(3) Embedded Intelligence :

The ability of a product, process or service to reflect on its own operational performance, usage load, or in relation to the end-user or environment in terms of satisfactory experience and smart improvement is characterised as Embedded Intelligence. This improvement through self-reflection, facilitated by information collected by sensors and processed locally or remotely, must be considered from the design stage such as to improve the product features, enhance the product lifetime and performance, increase quality of process or service delivery, or ensure customer satisfaction and market acceptance [68-71]. Embedded intelligence aims at delivering smarter products, systems or services to industry through their integration and purposeful use for a given application. Embedded intelligence (EI) system/service application contains various components/processes which include design for EI, intelligent software, packaging & interconnect, manufacturing solutions and/or system services.

The integration of embedded processors with sensors, intelligence, wireless connectivity and other components with high level operating systems, middleware and system integration services is possible and it is predicted that over the next 10 years “IT devices for industries including medical, manufacturing, transportation, retail, communication, consumer electronics and energy will take a development direction that makes intelligent designs become a part of all of our lifestyles”. This forecasts a significant growth for embedded systems in future years. The digital devices based on embedded systems just don't have keyboards and screens, since

they're buried inside stereos, vacuum cleaners, microwave ovens, and almost anything else that plugs into the wall or runs on batteries. Wireless-communications technology is wrapping the earth in layer upon layer of interconnectivity. And those tiny chips embedded in everyday gadgets will keep getting more powerful. Soon, the anonymous chips will get smart and be aware of their silicon neighbours, which is possible with the help of integrated sensors and wireless telecom systems. For example, the bedroom clock will just need to reach the phone to check on traffic patterns and flight schedules before deciding whether it should fiddle with its alarm time. Similarly, when rechargeable toothbrush detects signs of a cavity, it can send signals through the electrical wiring and get in electronic daybook to consult with dentist's digital appointment book, then display a few options on the bathroom mirror. Software agents with embedded intelligence will roam the wireless Web, autonomously managing most routine business and household chores. For example, if a product-design problem come up at work, the smart-card companion in the that place will be informed, and it will activate the display circuits in the paint on the nearest wall to display instead of using an electronic fold-up display. Welcome to tomorrow's world of embedded intelligence as a breakthrough technology of 21st century [72-73].

(4) HIV Antivirus :

Satisfactory and complete curing of HIV by discovering a suitable antivirus is one of the anticipated and most required technology breakthroughs of this century. With just 10 genes wrapped in a coating of protein and sugar, the virus that causes aids (left) has managed to stay several steps ahead of humanity's best efforts to control it. More than 55 million people have been infected around the world. But medicine is beginning to control this deadly scourge--with implications that go beyond aids. For instance, scientists have uncovered the wily molecular tricks HIV uses to slip its own genes into cells. That has enabled companies to devise drugs capable of blocking viral entry. The unprecedented research effort is also dramatically boosting our understanding of the immune system. In aids, clever new vaccines based on that knowledge are already offering the hope that the body could keep the virus in check on its own. And the aids breakthroughs will catalyse development of treatments for other diseases as well. Intensive researches are going on at several laboratories to develop suitable antivirus dosage for permanent cure of HIV/AIDS [74-75]. Scientists caution that a permanent cure for aids is still a dream. But new drugs, vaccines, and a growing international commitment to fight the illness as both a health and an economic problem should finally end this epidemic--and also help

improve the public health infrastructure enough to tame malaria and other terrible diseases [76].

(5) Pseudo Senses:

Sensation of existence through virtual reality, by creating artificial environment is another expected breakthrough of this century, it is predicted that virtualized reality will restore the sense of shared community that people had before we began sequestering ourselves in front of TV sets and computer screens.

In pseudoscience literature one frequently encounters the claim that there are some people, called "sensitives" or psychics," who somehow can pick up the thoughts of others and even transmit their own thoughts to people who are not "sensitives." This direct mind-to-mind communication is sometimes claimed to be instantaneous, and independent of distance. It is also often claimed that all people and even domestic animals such as cats, dogs, and horses -- possess this ability to some degree, and that ordinary coincidences are in fact no ordinary, but rather mysterious demonstrations of this supposed ability. Sometimes, but rarely, specific experiments are cited as having confirmed the existence of telepathy, clairvoyance, precognition, telekinesis, or other such "supernatural" abilities in humans or animals. Furthermore, in the course of evolution many kinds of animals have developed extremely acute senses of one kind or another, compared to those of humans. Dogs have much more highly developed sense of smell than do humans; hawks and eagles, more acute eyesight; bats, much wider range of hearing, etc.

Cognitive science through virtual reality represents an awesome look into our future. New theories about functions of our brain are unfolding at increasingly rapid intervals. Some experts believe a new understanding of the brain will lead to the creation of truly intelligent machines. Others suggest far-out technologies such as "Neural Virtual Reality" (NVR). NVR takes existing virtual reality technology to the next level by pumping virtual environments directly into the brain with neural implants. Transmitted signals trick the brain into believing the body is actually participating in a simulated experience. The implant tells the brain what the body is hearing and how it should feel. With all sensory inputs provided by NVR, a sufficiently realistic simulation is indistinguishable from reality, much like a dream. Today, we cannot even conceive all the applications that this extreme technology could provide. However, cognitive science promises a truly "magical future" for all to enjoy [77-79].

(6) Off Planet Production in micro-gravity :

Orbiting 220 miles above the Earth, the International Space Station offers more than just a spectacular view. It also gives scientists the chance to conduct research in the near absence of gravity. The result could be everything from new plant varieties to important new synthetic materials. Gravity, it turns out, is such a strong and pervasive force that it masks many interesting physical properties, including those related to combustion. In the space station, where gravity has only one-millionth the strength it has on Earth, hot gases do not rise, so flames are spherical and stable--and thus easier to study. Such flames can be used to create novel "combustion-synthesized" materials. One such material is a ceramic that could serve as an artificial bone. Powders are mixed and ignited to make the material, which is much more uniform when made in microgravity than when made on Earth. Researchers have also found that a rose is a rose except when it's grown in space. A rose carried aboard a 1998 shuttle flight had a different scent than roses grown on Earth. That heavenly fragrance was later synthesized on Earth and has already been used in a commercial perfume. Thus off-planet production in micro-gravity space may provide new varieties of plants, new structures & colour combinations of flowers, new breed of seeds and even new community of animals. It is anticipated that in 21st century such possibilities will be completely explored [80-83].

(7) Protein Maps to know how many active genes are coding for proteins in living being :

The decoding of the human genome has barely been completed but already scientists are delving into biology's next challenge: proteomics, the large-scale study of proteins. The goal is to understand the functions of the million or so proteins in the human body. With this knowledge, researchers say they can devise treatments to diagnose and eventually eliminate many diseases [84, 85, 2].

Mapping the human proteome is a monumental task. It will require hundreds of millions of dollars in investment and untold trillions of computations. The molecular contrasts tell the whole story: The human genome is made of DNA - simple, linear molecules containing just four basic constituents. Proteins, on the other hand, are exquisitely complicated structures wrought from 20 different building blocks called amino acids. These molecules fold their hundreds of thousands of atoms into precise configurations that can perform specific cellular tasks--building cellular structures, for example, or charging into the bloodstream as disease-fighting antibodies.

The natural origami underlying large proteins such as Factor VIII (left) - a common clotting factor in the blood--is so complex that scientists cannot yet predict the pattern, even with the help of the most powerful supercomputers. But solving the protein-folding mystery will yield

insights into numerous diseases, including Parkinson's, Alzheimer's, and mad cow. And the more they learn about proteins, the closer they come to curing killers such as breast cancer and diabetes [86-90].

(8) Customization of Physical and Mental Ability of Kids :

We all desire perfect lives for our children. So is there anything wrong with giving them every edge we can afford to ensure their success, including removal of genetic flaws before they're born. Deciding how and when to meddle with genes may raise the most difficult ethical questions facing humankind in the third millennium. Already, several doctors have announced efforts to attempt human cloning, making an exact genetic copy of anyone who hands over his or her DNA. Other scientists are furiously working to perfect "germline" engineering, in which a gene would be permanently removed, added, or altered in an embryo, ensuring that certain genetic traits would or would not be replicated in all future generations [35-37]. Surprisingly, cloning has already gained support from some doctors and ethicists as an infertility treatment of last resort. Germline engineering, though, raises more concerns, may sound okay for parents with deadly hereditary diseases to pluck out the offending gene from an embryo. But where might be the consequence ? Rich parents could use this technology to modify children in all sorts of ways, attempting to add genes for athletic prowess or intelligence, creating a social divide of genetic haves and have-nots. This may lead to a new race of reengineered people who might not be able to breed with those whose genetic makeup was left to chance [94-95].

(9) Development of Chameleon Chips which are reconfigurable photonic circuits using the idea of optical solitons :

Some computer scientists are hatching a novel idea that could modify the internal circuitry depending upon application. This will crunch the power requirement and trim costs as well. Such an integrated circuit chip is called chameleon chip [2, 96]. Today's microprocessors carry a general-purpose design, which is both good and bad. The good thing is that the chip can run a range of programs in a computer for different jobs, such as crunching spreadsheets or editing digital photos. The bad thing is that for any one application, much of the chip's circuitry isn't needed, and the presence of those "wasted" circuits slows things down. Based on Chameleon chips idea, one set of chips, little bigger than a credit card, could do almost anything, even changing into a wireless phone. The market for such versatile marvels would be huge, and would translate into lower costs for users.

Chameleon chips would be an extension of what can already be done with field-programmable gate arrays (FPGAS). An FPGA is covered with a grid of wires. At each crossover, there's a

switch that can be semi-permanently opened or closed by sending it a special signal. Usually the chip must first be inserted in a little box that sends the programming signals. But now, labs in Europe, Japan, and the U.S. are developing techniques to rewire FPGA-like chips and even software that can map out circuitry that's optimized for specific problems. The chips still won't change colours. But they may well colour the way we use computers in years to come [97-100].

(10) Flying cars through manipulation of gravitational force :

The absence of flying cars speaks to a failure of engineering or distorted incentives in the marketplace. But the humbling truth is that we don't have these vehicles because we still don't know, even in principle, how to directly manipulate gravity. Indeed, the cars missing from our skies should serve to remind us that, to a degree rarely appreciated, we have surprisingly poor control over most of nature's fundamental forces [101]. Physicists have compiled a comprehensive inventory of all the ways things can pull or push on other things, a complete itemization of nature's forces. They've found just four. The first is gravity, the force that keeps your feet on the ground. The second is electromagnetism, which is responsible for anything involving light or the arrangement of atoms. The third is the strong nuclear force, which binds protons and neutrons together inside every atom. And the fourth is the weak nuclear force, which (among other forces) helps guide the fusion reactions that power stars.

For all the power of modern science, we are masters of only one of these forces: electromagnetism. Laptops, smartphones, wirelessly connected thermostats, google glass - all our high-tech miracles exist because we've learned to control the electromagnetic force at the subtlest of levels. When it comes to electromagnetism, we have powers that are almost godlike. With the other three, we're not even close. For example, nuclear power plants rely on our remarkable knowledge of the strong and weak nuclear forces. But when all is said and done they simply use the heat generated by splitting atomic nuclei to boil water, which then spins turbines, which then generate electricity. That's not so different from a 19th-century steam engine. Compared with the precision of an electron microscope (or even a grocery-store laser scanner), our handling of nuclear forces is still at the level of slamming rocks together. The same is true of gravity. Obviously, we can make a plane fly by forcing air to flow over a wing, which generates the pressure to lift it off the ground. But the interaction of those air molecules is a result of electromagnetic forces and the fuel we use to power planes & blow rockets off the planet is a result of our understanding of chemistry, which again is a matter of electromagnetism. Thus, all our ways of flying involve a heavy-handed application of the

electromagnetic force through fuels and engines. The noise, the danger, the pollution and the inefficiency that accompany the current ways of flying are a testament to our crude approach to defying gravity.

The problem is due to the fact that we don't understand gravity at its most fundamental level. Much as a seemingly smooth shoreline is actually composed of quintillions of individual sand grains, every aspect of the world - matter, energy and motion - is actually parceled into infinitesimal building blocks. The four forces that shape the world come in little packages, too. With electromagnetism and the nuclear forces, we understand how the parceled behavior, the quantum mechanics of these forces works. And the digital culture we've built rests directly on our ability to understand and manipulate electromagnetism's quantum manifestations. But with gravity we remain in the dark. We have no theory of quantum gravity and without the ability to manipulate the quantum gravitational world, we won't be gliding around in the silky hush of hover-cars anytime soon. Instead we will have to fly the old-fashioned electromagnetic way. Hence, all our technological powers, we are still constrained by the deepest structures underlying physical reality. If one force can be easily manipulated at room temperature but another requires the power of a cosmic explosion, then those are facts we just have to work with [102-105].

(11) Immortality through nano-bio-technology & stem cell research :

Immortality is eternal life or the ability to live forever. Biological forms have inherent limitations which medical interventions or engineering may or may not be able to overcome. Natural selection has developed potential biological immortality in at least one species, the jellyfish. Certain scientists, futurists, and philosophers, have theorized about the immortality of the human body, and advocate that human immortality is achievable in the first few decades of the 21st century, while other advocates believe that life extension is a more achievable goal in the short term, with immortality awaiting further research breakthroughs into an indefinite future. newly developing technologies may be used to induce biological immortality in human beings. *Human embryonic stem cells* generated considerable excitement since they were a means of mass-producing replacement cells for the treatment of a host of degenerative diseases involving the loss or dysfunction of cells, including those in osteoarthritis, macular degeneration, diabetes, heart failure, Parkinson's disease, and numerous other disorders. The first report of the isolation of these cells marked the birth of the new field called *regenerative medicine*. When perfected, this technology offered the theoretical potential of rejuvenating an entire human body back to a youthful state**.** Hence *immortality* is the ultimate goal of ideal

technology so that it can create an avenue for deathless situation or enhancement of human life span [106-109].

There are two ways in which nanotechnology may be able to extend our lives. One is by helping to eradicate life-threatening diseases such as cancer, and the other is by repairing damage to our bodies at the cellular level--a nano version of the fountain of youth. The most exciting possibility exists in the potential for repairing our bodies at the cellular level. Techniques for building nanorobots are being developed that should make the repair of our cells possible. For example, as we age, DNA in our cells is damaged by radiation or chemicals in our bodies. Nanorobots would be able to repair the damaged DNA and allow our cells to function correctly. This ability to repair DNA and other defective components in our cells goes beyond keeping us healthy: it has the potential to restore our bodies to a more youthful condition. The extension of the human lifespan could be facilitated through the removal of a substance called lipofuscin from certain types of non-dividing cells, including the brain, heart, liver, kidneys and eyes. Lipofuscin is a metabolic end product that accumulates primarily within lysosomes (the garbage disposal organelles within cells). It's thought that when lipofuscin accumulates to certain levels, it begins to negatively impact cell function, which eventually manifests in many age-related conditions. Aubrey de Grey et al. have proposed that soil bacterial enzymes might have the capacity for degrading lipofuscin. It is proposed that humans might live as long as 1,000 years under the appropriate rejuvenative therapies. In 30 or 40 years, we'll have microscopic machines traveling through our bodies, repairing damaged cells and organs, effectively wiping out diseases. The nanotechnology will also be used to back up our memories and personalities. And in 35 to 40 years, we basically will be immortal [110-114].

(12) Fractal Models which are mathematical models used to represent fragmented geometry shapes :

Clever mathematical techniques are the foundation of increasingly realistic computer models and simulations. Now, math research is on the verge of creating tools that mathematicians hope will cut two ways: help scientists unlock explanations to many phenomena that remain mysterious and produce new modelling systems that could revolutionize product development and manufacturing. All this could be coming from fractals, those crinkly lines that look the same no matter how much they're magnified. "Fractal" is the term mathematicians use for patterns that repeat on all scales--like the spikes on a fern leaf that could be tiny copies of the fern itself [115 - 116]. Fresh research indicates that such recurring patterns may be more fundamental in nature than had been thought. If the new insights can be captured in fractal

algorithms, science could gain extraordinary new powers. The same basic formulas could be "exploded" in scope to help scientists better understand large-scale systems such as the influence on climate from patterns of sunlight reflecting off the ocean's surface. And they could predict traffic flows on the Internet, or on physical highways. Conversely, "imploding" the formulas would adapt them for small-scale use, such as the behaviour of molecules. That could save time in R & D by pointing out which avenues are more promising. Designers and engineers could update near-perfect models to speed their work on new products and processes [117-118].

(13) Space travel for everybody :

The earthly challenges facing humanity are the result of our heavy demand on resources and raw materials. Many of these materials can be found in space but the expense to extract them is a major barrier. In addition to cost, other obstacles to developing space are safety, reliability, and performance. According to the National Space Society there are four reasons why we need to pursue space exploration and colonization. These reasons—survival, growth, prosperity and curiosity—all point to the fact that we, as a species, want more room. Space exploration will give us a means to monitor the health of our planet, a source of resources and an outlet for our imagination. Using carbon nanotubes to make the cable needed for the space elevator, a system which could significantly reduce the cost of sending material into orbit. Nanotechnology will create the ability for humans to operate in space more safely. Applications where nanotechnology will impact space exploration are propulsion fuels, coatings, structural materials, smart uniforms, electronics and life support environments. These will be more efficient, stronger, self-healing and lighter than what is currently available [119-122].

2.3.3. Strategies for Managing these Technologies

Nanotechnology breakthroughs are expected to change the present lifestyle to a greater extent. The general purpose nature of nanotechnology and its advantages in solving both basic and advanced problems in all realm of society including, scientific, engineering, agricultural & food, medical & biomedical, building materials, electronics, cleaner air & water, renewable energy & storage, consumer products, automobiles & space technology, defense, and civil & mechanical engineering manufacturing will provide opportunity to find optimum solutions to many problems in the society. The anticipated breakthroughs in nanotechnology as central technology along with its related technologies like Optical Computation, Embedded Intelligence, Chameleon Chips, Flying cars, Immortality through nano-bio-technology, Space travel and other independent technologies like HIV Antivirus, Pseudo Senses, Off Planet

Production, Protein Maps, Customized Kids, and Fractal Models will eradicate poverty & deceases in the society and fuel to the development of advanced homogeneous society completely different thinking and lifestyle compare to present day society.

Optical Computing will bring faster computers, better storage and communications, advanced artificial intelligence, and simpler ways of interfacing new software and hardware – including connecting radical new applications from machines directly with our bodies. One day, possibly by the end of 21st century or sooner, it will be possible to merge computer programs into our dreams. Computer-assisted dreaming could enable us to create dreams that we could share with others. Interactive shared dreaming could become a popular leisure pursuit.

Similarly, the anticipated breakthrough in off-planet production in micro-gravity may provide new varieties of plants, new structures & colour combinations of flowers, new breed of seeds and even new community of animals and such possibilities will provide new opportunities in further research in science & technology as well as in business processes & industries. This will definitely affect the life style of human beings in terms of solutions to both basic needs and advanced comforts. The people in the society may get more varieties of products and services to make their life happier and more comfortable.

Similarly, the anticipated breakthrough in decoding of the human genome and producing artificial proteins through *protein mapping* will provide opportunity of discovering artificial food and curing many cruel deceases of human being which may lead to hungry-less and decease free, happy and comfortable society. "If we live 20 more years, probably, we may never die". How new technology break through might play out in human life in the process of improving happiness and comfort during 21st century resulting from new innovations in above 13 areas. Nearly all diseases will become curable during this period; replacing aging and worn body parts will become common practice leading to *immortality*. By the end of 21st century it is believed that, most adults will look forward to a radically increased lifespan with near-perfect health.

As the global economy continues to be transformed by new technology breakthroughs, a keen competition will develop for talent, intellectual property, capital and technical expertise. Many of these factors responsible for shaping how nations compete, interact and trade. Technical innovations will increasingly shape economies and market robustness. Technology will continue to drive global and domestic development. Competition will be fuelled increasingly by fast breaking innovations in technology and its adoption. If the proliferation of present technologies to form new business models is any indication of the speed and power of change

in the economy, future technology breakthroughs will make for an even more dramatic paradigm shift. The evolution of a techno-economy, as contrasted with the petro-economy of today, is an intriguing idea. Anticipated technology innovations yet to come will set the timeline for this economic transformation. These technology breakthroughs may become integrated into industries and may become an embedded component of new products.

The social acceptance of these technology breakthroughs depends on Geographical Parameters like location, demography, culture, class, etc., Economic Parameters like the market penetration for the technology, its demand etc., Psycho-Social Parameters like people view on given technology, Affective Parameters like comfort level, Cognitive Parameters like awareness of those technologies, Technical Administrative Parameters like process of regulatory measures, Political Parameters like ability to debate, contention and organized opposition to a technology. This also include normative and quasi-normative parameters for the social acceptability of such technology breakthroughs like Religious Acceptability, Cultural Acceptability, and Ethical Acceptability of the effects and consequences of the penetration of these technologies.

2.4 REVIEW ON NANOTECHNOLOGY INNOVATIONS & BUSINESS OPPORTUNITIES

2.4.1. Challenges for Human Prosperity

The emerging nanotechnology is expected to solve both basic needs and comfort needs of human beings. The basic needs of human being are food, drinking water, energy, cloth, shelter, health and environment and the comfort needs are realizing the automation in every field, space travel and expanded life-span and so on. Nanotechnology is sometimes referred to as a general-purpose technology. That's because in its advanced form it will have significant impact on almost all industries and all areas of society. It will offer better built, longer lasting, cleaner, safer, and smarter products for the home, for communications, for medicine, for transportation, for agriculture, and for industry in general [123].

(1) Food : One of the basic necessities of human being in this society is nutritious food. Due to various reasons, people of major part of the world are struggling to get nutritious food for their hungry. Nanotechnology innovation in agriculture is expected to solve the problems in food sector and maximizes productivity in agriculture. There is an ever-increasing demand for food and adequate nutrition, while world grain harvest has fallen short for the last few years. Biodiversity is being destroyed worldwide and half of our world's forests and a quarter of our coral reefs are gone during last century. The world population is currently at 6.4 billion and is

estimated to swell to 8.9 billion by the year 2050. It is anticipated that 98% of this growth will be in poorer countries. It is also predicted that there will be 5 billion city dwellers by 2030 which will place heavy demands on the growth and distribution of food. Nanotechnology will provide solutions through precision farming using nanosensors, nanopesticides, and inexpensive decentralized water purification. A more advanced nanotechnology solution will be plant gene therapy; creating pest resistant, high yield crops that require less water [124].

(2) Drinking Water : Another basic necessities of human being in this society is clean drinking water. People of many countries are severely suffering due to non-availability of pure drinking water. Nanotechnology has potential to provide efficient, cost effective and environmentally sustainable solutions for supplying portable water for human use and clean water for agricultural and industrial uses. Nanotechnology innovations in low cost water purification are expected to solve drinking water problem of the world. Agriculture currently uses 70% of the world's water supply. To feed 2 billion more by the year 2030 there will be a60% increase in demand on the water supply. Considering the current rates of consumption, population and development, some two-thirds of the world population will be affected by droughts by the year 2050 which will increase the demand for fresh water. Nanotechnology will provide solution for this challenge through inexpensive decentralized water purification, detection on the molecular level of contaminants, and greatly improved filtration systems. This helps conversion of sea water into drinking water at very low cost [125].

(3) Cleaner Breathing Air : Clean air for living beings breathing with required amount of oxygen content is very essential for sustained living on this earth. Based on continued and enhanced pollution and added green gases, the atmosphere gets polluted and contaminated. This created serious problems in human health conditions. Enhanced transportation vehicles and industrialization are partly responsible to this atmospheric degradation. Nanotechnology based new membranes use electrostatic forces to sort molecules by size and can also separate some gases, potentially providing an economical way to capture and prevent the atmospheric release of carbon dioxide from power plants & automobiles. By means of using nanotechnology based air cleaners at suitable places, the essential percentage of oxygen in the atmosphere can be maintained.

(4) Renewable Energy : Energy is the most important basic resource after food and water for human prosperity. Demand for energy on earth is forecasted as increasing 50% by the year2025 with most of these being fossil fuels. Currently over 1.6 billion humans have no access to electricity and 2.4 billion rely on plant material, vegetation, or agricultural waste as an energy

and heating source. It is estimated that our fossil fuel consumption is escalating and could become double by the year 2025. Meanwhile, Earth's glaciers are receding, the CO_2concentrations in the atmosphere have nearly doubled, and world temperatures, recorded since 1861, were the hottest in three of the past five years. 1998 was the warmest of record, 2001 came in the second warmest and 2004 was the fourth warmest [126]. Nanotechnology innovations in renewable energy solves entire energy requirement of human beings for their basic needs and for the comfortable life. Balancing humankind's need for energy with the environmental cost to our planet is a major challenge. Nanotechnology based energy solutions through more efficient lighting, fuel cells, hydrogen storage, solar cells, locally distributed power generation, and decentralized generation and storage by reinventing the power grid are expected to create more potential business opportunities.

(5) Clothing : The fourth basic necessity of human being is cloth. The nature of cloth required to protect their body from the surrounding environment depends on the geographical location on the earth surface. Nanotechnology research opened avenue to make composite fabric with nano-sized particles or fibers allows improvement of fabric properties without a significant increase in weight, thickness, or stiffness as compared to previously-used techniques. It supports creating fabrics that do not wrinkle, stain, or allow the growth of bacteria. Many products that available in markets like anti-microbial socks; underwear and sporting apparel; wind and water proof jackets; wrinkle and stain resistant suits; casual wear; and swimsuits that protect against UVA and UVB rays are all products that are treated with nano-coatings or use nanotechnology in the manufacturing process. The advantages of nanotech fabrics are water and stain resistant, insulates against heat or chill, dirt rinses off in rain, reduces odours and bad smell [127].

(6) Shelter : Another basic necessity of civilised human being is protective shelter. Nanotechnology offers interesting new opportunities in the construction sector through the development of energy efficient, ultra high strength, extra durable, extremely lightweight construction materials. Nano-modification of cement is an emerging field. Synthesis and assembly of materials in the nano-meter scale offers the possibility for the development of new cement additives such as novel super-plasticisers and nano particles. It is now possible to manipulate the fundamental structure of cement phases to control concrete properties, performance and durability. Nano-modification also provides crucial information for predicting the service life of concrete more accurately and insights on improving it further. Preceded by the IT and software revolution, nanotechnology and science are expected to usher

a new paradigm shift in all spheres of technology including infrastructure and construction [128].

(7) Human Health : The degraded environment and its consequence on human health is another challenge for human prosperity. In the previous centuries, men and women expected to live to 48 and 51 years respectively. But life expectancy is now 74 and 80 years and could be significantly longer with anti-aging advancements currently being developed. At the same time, 30 new highly infectious diseases have been discovered in the last 20 years. These diseases account for 30% of the deaths worldwide and include HIV/AIDS, Ebola, Cancer, and the Avian Flu. The important and major area of nanotechnology research is in human health and is making tremendous progress in the medical field. Some of the nanotechnology applications in the arena will be inexpensive and rapid diagnostics, new methods of drug delivery, and faster development of new drugs. Some longer term and even more powerful nanotechnology solutions will repair DNA and cellular damage and customize drug therapy. Nanotechnology may have its biggest impact on the medical industry compared to other industries. Patients will drink fluids containing nanorobots programmed to attack and reconstruct the molecular structure of cancer cells and viruses. There's even speculation that nanorobots could slow or reverse the aging process, and life expectancy could increase significantly. Nanorobots could also be programmed to perform delicate surgeries such nanosurgeons could work at a level a thousand times more precise than the sharpest scalpel. By working on such a small scale, a nanorobot could operate without leaving the scars that conventional surgery does. Additionally, nanorobots could change the physical appearance of human beings. They could be programmed to perform cosmetic surgery, rearranging the atoms of human body to change his/her ears, nose, eye colour or any other physical feature he/she wish to alter [129].

(8) Environment & Climate : There is an ever-increasing demand for natural resources and living space for humans, while toxics continue to build up in our water and soil. Biodiversity is being destroyed worldwide with 7 million hectares of forest being lost annually. Half of our world's forests and a quarter of our coral reefs are gone. With increasing threats especially to the oceans, biodiversity decreases each year. Damage to the atmosphere's ozone layer has slowed but a hole still remains. Many believe that man-made greenhouse gases are causing disruption to the planet's climate, a process popularly termed 'global warming.' Proposals to correct this are expensive and unlikely to be followed by developing nations who see economic advance as more urgent. Nanotechnology will provide solutions through precision pollution

monitoring using nanosensors, lower energy needs due to lightweight strong materials, and reducing the use of harsh cleansers through the applications of nanocoatings to surfaces. A more advanced nanotechnology solution will be building our products with molecular-level precision through the use of productive nanosystems, resulting in virtually no chemical waste and pollution [130].

2.4.2. Challenges

(1) Sustainable transportation :

Nanotechnology will become a key enabling platform technology for next generation transportation systems to develop more efficient and lighter materials for automotive and aircraft systems, High performance tyres for automobiles, efficient and non-platinum based catalytic converters, novel more efficient fuel and power sources etc.

(2) Information communication technology for everybody :

There are currently many people who lack widespread access to communications, information, basic technology services and tech resources. This lack of access creates insurmountable barriers to education, democratization, and economic growth. The use of nanotechnology applications will drastically reduce the cost and increase the performance of memory, displays, processors, solar powered components, and embedded intelligence systems. It will also enable networks to be self-configuring. These improvements would create a pervasive computing environment that would promote greater global communication, cross-cultural understanding and cooperation [131].

(3) Consumer Products :

There are many consumer products using nanotechnology on the market. But nanotechnology or nanomaterials in these products are not easy to recognize. Because nanomaterials are embedded into other materials or used in very small amounts, consumers may not be aware of their presence. The various products come under this category are cosmetics, products used in home and garden, sports, Textiles and Apparel, Cosmetic manufacturers use nanoscale versions of ingredients to provide better UV protection, deeper skin penetration, long-lasting effects, increased colour and finish quality etc. [132].

(4) Entertainment :

Nanotechnology is expected to improve home entertainment electronics, 3D televisions, performance of videogames etc. Macro-scale integrated nanotechnology manufacturing systems will improve product functionality, product design time and manufacturing speed and cost by orders of magnitude. This advance may profoundly affect economics and geopolitics,

creating enormous benefits and risks. It will be difficult to prepare adequately for such a powerful technology.

(5) Medicine :

The applications of nanotechnology in pharmacy supports preparation of drugs containing nano-sized active ingredients, breakthrough drug delivery systems that allow deposition of medications in previously inaccessible areas of the body, and improved diagnostic tests and medical devices. Nanotechnology in the form of nanoparticles has great potential in the drug delivery field. The main advantage of using nanoparticles for drug delivery is the specific delivery of drug in the targeted organ without affecting the non-targeted organs. In this wayside-effect of the drugs can be minimized. In the coming year's advancements in this field will led to an improved form of drug delivery as well as other prospects of medicine and pharmacy.

(6) Manufacturing :

Nanofactories-manufacturing systems that work on the atomic & molecular scale-are gradually moving from science fiction to science fact and one day could be used to build all types of items such as drugs, semiconductor chips and even cell-sized robots that patrol the human body. The first step would be to develop nanoscopic machines, called assemblers that scientists can program to manipulate atoms and molecules at their will. In order to make molecular manufacturing to be reality, one would need trillions of assemblers working together simultaneously. It is predicted that assemblers could first replicate themselves, and then build other assemblers. Each generation would build another, resulting in exponential growth until there are enough assemblers to produce objects. Trillions of assemblers and replicators could fill an area smaller than a cubic millimeter, and could still be too small for us to see with the naked eye. Assemblers and replicators could work together to automatically construct products, and could eventually replace all traditional labour methods and create a method of three dimensional material/device printer. This could vastly decrease manufacturing costs, thereby making consumer goods plentiful, cheaper and stronger. Eventually, such 3D printers allow us to replicate anything, including diamonds, water and food. Famine could be eradicated by machines that fabricate foods to feed the hungry [133].

(7) Space-travel : The challenges facing by humanity on the earth are the result of our heavy demand on various resources and raw materials. Many of these materials can be found in space but the expense to extract them is a major barrier. In addition to cost, other obstacles to developing space are safety, reliability, and performance. According to the National Space

Society there are four reasons why we need to pursue space exploration and colonization. These reasons—survival, growth, prosperity and curiosity—all point to the fact that we, as a species, want more room. Space exploration will give us a means to monitor the health of our planet, a source of resources and an outlet for our imagination. Nanotechnology will create the ability for humans to operate in space more safely. Applications where nanotechnology will impact space exploration are propulsion fuels, coatings, structural materials, smart uniforms, electronics and life support environments. These will be more efficient, stronger, self-healing and lighter than what is currently available.

(8) Extended life span : There are two ways in which nanotechnology may be able to extend our lives. One is by helping to eradicate life-threatening diseases such as cancer, and the other is by repairing damage to our bodies at the cellular level--a nano version of the fountain of youth. The most exciting possibility exists in the potential for repairing our bodies at the cellular level. Techniques for building nanorobots are being developed that should make the repair of our cells possible. For example, as we age, DNA in our cells is damaged by radiation or chemicals in our bodies. Nanorobots would be able to repair the damaged DNA and allow our cells to function correctly. This ability to repair DNA and other defective components in our cells goes beyond keeping us healthy: it has the potential to restore our bodies to a more youthful condition. The extension of the human lifespan could be facilitated through the removal of a substance called lipofuscin from certain types of non-dividing cells, including the brain, heart, liver, kidneys and eyes. Lipofuscin is a metabolic end product that accumulates primarily within lysosomes (the garbage disposal organelles within cells). It's thought that when lipofuscin accumulates to certain levels, it begins to negatively impact cell function, which eventually manifests in many age-related conditions. Aubrey de Grey et al. have proposed that soil bacterial enzymes might have the capacity for degrading lipofuscin. It is proposed that humans might live as long as 1,000 years under the appropriate rejuvenative therapies. In 30 or 40 years, we'll have microscopic machines travelling through our bodies, repairing damaged cells and organs, effectively wiping out diseases. The nanotechnology will also be used to back up our memories and personalities. This strongly make us to believe that in 35 to 40 years, we literally will be immortal [134].

2.4.3. Nanotechnology based Innovative Solutions

(A) Nanotechnology as Ideal Technology :

An ideal technology system should have characteristics to fulfil its objectives to solve all problems of human beings including both basic needs and advanced gadgets to support comfort

living to realize their dreams. Based on various factors which decides the ideal technology system characteristics, a model consisting of input conditions, output conditions, environmental conditions and system requirements [8]. The input Conditions include properties like : (1) Manipulate the fundamental nature of matter to provide solutions to basic and advanced problems of mankind, (2) In-expensive & self reliable in terms of resources to make it attractive to be used by people/countries of varied economical situations. (3) Ubiquitous so that the technology provides solutions and services at anytime, anywhere, any amount of time to the users. (4) Affordable to every body so that it uses common materials available in nature and manipulate effectively to the need of human being at affordable cost.

The Output Conditions include the characteristics like : (1) Solve basic needs like food, drinking water, renewable energy, clothing, shelter, health and clean environment. (2) Provide comfort life to the users by providing solutions to their desires. (3) Equality ; ideal technology provide equal opportunity and similar solutions to every user irrespective of their gender, religion, background, education, economic status, and country of origin. (4) Automation; ideal technology automates all processes in every type of industries to avoid human interference in work/control in order to provide expected output based on programming. (5) Immortality is the ultimate goal of ideal technology so that it can create an avenue for deathless situation or enhancement of human life span.

The System Requirement needs properties like : (1) General purpose technology to support all fields and problems of human & living beings on the earth. (2) Self-directed & self controlled & self regulated so that the technology can control itself in order to achieve its goal. (3) Easy, simple, quick & user friendly to solve all type of problems and to provide quick ideal solution. (4) Scalable so that it is used for solving small and simple problem to large and complex problems of life. (5) Omni-potent to identify and solve problems and provide comfortability to human being and feeling him like God. (6) Exploring new opportunities to improve and explore comfortability and further leisure in life of people. (7) Infinite potential for further development of life in the universe.

Table 2.2: Comparison of nanotechnology with ideal technology model [8]

S. No.	Major Problems of human beings in the Society	Ideal technology solution	Nanotechnology solution
1	Nutritious food for everybody	Basic feature of Ideal technology	Possible to solve using nanotechnology in agriculture.
2	Clean drinking water for everybody	Basic feature of Ideal technology	Possible to solve using nanotechnology filters
3	Renewable energy at affordable cost	Basic feature of Ideal technology	Possible through nanotech solar cells & battery technology

4	Quality and long lasting cloth	Basic feature of Ideal technology	Possible to solve using nanotechnology in fabrics.
5	Affordable Shelter to every body	Essential feature of Ideal technology	Possible to solve using nanotechnology in construction.
6	Health care	Basic feature of Ideal technology	Possible to solve using nanotechnology in medicine.
7	Environment & climate	Essential feature of Ideal technology	Possible to solve using nanotechnology as clean technology.
8	Sustainable technology for every body	Essential feature of Ideal technology	Due to its fundamental nature, nanotechnology is sustainable for everybody and everywhere.
9	Comfort life	Luxurious feature of Ideal technology	Possible to solve using nanotechnology in customer products & ability to upgrade all other technologies.
10	Space travel	Luxurious feature of Ideal technology	Nanotechnology supports low cost & efficient space travel.
11	Life span expansion	Desirable feature of Ideal technology	Bio-medical applications of nanotechnology supports life span expansion.

The Environment Conditions include : (1) Maintain clean environment through its processes and avoids foot print of processes while achieving specific function. (2) Infinite business opportunities by creating new products / services with ideal characteristics. (3) Adaptive to any situations to achieve stated goal. (4) No side effects so that it should be safe for users, and environment. Any technology which has the above properties/characteristics is considered as ideal technology and the conventional technologies have serious drawbacks/limitations in terms of the above properties.

The characteristics and opportunities of nanotechnology can be comparable with the abovementioned characteristics of ideal technology. This supports the possibility of realization of ideal technology using nanotechnology. It is predicted that nanotechnology being a general purpose technology can provide solutions almost all basic and high level problems like hypothetical ideal technology. Table 2.2 compares the possible ideal technology solutions with nanotechnology solutions for solving major problems of human being in the society [8].

(B) Nanotechnology as Breakthrough Technology of 21st Century :

Nanotechnology is considered as anticipated breakthrough technology of 21st century and is spreading quickly as disruptive technology to all areas of the society. A disruptive technology is a new technology that is significantly cheaper than current, and/or is much higher performing, and/or has greater functionality, and/or is more convenient to use. A disruptive technology will revolutionize worldwide markets by superseding existing technologies.

Disruptive technology sounds negative to only organizations that are unprepared for change, and fail to adapt, only to fall behind, and ultimately disappear. The results are not just *evolutionary*, they are *revolutionary*. Nanotechnology is going to be general purpose technology like information technology. It has wonderful features, which are not present in any other technology. Some of other anticipated technology breakthrough also depends on innovations in nanotechnology like Optical Computation, Embedded Intelligence, Chameleon Chips, Flying cars, Immortality through nano-bio-technology, and Space travel [7]. The phenomena, which were not possible few years back, are now easily implemented with the help of nanotechnology. Some of the nanotechnology based products features are described below :

(1) Nanosensors :

Nano-sensors are used for toxins in food, proteins, water; viruses, bacteria, pollutants in water, bioprocess monitoring, process control, biochemicals, intracellular activity, sensors onfoods for tracking, Some of the nano-sensors are [135] :

(a) Nanobiosensors: The nanosensors with immobilized bioreceptors probes which are selective for target analyte molecules are called nanobiosensors. These can be integrated into other technologies like lab-on-a chip to facilitate molecular diagnostics. Their applications include detection of microorganisms in various samples, monitoring of metabolites in body fluids and detection of tissue pathology such as cancer. Their portability makes them ideal for POC applications but they can also be used in laboratory settings.

(b) Nanowire biosensors: Surface properties of these can be easily modified therefore they can be decorated with virtually any potential chemical or biological molecular recognition unit, thus making the wires themselves analyte independent. Boron doped silicon nanowires are used to create highly sensitive, real time electrically based sensors for biological and chemical species.

(c) Viral nanosensors: Essentially the virus particles are called as biological nanoparticles. Herpes Simplex Virus (HSV) and adenovirus have been used to trigger the assembly of magnetic nanobeads as a nanosensor for clinically relevant viruses. By using a magnetic field, as few as five viral particles can easily be detected in a 10 ml serum sample.

(d) PEBBLE nanosensors: Probes encapsulated by Biologically Localized Embedding (PEBBLE) nanosensors consists of sensor molecules which are entrapped in a chemically inert matrix by a microemulsion polymerization process that produces spherical sensors in the size

range of 20 to 200 nm. These are capable of real time inter and intracellular imaging of ions and molecules and are insensitive to interference from proteins.

(e) Optical biosensors: Many biosensors which are currently marketed rely on the optical properties of lasers to monitor and quantify interactions of biomolecules that occur on specially derived surface or biochips. Example: Surface plasmon.

(f) Laser nanosensors: In this laser light is launched into the fibre and the resulting evanescent field at the tip of the fiber is used to excite target molecules bound to the antibody molecules. When laser falls on them, they release optical signals which are coded by photometric detection system. This system is used in analysis of proteins and biomarkers inhuman living cells.

(2) Shaping memory materials

Nanotechnology introduced the techniques to distort the plastic and silicon structures, which allowed the recovering of original shape of the material. This technology is named as SMM shaping memory materials. Metals and aluminium are reshaped and processed at nano scale to produce a chip, which can store bulk of information on it. Aluminium and silicon distortion were impossible before the arrival of nanotechnology.

(3) Assemblies and Chemical sensitivity of porphyrin

Porphyrins is the element with the unique binding properties that are widely exploited in natural world to attain beneficial and essential functions for life, nanotechnology has provided the most accurate and real some the mimic of these functions with synthetic counterparts which provides the basis of chemical bonding and sensitizing.

(4) Metal oxide nano-wires as chemical sensors

Another impressive feature of nanotechnology is that it made possible for the scientists to use metal oxides as the sensors. When metal is treated at nano scale they can carry huge amount of electrons and can be used as chemical sensors, as was discovered in early nineties and nano-wires were introduced.

(5) Use of nano-materials for water purification

Nanotechnology allowed the researchers to process the materials to be used in purification of drinking water such as sand, soil and even glass. Nano filtration plants are present in the developed countries of the world. Nano materials can purify water up to 99.9 percent without affecting the original flavour the water. It was seen for the first time that nanotechnology can extract the safest drinking water.

(6) Self-assembling

Self-assembling the key feature of nanotechnology. There is no other technology in which molecules under processing can rearrange themselves easily. Molecular nanotechnology can produce many new components from the existing ones by simply rearranging themselves.

(7) Miniaturizing mechanical surgery

Recent advances in sub-millimeter scale engineering showed the excellent work of nanotechnology in the field of medical sciences. Nanotechnology introduced such devices, which do not even leave a scar after major surgeries. it has also miniaturized the surgical instruments which are used in the diagnostics and therapeutics applications.

(8) Fabrication of electronic biosensors

Nanotechnology introduced the nano fabrications, which has reduced the cost of some of the major health equipment that includes electronic biosensors. Detection biosensors, which are nano- structured, detect and displays highly revolutionized images.

(9) New carbon nanotubes AFM technology

Nanotechnology also has great value in the field of nuclear sciences because of its extraordinary features to increase the atomic force. it was discovered in mid nineties that uranium if processed at nano level can empower the five times more powerful nuclear bomb. Nanotechnology enlighten the nano particle of carbon, nanotubes of carbon are used to build ultra-sharp tips for cutting the rigid surfaces. The technology of the new carbon tubes is named as AFM (Atomic Force Microscopy). The technology is used for the fabrication of probe tips with ultra sharp points. AFM is also used for synthesizing and for developing new components.

(10) General Purpose technology

Nanotechnology can create machines, peripheral home appliances with best functioning until now. It is the only technology, which is general purpose. From Light Emitting Diodes (LEDs)to socks, all are processed at atomic scale for increasing and improving the quality of the product.

2.4.4. Nanotechnology based Products

The nanotechnology-based products are now entering the consumer market in a big way. Nanotechnology has tremendous application potential in several areas such as Fast-Moving Consumer Goods (FMCG), cosmetics, healthcare, medicine, plastics, composites, coatings, printed electronics, optics, biotechnology, renewable energy and aerospace/ defense among others, where it has offered many opportunities to improve conventional technologies [136].

A wide range of commercialized products containing nanomaterials are already in the market, in areas like health care, cosmetics and fitness, home and garden appliances, electronics and computers, food and beverages, sports goods, paints, clothing, automotive and aerospace

components, etc. Table 2.3 contains the nanotechnology based product category available in the market along with the sub-categories and number of products in each category.

Table 2.3 : Information about the nanotechnology based products available in market as on 2016.

S. No.	Product Category	Sub-categories	No. of products in market
1	Appliances	1. Batteries 2. Heating, Cooling and Air purifiers 3. Large Kitchen Appliances 4. Laundry & Clothing care	68
2	Automotive	1. Exterior 2. Maintenance & Accessories 3. Watercraft 4. Lubricants	214
3	Cross Cuttings	1. Nano Coatings 2. Bulk Materials	142
4	Electronics & Computers	1. Audio 2. Cameras & Films 3. Computer Hardware 4. Display 5. Mobile Devices & Communications 6. Television 7. Video	101
5	Food & Beverage	1. Cooking 2. Food 3. Storage 4. Supplements	118
6	Goods for Children	1. Basics 2. Toys & Games	37
7	Health & Fitness	1. Clothing 2. Cosmetics 3. Filtration 4. Personal care 5. Sporting goods 6. Sunscreen 7. Supplement	908
8	Home & Garden	1. Cleaning 2. Construction Materials 3. Home furnishings 4. Luggage 5. Luxury 6. Paint 7. Pets	356

2.4.5. Nano Technology based Services

A service type of business provides intangible products *(products with no physical form)*. Service type firms offer professional skills, expertise, advice, and other similar products. Some

of the service business opportunities using nanotechnology developments are listed in table 2.4.

Table 2.4 : Service business opportunities using nanotechnology

S. No.	Nanotechnology based service business	Business Benefits
1	Collaborative services for nanotech product design	Information about collaborative opportunities
2	Safety services for nanotech products usage	Employee monitoring, advancing imaging, better testing, new characterization methods.
3	Security services using nanotech	Tagging and tracking, monitoring, advancing sensors technology, improved RFID technology in body armour, combating fraud with nanoparticle based inks.
4	Consultants service with nanotech cases, nanotech events & others	Nanotechnology consultation based earning opportunity
5	Judicial service for Contract lawyers with a lot of nano specific expertise	Opportunity for Judicial service by lawyers
6	Patent office's service with a lot of nano experience	Consultation opportunity for patent service
7	Nanomaterials R&D service, based on nanomaterials know-how	Latest R & D information and information on emerging products in the market
8	Imports of only nanomaterials & nanodevices	Business opportunity to import nano-materials and nanodevices
9	Analysis service, based on equipment for analysing nanostructures	Opportunity for nanostructure analysis service
10	Coating service, based purely on nano coating on surfaces/devices for specific purpose	Durable coatings of materials surface.
11	Tourism industry - Information speedup services through nanotech based displays at airports	Enhanced displays and user interfaces

2.4.6. Impact of Nanotechnology on Business

Nanotechnology is impacting businesses and expected to offer new and improved products and processes and supports the companies to innovate and enter to the new markets. Nanotechnology will change the way the businesses are being carried on. It will lead to the emergence of new businesses as well as business practices and also a new role for research &development, completely different types of product & services compared to present day products & services in the market, and intermediaries. Indeed, all the functional areas of business will undergo changes as follows :

• The new technology will transform business processes, the way products and services are created and marketed, dynamics of competitions, the organization structure of the enterprise and the nature of the enterprise itself. This will include product development, production,

marketing, supply management, customer and sales management, etc. The market driven business will change as product /services driven business.

• Local proximity and customization may no longer be a significant factor in retaining customer. Local markets will be replaced by global markets based on global products &services. Indeed, it may bring to reality the goal of making the whole world as one family by solving the basic problems of human beings. The general universal solutions are possible for most of the basic problems & problems related to comfortable life style.

• Transparency and openness continue and will continue, to be effective business strategy. Already many businesses have started recognizing key customers, employees and suppliers more like a partner in the business. Nanotechnology supported products and services will lead to better customer service, more personalized products, reduced costs, supply chain efficiency and faster time to market due to their effectiveness to all people irrespective of region (country), religion, community, gender and age. The most significant aspect of nanotechnology is new market creation for newly developed products and services which are going to be the part & parcel of everybody's life.

• The change in the business functions will lead to new business models and create new set of facts and circumstances that can materially change the economy and world growth rate.

• The nano-trend will emerge as a new platform for marketing of products and services that will displace and rebuild existing economy. It will affect organizational structure; require different skills for negotiation, new regulatory and legal framework, new environmental policy, taxation and many other things. The evolution of nanotechnology will have profound impact on competition, mobility of enterprises, effect on consumer behaviour, changes in the way the work is defined and managed. The advantages and benefits of nanotechnology products & services in parallel with advents of online communication & internet technology will enable businesses to save time on product design, design according to the individual customer specification, order and delivery of components, tracking sales and getting feedback from customers.

• The businesses can have virtual project team to develop and customize nanotechnology products, virtual learning space so that the employees of the companies for product design, development and marketing, who are dispersed over various countries can work together as if they are together in one physical room. Business can be connected to the retail points in order to ascertain market trends, demand of the products and with the suppliers upstream to order the desired requirements. Better demand forecasting and stock replenishment based on educating

the people online to create greater demand due to incredible advantages of nanotechnology products leads to large scale production which intern can lead to significant reduction in the cost.

• By means of educating more people to understand the advantages and benefits of nanotechnology based products and services, the nanotech companies and the country Government can create awareness among the people to encash the potential benefits in the process of solving both fundamental problems and problems related to luxurious life leading without much human efforts.

(1) Impact on production :

Design of nanotechnology products with tailored properties as per the requirement in the market is greater challenge for organizations. This also includes the production at greater efficiency to meet demand by means of automation to increase efficiency, controlling the wastage and to maintain the standard quality.

(2) Impact on marketing :

Product promotion Nanotechnology based solutions enhances promotion of products due to their attractive features which have to be advertised properly to attract many customers.

Corporate image : The innovative products and services based on nanotechnology will attract many customers so that newcomers started the business can establish corporate images very quickly. Corporate image means trust, which is necessary for direct sales.

(3) Impacts on organizations :

Technology and Organizational Learning: Rapid progress in nanotechnology based products & services will force companies to adapt quickly to the new technology and offer them an opportunity to experiment with new products, services, and processes. To be more flexible and responsive to the market, new processes must be developed. This type of corporate change must be planned and managed.

Changing Nature of Work: The nature of work and employment in the organizations will be transformed due to this disruptive technology. Driven by increased competition in the global market place, firms are reducing the number of employees down to a core of essential staff and outsourcing whatever work they can to countries where wages are significantly less expensive.

New product capabilities: Nanotechnology allows for new products to be created and customized in innovative ways. Such changes may redefine organizations' missions and the manner in which they operate. Mass customization enables manufacturers to create specific products for each customer, based on his or her exact needs.

(4) Impact on Economy :

The nanotechnology enables firms to produce global standardized products which are capable to solve both basic needs and comfortable life leading requirements at very low cost, the poverty will be eradicated and the people irrespective of their country of origin, irrespective of natural resources they have geographically, prosper and lead a happy life. As a result, the economy of all the countries will grow in exponential manner.

(5) Impact on Social life :

Due to its capabilities of solving both fundamental and esteem needs of human beings, nanotechnology changes both life-style and social life of human beings. The differentiation of people based on his or her financial conditions/status will disappear. All people of the world become tech savvy and become matured in thinking of equality and lead happy life. All types of social evils, sufferings due to ill-health will reach to an end.

2.5 CONCLUSION :

Even though ideal systems are hypothetical systems, which cannot be realized completely in practice, gives a broad idea on how the practical systems can be improved continuously to reach ideal system characteristics. The ideal system characteristics of technology, business, education, banking, electrical energy, software, computing and strategy, discussed in this review, under input characteristics, system characteristics, output characteristics, and external characteristics shows an opportunity to the scientists and engineers to develop such practical systems further with an objective to reach the goal. Based on the review, we have also discussed the possible characteristics of some of the future anticipated systems like ideal automobiles, ideal library, ideal home, ideal human being, ideal organization, ideal city, and even, ideal world.

The thirteen most anticipated breakthrough technologies predicted in this paper are expected to substantially affect the human life in the society during the present century. The predicted discoveries and innovations in Nanotechnology and its six related technologies mentioned in technology breakthrough model and other six independent technologies listed in the model are expected to make drastic changes in everyday life of human beings in the world. From high power & speed computers to space travel, from chameleon chips to flying cars, from embedded intelligence to immortality, solutions to basic problems like food, pure drinking water, renewable energy, health & shelter for everybody, and clean environment through nanotechnology will change the lifestyle of the people. Other independent technologies listed in the model like HIV antivirus, pseudo senses, off-planet production, protein maps,

customized kids, and fractal models are also helping to solve many problems of the society and support to solve many other problems. These breakthroughs are expected to create a new community of people called "super-tech-people" with modified social status. This will lead to development of new community without any partiality based on race, religion, country- origin, caste and even gender. The anticipated technology breakthroughs are change all the human beings as god who is ubiquitous, omnipotent and immortal. These breakthrough technologies certainly effect the religious, social, economic, political, cultural and ethical roots of the countries and supports the developments of a new heterogeneous generation as global citizens. The applications of nanotechnology in different identified areas provide lots of business opportunities. It includes Food, Medicine, Cleaner water, Better quality air, Electronics, Fuel Cells, Solar Cells, Batteries, Space Travels, Chemical sensors, Sporting goods, Fabrics, Cleaning products, Energy, Environment, Health, and Life span increase. The paper covers the applications, benefits and uses of nanotechnology innovations in different industries, possible business opportunities for new nanotechnology based products and services due to challenges for human prosperity on earth, the impact of nanotechnology on business, with an expected time scale and future possibilities of nanotechnology innovations and the magic (like science fictions) going to happen in human life. It is also discussed that how nanotechnology is going to be a disruptive innovation by solving all problems in the society like food, energy, drinking water, health and environment and rendering human life limitless [137-139].

REFERENCES :

[1] Mindaugas Bulota, Bertjan Maasdam, Sanne Tiekstra (2013). Breakthrough technologies - More with less, Kenniscentrum Papier en Karton, http://vnp.nl/wp-content/uploads/ 2014/01/64-Breakthrough-technologies-more-with-less.pdf.

[2] www.businessweek.com/bw50/2001/tech_planet.htm.

[3] Jo Anne Shatkin, (2008). Nanotechnology: Health and Environmental Risks, CRC Press, pp. 6 – 8.

[4] Oberdörster G., Oberdörster E., and Oberdörster J. (2005). Nanotoxicology: An Emerging Discipline Evolving from Studies of Ultrafine Particles. *Environmental Health Perspectives,* 17, pp. 823–839.

[5] Frank Stuer-Lauridsen, Anja Kamper, Pernille Borling, Gitte I. Petersen, Steffen Foss Hansen and Anders Baun (2007). *Survey of nanotechnological consumer products,* http://www2.mst.dk/Udgiv/publications/2007/978-87-7052-536-7/pdf/978-87-7052-537-4.pdf

[6] www.uneca.org/sites/default/files/.../st_innovation_report.pdf

[7] Aithal P. S., & Shubhrajyotsna Aithal (2015). Managing Anticipated Breakthrough Technologies of 21st Century - A Review. *International Journal of Research & Developments in Technology and Management Sciences*, 21 (6), 112 - 133.

[8] Aithal, P. S., and Shubhrajyotsna Aithal (2015). Ideal Technology Concept & its Realization Opportunity using Nanotechnology. *International Journal of Application or Innovation in Engineering & Management,* 4(2), 153-164.

[9] Von Bertalanffy, L. (1968). General systems theory. New York, 41973, 40.

[10] Aithal, P. S. (2016). Review on Various Ideal System Models Used to Improve the Characteristics of Practical Systems. *International Journal of Applied and Advanced Scientific Research*, ISSN: 2456 – 3080, 1(1), 47-56. DOI : http://doi.org/10.5281/zenodo.159749.

[11] Aithal P. S. (2015). Concept of Ideal Business &its Realization Using E-Business Model, International Journal of Science and Research (IJSR), 4(3), 1267 - 1274.

[12] Aithal P. S. (2015). Mobile Business as an Optimum Model for Ideal Business. *International Journal of Management, IT and Engineering (IJMIE)*, 5 (7), 146-159.

[13] Aithal P. S. and Shubhrajyotsna Aithal (2015). An Innovative Education Model to realize Ideal Education System. *International Journal of Scientific Research and Management (IJSRM)*, 3(3), 2464 - 2469.

[14] Aithal P. S. and Shubhrajyotsna Aithal (2014). Ideal education system and its realization through online education model using mobile devices, Proceedings of IISRO Multi Conference 2014, Bangkok, 7/01/2014, 140 - 146, ISBN No. 978-81-927104-33-13.

[15] Aithal P. S. & Shubhrajyotsna Aithal (2016) Impact of On-line Education on Higher Education System, *International Journal of Engineering Research and Modern Education (IJERME),*1(1), 225-235.

[16] Aithal P. S. (2016). The concept of Ideal Strategy & its realization using White Ocean Mixed Strategy. International Journal of Management Sciences and Business Research (IJMSBR), 5(4), 171-179. DOI : http://doi.org/10.5281/zenodo.161108.

[17] Sridhar Acharya P. &Aithal P. S. (2016).Concepts of Ideal Electric Energy System for production, distribution and utilization. *International Journal of Management, IT and Engineering (IJMIE)*, 6(1), 367-379.

[18] Aithal P. S. (2016). Concept of Ideal Banking and Realization of it using Ubiquitous Banking, *Proceedings of National Conference on Changing Perspectives of Management, IT, and Social Sciences in Contemporary Environment*, Manegma 2016, SIMS, Mangalore, India, Vol. 14, 13-24, ISBN 978-93-5265-6523.

[19] Aithal P. S. (2016). Smart Library Model for Future Generations. *International Journal of Engineering Research and Modern Education (IJERME)*, 1(1), 693-703.

[20] Aithal, P. S., & Vaikuth Pai, T. (2016). Concept of Ideal Software and its Realization Scenarios. *International Journal of Scientific Research and Modern Education (IJSRME)*, 1(1), 826-837.

[21] Aithal, P. S. & Priyesh Pai, T. (2017). Opportunity for Realizing Ideal Computing System using Cloud Computing Model. *International Journal of Case Studies in Business, IT and Education (IJCSBE),* 1(2), 60-71. DOI: http://dx.doi.org/10.5281/zenodo.1094995.

[22] Aithal P. S. and Shubrajyotsna Aithal (2015). Nanotechnological Innovations & Business Environment for Indian Automobile Sector: A Review. *International Journal of Scientific Research and Modern Education*, 1(1), 296-307.

[23] Aithal P.S. and Shubhrajyotsna Aithal (2016). Business Strategy for Nanotechnology based Products & Services. *Journal of Management Sciences and Business Research*, 5(4), 139-149.

[24] Aithal P. S. and Shubhrajyotsna Aithal (2016). Nanotechnology Innovations & Business Opportunities: A Review. *International Journal of Management, IT and Engineering*, 6 (1), 182-204.

[25] Aithal P. S. & Shubrajyotsna Aithal (2016). Nanotechnology Innovations and Commercialization – Opportunities, Challenges & Reasons for Delay. *Proceedings of National Conference on Changing Perspectives of Management, IT, and Social Sciences in Contemporary Environment*, Manegma 2016, SIMS, Mangalore, India, Vol. 14, pp-1-12, ISBN 978-93-5265-6523.

[26] Aithal P. S. & Shubhrajyotsna Aithal (2016). Nanotechnology Innovations & Business Opportunities in Renewable Energy Sector. *International Journal of Engineering Research and Modern Education (IJERME)*. 1(1), 674- 692.

[27] Aithal P.S., & Shubhrajyotsna Aithal (2016). Opportunities & Challenges for Green Technology in 21st Century. *International Journal of Current Research and Modern Education (IJCRME)*, 1(1), 818-828. DOI : 10.5281/zenodo.62020.

[28] Aithal P.S., (2016). A Review on Opportunities and Challenges for Mobile Business Activities in India. *International Journal of Management, IT and Engineering (IJMIE)*, 6 (1), 124-148.

[29] Aithal, P. S. (2016). A Review on various E-business and M-business models & Research Opportunities. *International Journal of Management, IT, and Engineering (IJMIE)*, 6(1), 275-298.

[30] Prithi Rao & Aithal P. S. (2016). Green Education Concepts & Strategies in Higher Education Model. *International Journal of Scientific Research and Modern Education (IJSRME)*, 1(1), 793-802.

[31] Aithal, P. S. and Suresh Kumar, P. M. (2015). Applying SWOC Analysis to an Institution of Higher Education. *International Journal of Management, IT and Engineering (IJMIE)*, 5(7), 231-247.

[32] Aithal, P. S., Suresh Kumar, P. M. and Pavithra Kumari (2015). Methods And Approaches For Employability Skill Generation In Higher Educational Institutions. *International Journal of Management, IT and Engineering (IJMIE)*, 5(7), 390-410.

[33] Krishna Prasad, K., & Aithal, P. S. (2015). Massive Growth of Banking Technology with the Aid of 5G Technologies. *International Journal of Management, IT, and Engineering (IJMIE)*, 5(7), 616-627.

[34] Aithal, P. S. (2015). Biometric Authenticated Security Solution to Online Financial Transactions. *International Journal of Management, IT, and Engineering (IJMIE)*, 5(7), 455-464.

[35] Aithal, P. S., & Varambally, K. V. M. (2006). Security Issues in Online Financial Transactions with Special Reference to Banking Industry. Quality in Service Sector and Managerial Challenges – Allied Publisher Pvt. Ltd, 103-114.

[36] Varambally, K. V. M., & Aithal, P. S. (2009). Mobile Business Technology and Business Proliferation of Banks – A futuristic Approach. *Amity Business Review*, 10(1), 9–25.

[37] Aithal, P. S., & Varambally, K. V. M. (2015). Customer Perspective on Online Mobile Banking in India - An Empirical Study. *International Journal of Management, IT and Engineering (IJMIE)*, 5(7), 77-97.

[38] Aithal, P. S. (2015). Biometric Authenticated Security Solution to Online Financial Transactions. *International Journal of Management, IT, and Engineering (IJMIE)*, 5(7), 455-464.

[39] Aithal, P. S. (2015). Recommendations on Policy & Regulatory Guidelines for Mobile Banking in India. *International Journal of Management, IT, and Engineering (IJMIE)*, 5(7), 1-20.

[40] Aithal, P. S. (2015). Factors Affecting Banker's Perspective on Mobile Banking. *International Journal of Management, IT, and Engineering (IJMIE)*, 5(7), 28-38.

[41] Aithal P. S. (2016). A Review on Advanced Security Solutions in Online Banking Models, *International Journal of Scientific Research and Modern Education (IJSRME)*. 1(1), 421-429.

[42] Sridhar Acharya P. & Aithal, P. S. (2015). Innovations in Effective Management of Energy using Green Technology. *International Journal of Conceptions on Management and Social Sciences*, 3(2), 18 – 22.

[43] Sridhar Acharya P. & Aithal, P.S. (2016). Impact of Green Energy on Global Warming - A Changing Scenario. *International Journal of Scientific Research and Modern Education (IJSRME)*, 1(1), 838-842.

[44] Porter M. E., Competitive Strategy, New York, The Free Press, 1980.

[45] Kim W. C., and Mauborgne R., (2004). Blue Ocean Strategy: How to Create Uncontested Market Space and Make the Competition Irrelevant. *Harvard Business Review*, October, 71-81.

[46] Silviu M. and Adrian D. T. (2013). The Green Ocean Innovation Model. *Global Advanced Research Journal of Management and Business Studies*, 2(11), 536-541.

[47] Aithal P.S., Suresh Kumar P. M. (2015). Black Ocean Strategy - A Probe into a New type of Strategy used for Organizational Success. *GE International Journal of Management Research*, 3(8), 45 - 65.

[48] Aithal P. S. (2015). Strategy Development and Deployment in Higher Education Institutions. *Elixir International Journal*, 84, 33594 – 33597.

[49] Aithal P. S. & Acharya R. K. (2016). Strategic Management Models & Indian Epics. *International Journal of Management Sciences and Business Research (IJMSBR)*, 5(4), 180-188.

[50] Aithal P. S., Shailashree V. T., & Suresh Kumar P. M., (2015). Application of ABCD Analysis Model for Black Ocean Strategy. *International Journal of Applied Research*, 1 (10) pp 331 – 337.

[51] Aithal, P. S., Suresh Kumar P. M. (2017). Ideal Analysis for Decision Making in Critical Situations through Six Thinking Hats Method. *International Journal of Applied Engineering and Management Letters (IJAEML)*, 1(2), 1-9. DOI: http://dx.doi.org/10.5281/zenodo.838378.

[52] Aithal P. S., Padmanabha Shenoy, & Priyanka Neelam (2015). Opportunities & Challenges in Starting Software Company in Developing Countries. *International Journal of Management, IT and Engineering (IJMIE)*, 5(7), 201-214.

[53] Penna Sparrow, Characteristics of a Good Software, Referred from http://www.ianswer4u.com/2011/10/characteristics-of-good-software.html.

[54] Sutherland, K., & Deegan, M. (2016). The Universal Library. In *Transferred Illusions* (pp. 133-168). Routledge.

[55] Suresh Kumar P.M., & Aithal P.S. (2016). Working from Home - A Transition in the concept of Workplace. *International Journal of Current Research and Modern Education (IJCRME)*, 1(1), 244-249.

[56] Reshma, Aithal P. S., Shailashree V. T., & Sridhar Acharya P. (2015). An empirical study on Working from Home: A popular e-business model. *International Journal of Advance and Innovative Research*, 2(2), 12-18.

[57] Harischandra P., Shylesh S, Aithal, P.S. (2016). Information Technology Innovations in Library Management: A Case of SIMS. *International Journal of Current Research and Modern Education (IJCRME)*, 1(1), 657-676.

[58] Rogers, E.M., 'Diffusion of Innovation', The Free Press, NY, (1995).

[59] Morgan, R. M. and Hunt, S. D. (1994). The commitment-trust theory of relationship marketing, *Journal of Marketing*, 58(7), 20–38.

[60] http://www.understandingnano.com/nanotech-applications.html

[61] Wilkinson, J. M. (2003). Nanotechnology applications in medicine. *Medical device technology* 14(5), 29-31.

[62] http://www.nanowerk.com/nanotechnology-applications.php

[63] Cao, Guozhong. Synthesis, Properties and Applications. London, Imperial College Press, (2004).

[64] Wolf, Edward L. (2008). Nanophysics and nanotechnology: An introduction to modern concepts in nanoscience. John Wiley & Sons.

[65] Vasavi, B., Ch. Bhargava, Hemanth Chowdary (2012). Optical Computing Alternative for High Speed Interconnectivity and Storage**.** *International Journal of Information and Communication Technology Research***,** 2(2), 112 - 121.

[66] Dolev. S and Oltean, M (Eds.): OSC 2009, LNCS 5882, pp. 2–4, (2009).

[67] Goswami, D. (2003). Optical computing. *Resonance*, *8*(6), 56-71.

[68] Guo, Bin, Daqing Zhang, and Zhu Wang. (2011). Living with internet of things: The emergence of embedded intelligence." Internet of Things (iThings/CPSCom), 2011 *International Conference on and 4th International Conference on Cyber, Physical and Social Computing*. IEEE.

[69] Basten, Twan, Marc Geilen, and Harmke de Groot, eds. Ambient intelligence: impact on embedded system design. Boston: Kluwer Academic Publishers, (2003).

[70] Remagnino, Paolo, and Gian Luca Foresti (2005). Ambient intelligence: A new multidisciplinary paradigm. *Systems, Man and Cybernetics, Part A: Systems and Humans*, IEEE Transactions on 35.1, pp. 1-6.

[71] Kirk, Rod, Tim Christianson, and Danial Faizullabhoy (1992). Embedded intelligence. BYTE 17(3), pp. 195.

[72] Deakin, Mark (2011). The embedded intelligence of smart cities. Intelligent *Buildings International*, 3(3), 189-197.

[73] Berger, Robert J. (2003). Open Spectrum: A Path to Ubiquitous Connectivity. *ACM Queue*, 1(3), 60-68.

[74] TONG, Qiao-xia, and Duan-de LUO. (2006). Progress in antivirus treatment of AIDS. *Practical Journal of Clinical Medicine*, 5, 002.

[75] Norris, Vic, Mark S. Madsen, and Shaun Heaphy (1993). Designer antiviruses for HIV. *Trends in microbiology*, 1(9), 355-357, (1993).

[76] Esté, José A., and Tomas Cihlar (2010). Current status and challenges of antiretroviral research and therapy. *Antiviral research*, 85(1), 25-33.

[77] Lanier, Jaron, and Frank Biocca. (1992). An insider's view of the future of virtual reality. *Journal of communication*, 42(4), 150-172.

[78] Gutierrez, Mario, Frédéric Vexo, and Daniel Thalmann. (2008). Stepping into virtual reality. Springer.

[79] Fuchs, Philippe, Guillaume Moreau, and Pascal Guitton, eds. Virtual reality: concepts and technologies. CRC Press, (2011).

[80] Kriegh, Michael, and Julie Kriegh. Growth, form and proportion in nature: lessons for human habitation in off planet environments. No. 2003-01-2653. SAE Technical Paper, (2003).

[81] Uri, John J., and Vic Cooley (2003). International Space Station-a unique place for research. Aerospace Conference, 2003. Proceedings. IEEE. Vol. 1. IEEE.

[82] Nickerson, C. A., Ott, C. M., Wilson, J. W., Ramamurthy, R., & Pierson, D. L. (2004). Microbial responses to microgravity and other low-shear environments. *Microbiology and Molecular Biology Reviews*, *68*(2), 345-361.

[83] Ivanova, T., Sapunova, S., Kostov, P., & Dandolov, I. (2001). First successful space seed-to-seed plant growth experiment in the SVET-2 space greenhouse in 1997. *Space Research Institute, Bulgarian Academy of Sciences*. pp 12-23. *http://www. space. bas. bg/astro/Aerosp16/tania1. pdf.*

[84] Wilkins, M. R., Sanchez, J. C., Williams, K. L., & Hochstrasser, D. F. (1996). Current challenges and future applications for protein maps and post-translational vector maps in proteome projects. *Electrophoresis*, *17*(5), 830-838.

[85] Bouchez, T., Blieux, A. L., Dequiedt, S., Domaizon, I., Dufresne, A., Ferreira, S., ... & Martin-Laurent, F. (2016). Molecular microbiology methods for environmental diagnosis. *Environmental chemistry letters*, *14*(4), 423-441.

[86] Ahmed, Nuzhat, and Gregory E. Rice (2005). Strategies for revealing lower abundance proteins in two-dimensional protein maps. *Journal of Chromatography B*, 815(1), 39-50.

[87] Braun, H. P., & Senkler, M. (2012). Functional annotation of 2D protein maps: the GelMap portal. *Frontiers in plant science*, *3*, 87.

[88] Futschik, Matthias E., Gautam Chaurasia, and Hanspeter Herzel (2007). Comparison of human protein–protein interaction maps. *Bioinformatics*, 23(5), 605-611.

[89] Gerrits, R. J., Lunney, J. K., Johnson, L. A., Pursel, V. G., Kraeling, R. R., Rohrer, G. A., & Dobrinsky, J. R. (2005). Perspectives for artificial insemination and genomics to improve global swine populations. *Theriogenology*, *63*(2), 283-299.

[90] Sasaki, T., Matsumoto, T., Antonio, B. A., & Nagamura, Y. (2005). From mapping to sequencing, post-sequencing and beyond. *Plant and cell physiology*, *46*(1), 3-13.

[91] Stock, Gregory, and John Howland Campbell (2000). Engineering the human germline: An exploration of the science and ethics of altering the genes we pass to our children. Oxford University Press, USA, (2000).

[92] Engelhardt, H. Tristram (2002). Germline engineering: the moral challenges. *American journal of medical genetics*, 108(2), 169-175.

[93] Baird, Stephen L. (2007). Designer Babies: Eugenics Repackaged or Consumer Options?. *Technology Teacher*, 66(7), 12-16.

[94] Sebo, Zachary L., Han B. Lee, Ying Peng, and Yi Guo (2013). A simplified and efficient germline-specific CRISPR/Cas9 system for Drosophila genomic engineering. *Fly*, 8(1). 8-9.

[95] Stock, Gregory. (2005). Germinal choice technology and the human future. *Reproductive biomedicine online*, 10, 27-35.

[96] http://www.businessweek.com/bw50/2001/tech_chameleon.htm

[97] Mark Weiser. (1991). The Computer for the Twenty-First Century, *Scientific American*, 94-10, (1991).

[98] Kalte, H., Langen, D., Vonnahme, E., Brinkmann, A., & Ruckert, U., (2002). Dynamically reconfigurable system-on-programmable-chip. In Parallel, Distributed and Network-based Processing, 2002. Proceedings. 10th Euromicro Workshop on (pp. 235-242). IEEE.

[99] Yoon, J. H., Nam, E. H., Scong, Y. J., Kim, H., Kim, B. S., Min, S. L., & Cho, Y. (2008). Chameleon: A high performance flash/FRAM hybrid solid state disk architecture. *Computer Architecture Letters*, 7(1), 17-20.

[100] Smit, G. J., Kokkeler, A. B., Wolkotte, P. T., Hölzenspies, P. K., van de Burgwal, M. D., & Heysters, P. M. (2007). The Chameleon architecture for streaming DSP applications. *EURASIP Journal on Embedded Systems*, (1), 11-12.

[101] Becker, E. P. (2017). The future of flying is near. *Tribology & Lubrication Technology*, *73*(8), 96.

[102] Millis, Marc G. (1997). Challenge to create the space drive. *Journal of Propulsion and Power*, 13(5), 577-582.

[103] Gregory Daigle, http://gravitymodification.com /wp-content/uploads /2014/07 /Terrestrial-and-space-applications-of-gravity-like-fields.pdf (accessed 01 November 2014).

[104] Adam Frank, http://www.nytimes.com /2014/06/08/opinion/sunday/i-was-promised-flying-cars.html? (accessed 01 November 2014).

[105] Charles Platt, Breaking the Law of Gravity, http://archive.wired.com/wired/archive/6.03/antigravity_pr.html, (accessed 01 November 2014).

[106] Clarke, M. F., Dick, J. E., Dirks, P. B., Eaves, C. J., Jamieson, C. H., Jones, D. L., ... & Wahl, G. M., (2006). Cancer stem cells—perspectives on current status and future directions: AACR Workshop on cancer stem cells. *Cancer research*, 66(19), 9339-9344.

[107] Rando, T. A. (2006). Stem cells, ageing and the quest for immortality. *Nature*, 441 (7097), 1080-1086.

[108] Bongso, A., & Richards, M., (2004). History and perspective of stem cell research. Best Practice & Research Clinical Obstetrics & Gynaecology, 18(6), 827-842.

[109] Joy, Bill (2000). Why the future doesn't need us. *Nanoethics–the ethical and social implications of nanotechnology*, pp. 17-39.

[110] Keiper, A. (2003). The nanotechnology revolution. *The New Atlantis*, (2), 17-34.

[111] Parry, B. (2004). Technologies of immortality: The brain on ice. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences*, 35(2), 391-413.

[112] Sethe, Sebastian (2007). Nanotechnology and life extension. *Nanoethics—the ethical and social implications of nanotechnology*. New Jersey, pp. 353-365.

[113] Rommetveit, K. (2012). Immortality. In Sacred Science? Wageningen Academic Publishers, pp. 111-126.

[114] http://www.thatsreallypossible.com/news/852/nanotechnology-superhumans/

[115] Di Martino, G., Iodice, A., Riccio, D., & Ruello, G. (2007). A novel approach for disaster monitoring: fractal models and tools. *IEEE Transactions on Geoscience and Remote Sensing*, *45*(6), 1559-1570.

[116] Kashtanov, A., & Petrov, Y. (2004). Fractal models in fracture mechanics. *International journal of fracture*, 128(1-4), 271-276.

[117] Singh, S. L., S. N. Mishra, and W. Sinkala. (2012). A new iterative approach to fractal models. *Communications in Nonlinear Science and Numerical Simulation*, 17(2), 521-529.

[118] W. Wertz, Fractal models in biology, http://www.statistik.tuwien.ac. at/forschung/MS/MS-2009-1complete.pdf

[119] Keiper, Adam (2003). The nanotechnology revolution. *The New Atlantis*, 2, 17-34.

[120] Peterson, Christine, and Jacob Heller. (2007). Nanotech's promise: Overcoming humanity's most pressing challenges. *Nanoethics: The ethical and societal implications of nanotechnology*, 57-70.

[121] Yousaf, A. S., and Salamat Ali (2008). Why Nanoscience and Nanotechnology? What is there for us?. *J. of Faculty of Eng. & Technol*, 5, 11-20.

[122] Tarun Singhal, Deepak Rana, Arvind Dewangan and Nitin Agarwal (2010). Various Prospects of Nano Technology. *International Journal of Nanotechnology & Applications*, 4(2), 125-132.

[123] Wonglimpiyarat, Jarunee. (2005). The nano-revolution of Schumpeter's Kondratieff cycle. *Technovation*, 25 (11), 1349-1354.

[124] Gruère, Guillaume P. (2012). Implications of nanotechnology growth in food and agriculture in OECD countries. *Food Policy,* 37(2), 191-198.

[125] Brame, Jonathon, Qilin Li, and Pedro JJ Alvarez (2011). Nanotechnology-enabled water treatment and reuse: emerging opportunities and challenges for developing countries. *Trends in Food Science & Technology,* 22(11), 618-624.

[126] Knell, Mark, (2011). Nanotechnology and the sixth technological revolution. In *Nanotechnology and the Challenges of Equity, Equality and Development*, pp. 127-143. Springer Netherlands.

[127] Kaounides, L., Hailing Yu, and T. Harper (2007). Nanotechnology innovation and applications in textiles industry: current markets and future growth trends. *Materials Science and Technology,* 22 (4), 209-237.

[128] Bartos, Peter (2004). *Nanotechnology in construction*. Vol. 292. Royal Society of Chemistry, 2004.

[129] Cattaneo, A. G., Gornati, R., Sabbioni, E., Chiriva-Internati, M., Cobos, E., Jenkins, M. R., & Bernardini, G. (2010). Nanotechnology and human health: risks and benefits. *Journal of applied Toxicology*, *30*(8), 730-744.

[130] Diallo, Mamadou, and C. Jeffrey Brinker (2011). Nanotechnology for sustainability: environment, water, food, minerals, and climate. *Nanotechnology Research Directions for Societal Needs in 2020*. Springer Netherlands, pp 221-259.

[131] Hullmann, Angela (2007). Measuring and assessing the development of nanotechnology, *Scientometrics*, 70(3), 739-758.

[132] Kimbrell, George A. (2006). Nanomaterial consumer products and FDA regulatory challenges and necessary amendments. *Nanotech. L. & Bus.,* 3, pp 329.

[133] Hocken, Robert J., and Jimmie A. Miller (1993). Nanotechnology and its impact on manufacturing. *Tokyo: Japan/USA Symposium on Flexible Automation*, Japan, p 15.

[134] Gelles, David (2009). IMMORTALITY 2.0. *The Futurist,* 43(1), p 34.

[135] Gupta A, Arora A, Menakshi A, Sehgal A, Sehgal R, (2012). Nanotechnology and Its Applications in Drug Delivery: A Review. *Webmed Central: International Journal of Medicine and Molecular Medicine*, 3(1), 2867.

[136] www.nanotechproject.org/cpi/browse/categories/appliances/

[137] Aithal, P. S. (2016). Review on Various Ideal System Models Used to Improve the Characteristics of Practical Systems. *International Journal of Applied and Advanced Scientific Research*, 1(1), 47-56. DOI : http://doi.org/10.5281/zenodo.159749.

[138] Aithal, P. S., Shubhrajyotsna Aithal, (2015). A review on Anticipated Breakthrough Technologies of 21st Century. *International Journal of Research & Development in Technology and Management Sciences*, 21(6), 112 – 133. DOI : http://doi.org/10.5281/zenodo.61617.

[139] Aithal, P. S. (2016). Nanotechnology Innovations & Business Opportunities : A Review. *International Journal of Management, IT and Engineering (IJMIE)*, 6(1), 182-204. DOI : http://doi.org/10.5281/zenodo.161153.

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