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The Impact of Emerging Technologies on Human Values

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ABSTRACT

History has shown the role of technologies in building and destruction of great civilizations and its impact on global peace. The ten basic human values and human value related indices such as HVI, HDP, GDP and CPI have been developed to distinguish the nations in terms of economy, education, health and living conditions. The nations topping the list are also the nations superior in emerging technologies such as nanotechnology, biotechnology and others. Nanotechnology is one of the unique technologies, which have the potential to narrow down the rich, and poor divide in nations. Nanotechnology has the potential to bridge the gap between developed and developing countries by developing a closer relationship to reduce involuntary sufferings. This can be testified by the proven role

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of nanotechnology in remediation of environment, providing health, clean water, harvesting water from air, eco-friendly housing from green nanomaterials, eradicating malaria, water borne diseases, human tissue regeneration, increasing agricultural yields, as generate innovations with embedded human values. The morally neutral threatening technologies like nanotechnology would lead to circumvent socio-political opposition, the rich and poor divide and address the involuntary sufferings by providing human value based solutions. Nanotechnology is the tool given by nature to transform the silos mentality to a collaborative mentality for real world problem solving and respond to the challenges of human sufferings.

Key Words:
Human Value Index (HVI), Human Development index (HDI), Nanotechnology, Green Nanomaterials, Environmental Remediation, Eco-friendly materials, Photocatalysis, Water treatment, Rich poor divide

1.0 Introduction

There is universally no accepted definition of human values despite its importance to human society and its strategic impact on engineering, science and advancement of human civilization. It may best be defined as feelings and convictions' regarding what is of strong worth in our individual and collective actions, values inherited in society. Ideologies and shared ethical and moral beliefs, which are the binding forces for communities.

The value theory defines values as desirable, trans-situational goals, which vary in importance and serve to guide human beings in their lives. The human values have changed from time to time, with the rise and fall of different civilizations from Stone Age to silicon age. The impact of human values on society has been influenced by socio-economic conditions and scientific and technological growth. Basically, ten human values are implicit in the theories of the works of theorists and researchers (1, 2).

The ten values are represented by self-direction, stimulation, hedonism, power, security, conformity, benevolence, tradition, universalism and achievement. A theoretical model of relations among ten motivational values is shown in figure 1.

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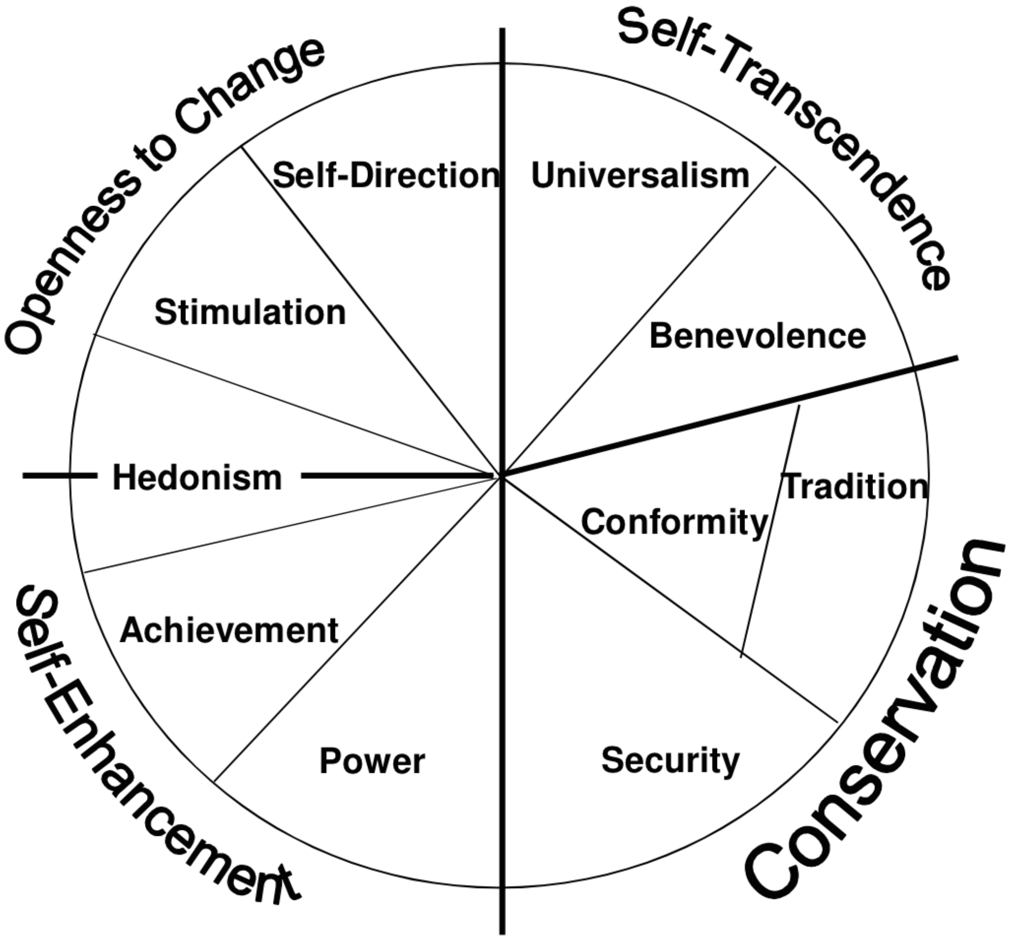

Figure 1 - Theoretical model of relations among ten motivational types of value (Courtesy: Shalom It. Schwartz, The Hebrew University, Jerusalem)

An analysis of the leading causes of rise and fall of powerful umpires in the context of human values is essential to understand the elements which were responsible for their collapse whereas, power in terms of arms and wealth touched great heights. Unfortunately, the universalism and benevolence values simultaneously dissipated.

With the loss of these values, the elements of security social welfare, openness and self-enhancement touched their lowest level leading to the disintegration of human values with the collapse of the empires. In this process of falling of mighty empires, most of the binding elements of human values such as wisdom which governs knowledge, integrity and individual morality, physically, spiritually and meta-physically; wisdom (sound judgments and actions for a better future of society); faith (confidence in action), respect, honesty, caring and universal cooperation with a high degree of tolerance were disintegrated.

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Science and technology always had a great impact on the survival and perishment of great civilizations. The word 'wisdom' is one of the pillars of human values and it includes the impact of scientific and technological developments on society in long term and short term. The human developments in science and technology when synergistically combined should strengthen human values, if the technology is constructive. On the other hand, technology which weakens the human values, which is disruptive. The success of scientific and technological advancement and development depends on how deep the human values are embedded in technologies.

The focus on economic and political values without due regards to human values may transform an innovation from being constructive to destructive as observed by past engineering catastrophes such as falling of roof of Tehran International Airport in 1979. It was the accumulation of snow on the roof which caused excessive compressive stresses and led to the falling of the roof. A large number of accidents have occurred in the year 2014 which is considered as the deadliest year in human history (3). As exemplified by crashing of Malaysian Flight 17 and 336, Air Algiers Flight number 5017, TransAsia airline flight 222. In only 138 days 700 precious human lives were lost. One prime factor leading to the disaster was lack of technical training courses integrated with human values which binds the professional education with service and changes the professional approach from being subjective to objective.

Hundreds of examples of catastrophes from transport, defense, communication, pharmaceuticals and manufacturing industries can be sighted which reflects the missing link of human value based elements in the technical and professional programs. The human value based programs would provide a much deeper insight into the actions and consequences. Emerging Technologies which show how engineering disasters stress the importance of human value integrated professional education for engineers, to transform the education from being job oriented to human value based professional education for engineers, are the needs of the society undergoing a dramatic transformation.

With the new era of emerging technologies an understanding of the definitions of technologies, which are transforming the society, and the structure of value relations and understanding of their principles of emerging technologies becomes essential. A brief explanation of some technologies is provided below.

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2.0 Emerging Technologies

There is no universal definition of emerging technologies (ET). It can be defined as any new, innovative and novel technology, which adds a new dimension to an existing technology. The term is, however, related to place, domain and application potential. For instance, the eco friendly housing concept (environment friendly) may be called as an emerging technology in a country like Saudi Arabia where it has just been taken off in recent years, whereas it is an already established technology in USA and not an emerging technology. Self-cleaning textile technology is an emerging technology in Pakistan whereas it has fully emerged in India and well-established in UK (4-6).

In the technologies which have emerged in the last two decades, nanotechnology has made the biggest impact and it has revolutionized manufacturing, energy, communication, building and construction, healthcare, food industry, transportation, defense, and water technology (7-16).

Green engineering may be considered as an offshoot of nanotechnology, although it is new and distinct discipline on its own. It involves design, commercialization and use of processed and products that are clean, feasible and economical and minimize generation of pollution to keep the environment clean.

The two technologies are also amongst the top fifty technologies which are dramatically uplifting socio-cultural levels of the society (17) as shown in figure 2.

Figure 2 – Top Fifty Technology Web By courtesy: (Frost and Sullivan)

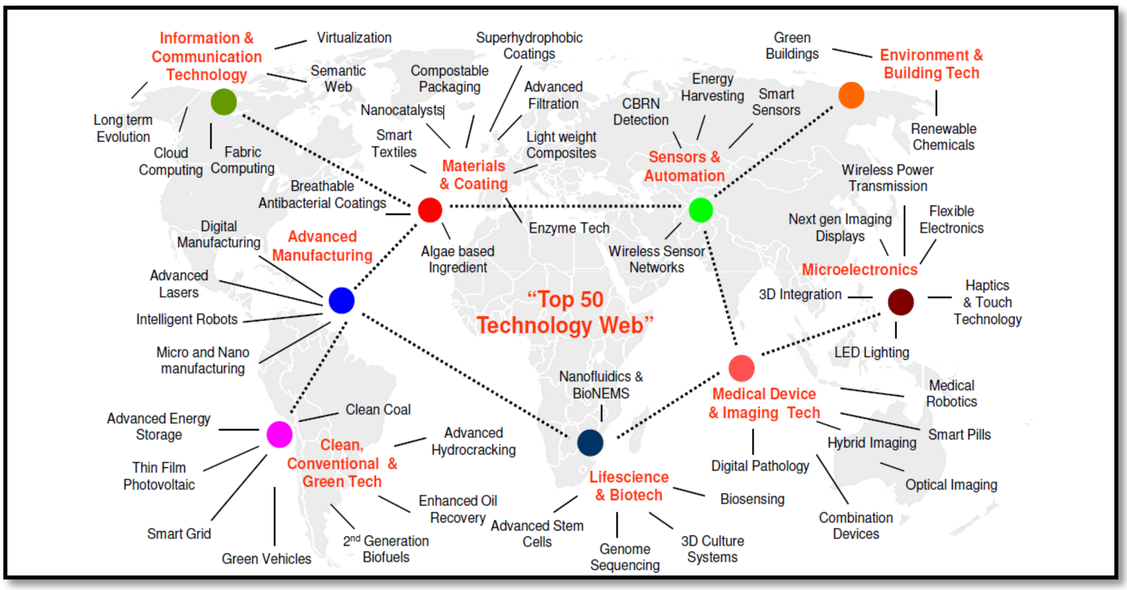

Figure 2 – Fifty Top technologies (Coutesy: Frost and Sullivam, 2011)

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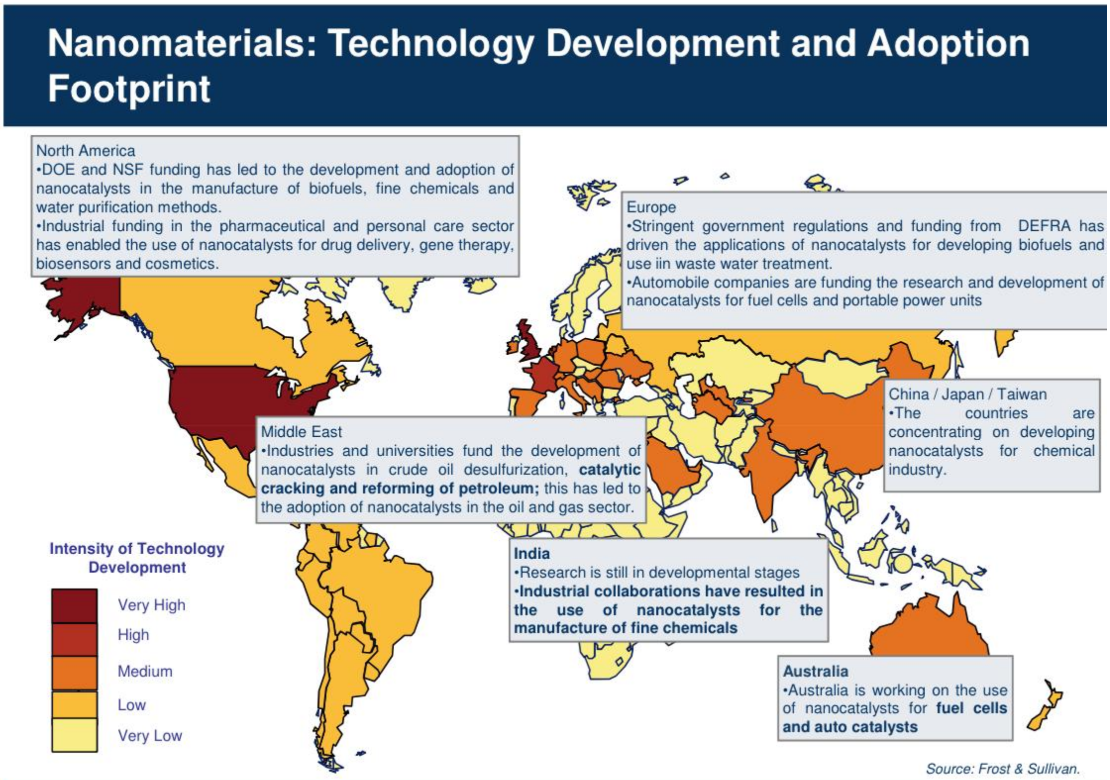

Figure 2 (b) Top Fifty Technology Techvision 2020 Program

It is therefore important to access these technologies in the context of human values and their impact on developed and developing nations. However, the distinction between developed and developing nations needs to be clarified. The distinction between the two would depend on the two indices Gross Domestic Product (GDP) and Human Developing Product (HDP) which combines GDP with educational standards and life expectancy which reflects the quality of governance of the state and its binding with the population for improved living standard countries. Countries in the sub-saharan Africa, Latin America, South Asia, South East Asia are typical examples of developing countries. These countries continue to suffer from the lack of water, food, sanitation, education and healthcare as well as economic crises. Lack of sound infrastructure of education, research and development, innovation and venture capital are the major threats to the development. High technical research for these countries is yet a dream to be realized. India, Brazil, Korea, China are the in the midway of developed countries.

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3.0 Developed Countries

Most of the European countries, USA, Canada, Australia and Japan are no doubt developed nations based on GDP or HDP Indices. The increasing flow of technical knowledge from these countries to developing countries shows the big technical void that exists between the developed and developing countries. With the advent of the new technologies such as nanotechnology, it is a big divide has been created between the rich and poor countries.

4.0 Loss and Gains

The development of new technology by developed nations has adversely affected the socio-economic conditions of developing countries. The focus of this paper is on nanotechnology and green engineering keeping in view the dramatic impact these technologies have made on the globe.

As a consequence of development of nanotechnology the conventional raw materials such as copper, steel ores, bauxite, aluminum and precious metals like platinum, radium and rhenium, besides others are being mined in developing countries and exported to developed countries. Table 1 shows production of some important raw materials in the world on the basis of their percentage contribution to the total world production.

Table 1 – Production of Important Raw Materials by Developing Nations (Reference)

Raw materials	**Countries**	**Percentage of World Products**
Copper	Chili	36%
Silver	Peru	15%
Gold	(a) South Africa (b) China (c) Australia (d) Indonesia	(a) 12.7 % (b) 11% (c)2.7% (d)9.9%
Iron Ores	(a) China (b) Australia (c) Brazil (d) India	(a)9.44 % (b) 18% (c) 13% (d) 5%
Bauxite	(a) Australia (b) China (c) Brazil (d) New Guinea	(a) 31.34% (b) 18.41% (c) 13.03% (d) 8.36%
Indium	China	55%
Lithium	-	N.A
Tantalum	Congo, Ethiopia, Rawanda, Nigeria, Nambia, Zimbabwe	23%
Nickel	(a) Indonesia (b) Cuba (c) Columbia (d)	(a) 9% (b) 5% (c) 5% (d) 5%

	Dominican Republic (e) Botswana (f) Chili (g) China (h) Peru	(e) 3% (f) 2.28% (g) 17% (h) 2.5%
Manganese	(a) Chili (b) China (c) Peru	(a)2.8% (b) 17% (c)6%
Chromium	(a) South Africa, (b) Kazakhstan (c) India	(a) 44% (b) 12% (c) 17%
Cobalt	(a) Congo (b) Zambia (c) Cuba	(a)31% (b)7% (c)7%
Niobium	Brazil	88%
Tungsten	China, Russia, Bolivia, Vietnam	N.A
Platinum	South Africa	8%
Fluorspar	Mexico	N.A
Magnesium	Turkey	N.A
Graphite	India	N.A

N.A= Data not available

Table 1 is just a brief list showing the contribution of different countries rich in minerals. The export of minerals contributes to a significant portion of their resources. However, a danger now looms over these countries as in the recent decades and in too distant a future, the conventions materials like aluminium, copper, platinum, for example are being gradually replaced by nanomaterials. Unless these countries develop the technology and undertake risks of transforming the raw materials to finished goods, nanotechnology would deepen the rich-poor technology divide and bring another crisis. This point is well illustrated by Tungsten, mined in China with a global market of over 1.8 billion dollars. Tungsten, the key material for lightening is now being replaced by nanostructured ceramics LED's and carbon nanotube filaments in near future and are ready to capture the lightening market. The same situation exists with aluminium, plastics, construction materials and surgical implantations. The nano-replacements are decreasing demands of raw materials, increasing imports and leading the developing countries to increased trade deficit and astronomical debts. The developing countries are paying the penalties of technical backwardness.

5.0 Impact of Emerging Technologies

The emerging technologies such as nanotechnology and green engineering may have a positive or a negative impact on social structure, international trade, ethical, economy, human relations and human values.

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5.1 Positive Impacts

1. Exploit the natureand possess the ability to continue the transformation of nature in the form of engineering products.
2. Revolutionize manufacturing, health care, energy, supply, communications, socio-economic structure and defense of a country.
3. Sustainability i.e. minimize the depletion of resources by generating alternate and more durable materials.
4. Producing products without harming the environment or human health.
5. Address the environmental challenges with the added capability of producing materials with self-cleaning properties.
6. Minimize the rich and the poor divide and maximize the capability of sharing new technologies
7. Knowledge intensive;(interdisciplinary) technologies with wide applications for the benefit of the society.
8. Establishing the highest set of moral, ethical and human values.
9. Act as a "tsunami" of alleviation of poverty and human health.
10. Address the needs of developing countries without disrupting their moral, ethical, cultural and social value.

5.2 Negative Impacts

The negative impacts include monopolization, hidden risks, a greater rich-poor divide, threat to environment, human health, socio-economic inequality, depletion of resources, de-stabilization of international relations, and degradation of moral, ethical and human values.

Any new or emerging technology, therefore, needs to be judged on the basis of its impact on society over a long period of time.

6.0 Emerging Technologies and Global Peace

It is an amazing fact from history that technology was a major driver for dominance of great powers. The Mongols, Romans, Britishers used advanced military and allied technologies in materials, communication, navigation, transportation to colonize and inflict cumulative damage on the helpless population. The U.S is a super power because of its edge in nuclear weapons, aircraft carriers fleet, long range bombers and other hidden deadly device. The use of technology can be exploited to the benefit or destruction of mankind. The point of views of techno-utopians and techno-pragmatics differ on the use of emerging technologies. What is

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needed is control of technology and its exploitation to bring global peace by common sharing of their economic, ethical and moral values.

6.1 Nanotechnology and Green Engineering

Nanotechnology and green engineering are the two potential technologies which can be utilized to promote global peace by sharing human values. Following are the measures, which could be adopted to promote understanding, harmony and global peace:

a. Developing a global network of developing water remediation nanotechnologies for exchange of information on new trends and technologies
b. Global participation of developed countries with the developing countries on the utilization of nanotechnology is a major health concern such as bone and cartilage damage, osteoarthritis and bone tumours, vascular tissue regeneration, durability of surgical implantation.
c. Control of development of endangering future programs such as nano-rotary and molecular manufacturing of weapons, a technique emerging from nanotechnology and its substitution
d. Regional and international cooperation on reducing pollution through green engineering practices
e. Increasing international trade in nano-materials between the developed and developing countries
f. Narrowing of rich and poor divide by liberating patent rights for developing nations and increased flow of high-tech trade
g. Sharing of expertise and decentralizing systems for existing and developed for early warning of earthquakes, floods, storms, etc such as nano-sensors and other devices. Developing of new packaging transport facilities, temporary clean and healthy living facilities using nano-textile fibres with self-cleaning properties
h. Addressing economic stagnancy by developing an innovative culture in developing countries to to replace borrowing culture which creates economic inequity and endangers world peace
i. A new approach for international cooperation on eco-friendly housing using green nano-materials and harvesting water from air using nanotechnology
j. Integration of new technology courses with moral, ethical and human values

The technological ingredients for global peace can be further strengthened by implanting human values in technology courses to produce a new generation of scientists, engineers, academicians and managers who can re-shape the thinking from being materialistic to being humanistic to leave our next generation in a more peaceful world and clean environment.

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6.2 Emerging Technologies with Human Values in Harvesting Water

Despite the highly promising potential of nanotechnology in water remediation, it has captured only a market worth $1.5-1.6 billion dollars mainly because of the slow pace of replacement of conventional technologies by nanotechnology. It may be attributed to monopolies, centralization of technologies, spending limitations, risks and problems associated with transfer of technology. Nearly 1 billion people lack access to improved water supply within the kilometers of their home. In poor countries, four billion people collectively spend more than 20 billion dollars per year on water collection and treatment (19, 20).

6.3 Water Technologies

For centuries, conventional technologies for sand anthracite water filtration such as filtration, reverse osmosis, chlorination and ionization have been used. Figure 3(a)

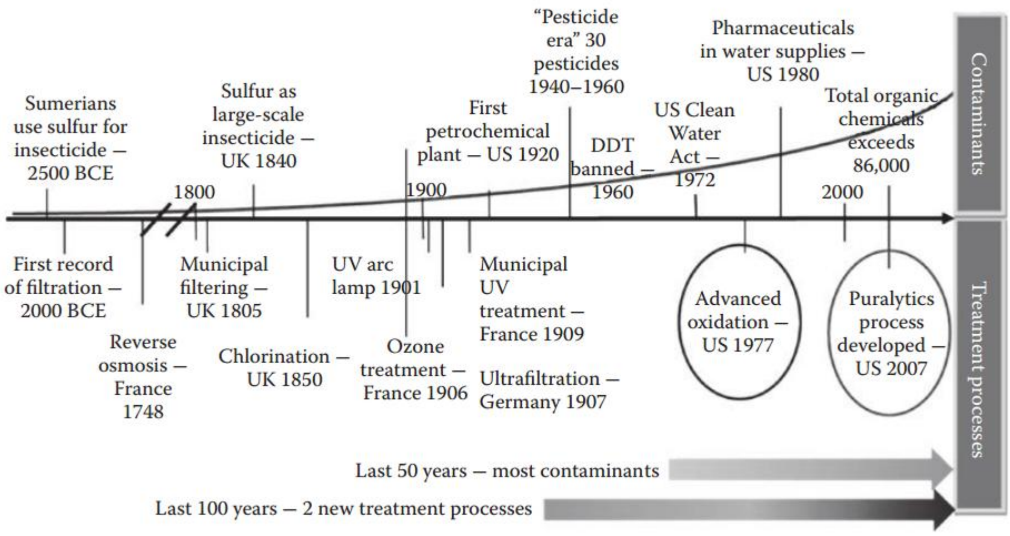

Figure 3(a) – Water Filtration Technology

Unfortunately, with the dramatic industrialization over one hundred new contaminants are being introduced in the environment each year. The new contaminants were not taken into consideration in 19th and 20th century while designing filtration processes. What is needed now is a technology that removes both the older and the new contaminants. Fortunately, research in nanotechnology on water mediation is now in a position to address the issues. In the last one hundred years, more than 100 contaminants were released in the water whereas only two new processes based on technology were evolved i.e arduous oxidation and paralytics process (figure 3 b).

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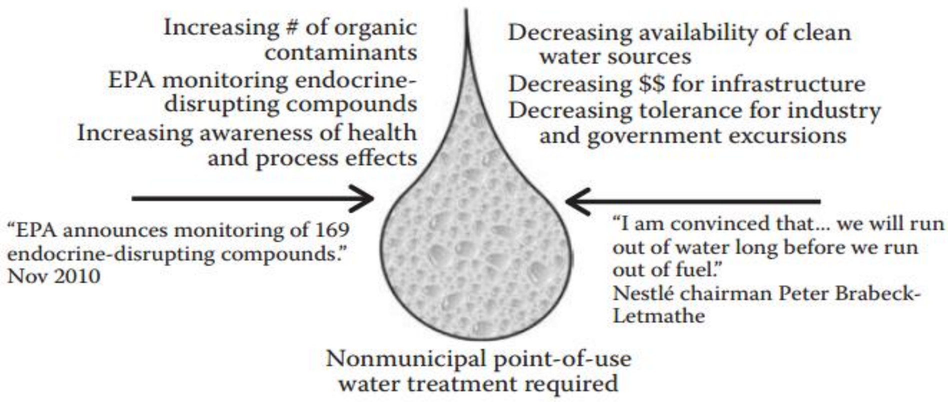

Fig 3(b) – Drinking Water Solution (Courtesy: Aqua Nanotechnology CRC Press 2015)

Several of the contaminants in water lead to cancer and birth defects. Two nanotechnology based techniques, namely, Puralytic processes and photocatalytic oxidation have made a wide impact. In the first process either the light energy or the energy supplied by semi-conductor light emitting diodes (LED) or open sunlight activates a nano-coated fibrous mesh and five different processed are emerged; photo-catalytic oxidation, photo-catalytic reduction, photo-adsorption, photolysis and photo-disinfection (Figure 4).

Figure 4 – Photochemical Process

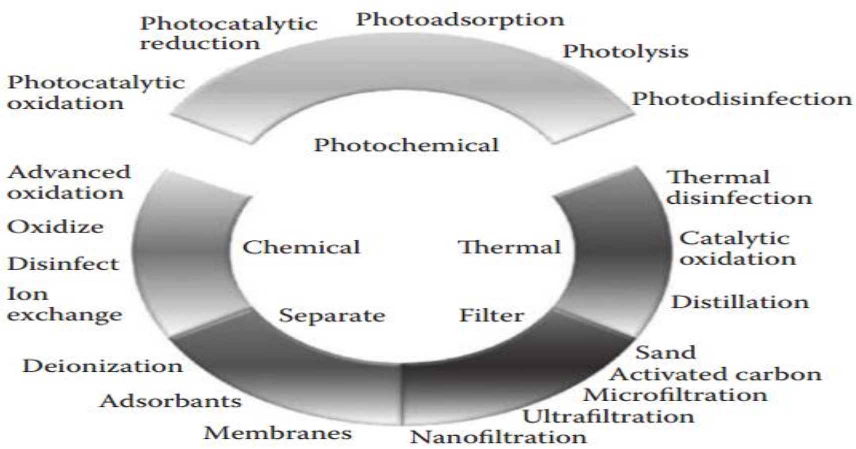

Figure 4- Photochemical Process (Courtesy: Aqua Nanotechnology CRC Press 2015)

Photocatalysis is the focus of the attention for the last two decades and its principles are being summarized below:

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Photocatalysis causes the oxidation of organic substance by U.V radiation (wavelength 276nm) in the presence of insoluble semiconductor photo-particles (photocatalyst). On adsorption of photons by these particles, electrons are promoted from the valence to conduction band generating mobile electrons (e-) and holes (h+). These holes are highly oxidizing and react with the water molecules to form the hydroxide radical OH- ($h^+ + H_2O \rightarrow OH^- + H$). The electrons may generate superoxide radicals $e^- + O_2 \rightarrow O_2^-$. From its superoxide hydroperoxyl radical, hydrogen peroxide is formed which may take up another electron from the photocatalytic particle and generate more OH^- radicals. The OH^- radicals and the other oxidizing species produced belong to the group of advanced oxidation process and they are mostly effective for water disinfection.

Several types of photo-catalytic reactors have been designed for water purification. The development of large scale reactors are riddled by problems of light distribution and large surface area for catalyst. Photocatalytic reactors are being developed for a wide range of disinfection of micro-organisms in various media, cleaning of air, killing of virus and pathogens (21-23).

One serious limitation of photocatalytic technology is its prohibitive coast and developing the technology at industrial scale for exploitation in the developing countries. Stringent patent rights, difficulties in procurement of nanomaterials and technical divide have limited the growth of this technology. Despite the odds, countries like India and China have made a big headway in developing this technology.

Attempts have been made to simplify the photocatalytic technology by making mini photocatalytic reactors of glass bottles using the sunlight initiation. The half side of the glass bottles is coated with TiO_2 (photocatalyst) and dried at 105°C. It is followed by annealing at 250°C. The bottles filled with water were exposed to solar radiation to achieve a temperature of 55°C. The photodegradation could also be achieved by irridiation from a 150W xenon lamp.

Complete inactivation of E-Coli was achieved in drinking water. Isopropanol after 24hours was completely degraded (24) by photocatalysis. A recent work showed that water could be filtered by crumb-rubber (0.2-0.5mm. dia) in a filtration column followed by passing in a U.V assisted photocatalytic reactor with n-TiO_2 as a photocatalyst (25). The effluent from a river showed a dramatic reduction in turbidity (from 238NTU to 4NTU) and inactivation of E.Colliform and E.Shiggela as such. What is needed is the cheap cost effective versions of photo-catalytic technology for extensive use of rural areas. The picture below shows how acute is the water shortage and the people are ready to drink water from any polluted source to meet the biological demands of the body (Figure 5a, 5b).

Figure 5(a) – A pathetic picture of water demand

Figure 5(b) – Contaminated water as a only source of drinking

Highly impressive demands have been made in developing nanostructured membrane for heavy metal removal (26). Reusable polyurethane foams with silver nanoparticles have been successfully used in water filtration. In a recent development multiwalled carbon nanotubes have been used for detection of highly toxic water contaminants (27, 28). Polymer-clay nanocomposite have been developed in recent years to remove heavy metals from the industrial water. They have been used because of their layered structure, mechanical stability and high catech exchange capacity. Nanofibres such as cellulose nanofibres, chitin and chitosan nanofibres are being studied for the removal of heavy metals such as mercury, cadmium, Arsenic, Chromium from industrial waste water. Lately graphene sheets are also being employed for removal of heavy metal ions (29-31).

As summarized above by facts, nanotechnology has dramatically changed the water treatment scenario and achieved what was not possible by conventional method before. It is now significantly contributing in uplifting of the socio-economic structure and added human values and acting as a bridge to fill the big void created by the inability of conventional technique to address the new issues in water pollution due to the rapid growth of industrialization as new products.

7.0 Nanotechnology and super hydrophobicity

Hydrophobic surfaces are nanostructured surfaces where the contact angle between the water drop and the substrate is greater than 90 degrees. Lotus flower is one example where the leaves of the lotus flower show an angle of 120 degrees. The hydrophobic surfaces (water-repellant) are the focus of attention of researchers because of their novel applications.

To make a surface super hydrophobic, it is essential to create an appropriate surface roughness and to coat it with low energy compounds. Surface energy is controlled by chemical modification of the subshole by fluorination and applying other low energy hydrophobic coatings. Mostly fluorine-based polymers have been used as coatings. To judge the magnitude of hydrophobicity, the wet contact angleof water drop is measured. If the wet contact angle of the substrate is less than 90°, it is hydrophilic (water attractive). If greater than 150°C the coated substance is termed super hydrophobic. On hydrophobic surfaces water rolls down the surface without least contact. The lotus flower is a perfect example as the leaves of the plant remain dirt free despite the plant thriving in dusty pools (32, 33). The image of lotus leaves as shown in the figure 6. It is a perfect example of nanotextured surface created by nature. The unique structure lends to lotus its self cleaning properties.

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Figure 6 – Lotus Flower

On a rough surface air is trapped which makes it hydrophobic. The effect of surface roughness on hydrophobicity was clearly demonstrated by Cassix and Baxter (1944) (34) and Wenze (1936) (35). Various techniques of creating surface roughness such as sandblasting, shot penning, have been applied to create surface roughness. Surfaces have been modified by fluorinated polymers, fluoroalkylsilane and per fluorinated polymer monolayers (36, 37, 38, 39).

Researchers have created super hydrophobic poly-lactic acid (PLA) fabrics via UV-photografting of hydrophobic silica particles functionalized with vinyl surface groups over silica micro structure (40, 41).

Being inspired from the touch men not plant, touch sensitive apparels have now been designed. These fabrics shrink and de-shrink in response to external stimuli touch, sound and light. Researchers have designed folding and unfolding smart fabrics with therapy features (41).

Bioinspired camouflage apparels have been recently designed based on the fish and chameleon skin, which contains a dark layer of melanin housed in melanophores with reflective iridophores. These cells are filled with pigment granules with color changing capabilities like chameleon. The beauty of these cells is their inherent ability to change color and which remain indiscernible from the surrounding environment. Luminative fabrics with flexible arrays of light emitting diodes have been produced without compromising their soft touch (42).

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Supersensitive biofilters have been made through a modified electrospinning process by manipulating magnetized nanoparticles in a magnetic field enabling the centre of size (100-300mm) and position of nanofibres. It is believed that these fibres would produce protection against infectious agents that cause acute respiratory syndrome (SARS and Avian flu).
Nanotechnology has ushered a new era in textile and added properties unknown to mankind by inspiration from nature. Superhydrophobicity is not limited to textile only, it has touched very critical area in emerging technology in the recent decades in a wide spectrum major engineering field. It has found important applications in automotive, aerospace, optometric, medical devices, microfluids, energetics and marine engineering due to its anti-icing, self-cleaning, anti-wetting, anti-corrosion, anti-foulingand anti-microbial applications. Increasing focus is given on the production of anti-reflective coatings and biocide coatings for health care. The hydrophobic surfaces have been prepared by lithography, chemical vapor deposition, electrodynamics, electro-spinning, plasma techniques, electro-chemical methods, set geo-processing, hydrothermal methods as self assembled monolayers (43-50).

One of the major engineering application of superhydrophobic surfaces in drag reduction in ocean going vessels resulting in reduction of fuel consumption and increase of speed of ships and boats including the high speed boats to catch pirate boats (51).

The hydrophobic technique has been used for controlled flow of fluid. An electric field can cause a jump of droplets from the surface without splitting. The phenomena of jumping droplets can be utilized to increase the heat transfer rate of condenser tubes in power plant. Biofouling has been a leading cause of concern in ships hulls for decades. The use of traditional biofoiling agents pollutes the marine environment.
The hydrophobic surfaces do not allow the adhesion of microorganisms to the surface breakthrough prevention in a big biofouling (52).

Because of the low surface energy of superhydrophobic surfaces, the tendency of surfaces to attract microorganisms silane oil coated enamel fluorinated ethylene-propylene (FEP) coated abutments showed a significant reduction in adhesion of biofilms (53).

Corrosion in one of the major disasters that hits the natural resources and economy of a country. It is estimated that corrosion cost, about 3.5% of GNDP in developed countries and even more in oil producing countries, however, the real figures from oil rich countries like Saudi Arabia are not disclosed. All materials, corrode without exception, some less some more. The conventional corrosion control methods include, inhibitortreatment, cathodic protection, use of corrosion resultant materials, environmental conditioning as prevention by design.

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Superhydrophibic surfaces offer a new technology to prevent corrosion. As the ingress of water, moisture, dew, is a major factor in corrosion, superhydrophobic surface have the capability to mitigate corrosion as shown by recent studies on steels, aluminum, and copper alloy (52-58).

Copper is an important metal, because of it, application in microelectronics and chemical industries however it is subjected to corrosion in chloride containing environment. Fabrication of hydrophobic surface by fatty acids such an myoistic acid and stearic acid on copper prevents corrosion. Polyethylene and polypropylene surfaces have also been implanted on copper alloys which mitigate corrosion. Aluminum alloys have also been protected against corrosion by anodizing and polymeric coating (60).

Super hydrophobic surface, prolong the lifetime of equipment and component in the macro mini and nano-range. Hydrophobic surface are also a great asset in protecting the internal surface of pipelines used in transportation of heavy oil. Oil adhesion to the pipe walls is eliminated by hydrophobic surface nanotechnology in human lives.

9.0 Bio-Inspired Approach

Biomimetics (copying nature) has always stimulated the interest of engineers in the past and the current nano age. The design of Eiffel's tower was based after studies on human bones by Gustavo Eiffel (61).The marvelous Crane designed with one of the biggest boon in architecture was designed by Cullman (Thompson, 1942) (62) after studies on the porous architect of trabecale, enduring balance of tension and compression.

The bio-inspired approach was the key factor which lead to the development of the technology of super hydrophobicity (63, 64), which is now extensively used in textile materials, rain wear, upholstery, sportswear, automobile interior construction materials, energy conservation and generation, drag reduction, surgical implantation, household appliances, aeroplane, ships and cars and nano and micro devices such as nano and micro sensors.

Harvesting Drinking Water From Fog

Atmospheric water capture (AWC) for human consumption is set to be revolutionized by increasing demand of drinking water and the latest developments in materials science and nanotechnology. Advances have shown ways to produce super hydrophobic hierarchical surface with a maximum water contact angle as described earlier. Today the most widely

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used material for harnessing drinking water from fog is polypropylene (hydrophobic). It is also called Racheal and classified under a group of mosquito netting fabrics coated with oils, gels of nanoparticles which can be applied by spray gun. The nets of polypropylene coated with hydrophobic nano structured surface show improvements in water capture by at least 30% (64, 65).

The re-focused efforts have shown new economical methods of water capture from atmosphere by nations hit by water scarcity. At international level organizations like AITEX, AIDICOY and AIMME in Spain are focusing on water capture using nanotechnology. The water capture projects were able to produce sufficient water in area of no water, but abundant fog, sufficient for population and animals. Nylon and propylene fabric panels are being replaced by steel mesh panels in recent years to optimize yield and produce cleaner drinking water (65). Substantial progress has been made in recent years (66-69).

In a recent development the top ¾ surface is hydrophobic and the remaining surface is hydrophobic allow fast rolling of water beach and fast drainage. The water yield can now be optimizedto 10L/m^2 of the total area the water capture net surface which is twice the yield rate of polypropylene samples. This technique does not need any machinery and equipment on even the water transport in based on gravity flow. The storage tanks made from eco-friendly materials are underground with least danger of contamination. The quality of drinking water is compatible with the demand of W.H.O.

Majority of the developing nations cannot afford desalination, due to costly fuel requirements. Several methods have been suggested to capture water from the dew in deserts due to night sky radiation cooling.In India, successful attempts have been made to harness drinking water from dew in desert area with abandoned fog days. Condensed surface made from polyethylene mixed with titanion oxide and barium sulphate were successfully employed either on the ground to make a small farm of condensed frames, fitted with gutters and drainage on the roof of houses. The collection accessories were supported on the ground by a frame. The condensers were successfully installed in Kothara-Kutch in India (70).

A system composing of calcium chloride (adsorber) on a sandy layer was laid and exposed to night sky. The condensed surface unit hadan area of 0.5m^3. During the day it has covered by a glass sheet to condense the vapor and regenerate the dessicant. Under the climates of Taif in Saudi Arabia 1.0 Liter water per m^2 was captured from dew (71).

In Pakistan, thousands of persons died in 2013 due to famine and water scarcity. The tharparkardesert is the largest in Pakistan 22,000 square km with the population of 9 to 10 m highest density in a desert in the world. The yearly rain varies between 2m-3mm. The drinking water wells contain brackish and contaminated water. The underground water is unfit for human consumption and people die from kidney failures, liver disease as bone deformation. A team of water researchers in Pakistan has submitted a proposal under U.S. PAK cooperation program to harvest. Water from the areas with sufficient dew night and proposed a technique of water capture based on nanotechnology. Given sufficient number of dew days, it may be possible to provide water to the thirstiest land in Pakistan. Nanotechnology may prove a big blessingfor the sufferings of the people in Thar Desert (72).

Figure 7: A typical well which is drying out in Tharparkar

As summarized above, nanotechnology in playing a leading role to address the sufferings of the population threatened by water contamination and shortage.

10.0 Nanoparticles and Environmental Remediation

The treatment of water and air in the rapid industrialization age is a great challenge and nanomaterials are playing a very important role in environmental cleaning. They act as adsorbents, catalysts, and sensors due to their large surface area and reactivity. The most

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widely used nanoparticles are silver, iron, gold, iron oxides, titanium oxides, etc. Silver particles are well known for disinfection of contaminated water (73).

n-Tio_2 is not only known to destroy organic and inorganic contamination in air and water, it also kills viruses including polyvirus, hepatitis B, and M.S.2 bacteriophage (74).
Membrane technologies have shown reliable removal of contaminant, without the formation of harmful products. Nano-filtration removes low molecular weight solutes such as glucose, lactose and micro pollutants. It also removes hardness of organic molecules. The separation performance of nano-filters is 60% (75).

Filtration by membrane with carbon nanotube walls effectively removes escheria coli from drinking water membrane that have carbon nano-tubes (CNT)as pores could be used in large desalination and reverse osmosis plant. A membrane with switchable hydrophobic and hydrophillic properties was developed on stainless steel to separate oil from water (76).
In recent years dendritic nanopolymers have been the focus of research because of their low operating pressures and energy consumption. They have been effectively appliedin industrial water system polydiamminoamines (PAMAN) have found a great potential due to their three dimensional structure. They have been used to remove polycyclic hydrocarbon separation of CO_2, and rejection of salts such as $MgCl_2$, $MgSO_4$, NaCl, etc (77).

Carbon nanotubes are being extensively used for water disinfection because of their high adsorption, power capacity to adsorb a wide range of pollutants and their enhanced reactivity. They remove bacteria and toxic contaminants from water. CNTs have shown high adsorption power for benzene 1,2, dichlorobenzene and ethyl-benzene (78).

The detection of organic pollution in soil, air, water, has always been a problem. Nanoparticles based nanosensors are playing an effective role in monitoring environmental pollution. The nano biosensors fabricated by coating graphene gold nano composites (GAUNCP), Cd-Te-Graphene-CDS and horseradish peroxidase (HRP) on gold electrode was found eleven fold more effective because of the improvement of conductivity between graphene sheets (79).

The nano materials era has revolutionized environmental remediation and it is a key player with unique properties to addressthe challenge of global cleaning.

Despite the rapid progress made in nanotechnology more work is needed to understand the behavior of nano materials and their potential impact upon the environment. Green nanotechnology is based on producing nanomaterials without harming the environment on

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human health. It producesnano-products which provide solution to environmental challenges. Industrial ecology in green materials requires a holistic approach starting from raw materials to their end disposal without an adverse impact on environment.

11.0 Green Nano-Engineering, Green Chemistry and Green Engineering

It is worth examining the compatibility of green nanotechnology with the well known twelve principles of green engineering. The table shown below illustrates how the challenge posed by green engineering principles is addressed by green nanotechnology.

Table 2- Green Engineering, Green Nanotechnology and Green Nanotechnology design and Practice

	Green Engineering Principles	**Green nano-technology**	**Green Nano-technology Design and Practice**
1	Preventing of Waste	Design eco-friendly and materials with no risk	Use nano-materials with optimum functional properties and avoid the use of toxic nano particles
2	Atom economy	Design to minimum waste, use synthetic method with least byproducts	Degradation of the waste should not pose environmental hazard
3	Less, Hazardous use chemical synthesis	Design to produce least wastage and avoid hazardous materials	Use formulatives routes which team with minimum impact of by products on environment
4	Less hazardous chemicals	Choose alternate materials over conventional	Adopt a synthetic methodology based on green materials
5	Safer solvent/ Reaction Media	Design to minimize waste	Use new techniques such as nanofilteration to minimize the synthetic steps, select benign materials
6	Energy Efficiency	Design with materials which are energy efficient	Use approach to enhance materials efficiency such as the use clearing masses in building
7	Renewable feedstock	Use of resources design storage.	Use stocks from benign renewable stocks
8	Reduces derivatives	Select less hazardous materials approach, appropriate catalysis and safer chemical route	Develop new synthetic alternate media, and catalyst.

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9	Catalysis	Nanocatalyst with least hazardous effect	Select nano-catalysts as with a high degree of recovery. Use alternate reaction and adopt a bottom up approach.
10	Degradation/ end life	Adopt cradle to grave design approach	Extend life cycle appropriate use of benign materials. Exclude materials with harmful effects.
11	Real time monitoring	Design to control efficiency	Use real-time monitoring techniques
12	A safer chemistry	Design for benign products and non-hazardous reaction	Adopt routes for non-hazardous reactions as minimum emission at high temperature.

11.1 Green Nanotechnology Regime

Green nanotechnology encompasses:

- Toxic issues in disposal
- Planning ahead of life time
- Sustainable resource
- Extraction and environments
- Emission and wastage of nano-materials
- Wastage and emission of energy
- Efficiency of design and its effect on pollutant
- Food prints of sustainable green nanomaterial
- Sharing of information with stakeholder
- Innovative methods of waste removal
- Green treatments, nano-filtration, membrane filtration, nano porous substances and magnetic nanoparticles for removal of Mercury and Arsenic. Use of carbon nanotubes, improved nanocatalyst for more efficient reactions. Green nanotechnology has given a new knowledge to the use of green materials in housing, construction, apartments and roads for a better life and healthier living. It offers great promise for more sustainable processes and products expected to be produced in next industrial revolution.

12. Eco-Friendly Housing based on Green Engineering/ green nano technology

The recent focus of building researches is on designing passive housing with low energy requirement to achieve living comfort by use of construction green and recycled base material as shown in table 3.

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Harnessing Green Engineering for Eco-Friendly Housing and Utilities in South Asian Countries

Table 3: Examples of constructional green and recycled base materials

	Materials	**Examples**
	Base materials	Lightweight aluminum alloys, thin corrugated sheets, thin polypropylene, reinforced bricks sun dried, fly-ash, sand lime bricks, roofing tiles, lintels, slabs, pre-cast cement-concrete blocks, phosphor-gypsum wall panels, cellular lightweight concrete blocks, ferro commend, Portland slag (adobe bricks mixed with straws and furnace fired (2000°C), bamboo matting, bamboo, base board and play board, granite, and dried timber, glass reinforced gypsum and dried timber are common base materials.
	Concrete, Recycled bars, and aggregates	• Blended Portland cement with pozzalana material up to 40%(pozzalana material and fly ash slag, clay and sun dried bricks and clay roofing tiles, cellular light weight cement. • Sand and aggregates from pulverized debris or sintered fly ash used in concrete and mortars • Recycled steel bars or cellular light weight concert bricks • Precast components for beam, slabs, staircase, lofts, balconies, pre-cast concrete blocks, and light weighed concert blocks.
	Masonry	Gypsum blocks, pulverized debris and cement block.
	Plastering	• Industrial waste based bricks/blocks – phospho gypsum blocks. • Increased percentage of pozzolona material in blended Portland cement. • Calcium silicate/fiber reinforced clay plaster (fiber may be natural such as hemp, flex, bamboos, straws of wheat, barley woods and jute.
	Flooring	Marble quartz, granite and glass may be used. It is poured with a binder, in old ages, goats milk was added as a binder. On the more sophisticated side, recycled glass from automotive and aeroplane windows may be used. Bamboo board flooring and non-vitrified tiles appears to be a good eco-friendly choice. Cork is a great eco-friendly building material and it provides a soft, durable material.

		A sustainable harvested tree is cut at the top in a least damaging way to surrounding trees. All sustainable trees should be cut at the top to obtain eco-friendly wood. One has to watch out for sustainable harvested label.
	Roofing	Fiber-reinforced polymers and bamboo matt and corrugated roof sheets may be used. Clay tile are 100% recyclable, and they are placed high in the list of eco-friendly materials.100% recycled tiles for roofing are now available. Microclimate roofing tiles are also very promising.
	Windows and Doors	Bamboo reinforced concert frames, recycled steel channels and recycled aluminum channels.
	Insulators	Ferro cement and pre cast RCC, lintel may be used for insulation. Industrial recycled cotton fibers (0.5%), fiberboards, wood fiber and cellulose made from recycled newsprints and insulation bricks from rice husk may be used. The sustainable design of houses requires good ventilation, six air changes per hour. Use of natural lighting elimination of aerosol, less energy consumption and recycling facilities for water are essential, for both rural and in urban areas. Use of polyvinylchloride(PVC) and recycled aluminum and bars are cost effective and environmental friendly.
	Outdoor paving materials	Fly ash / industrial waste / pulverized debris, block
	Water transport materials	Products such as recycled aluminum, brass component and polymer for hot/cold water system
	Wood working material	Renewable timber Phenol bonded plywood mica laminates and veneeron compatible boards instead of natural timber may be used. Bamboo plies /mat board, bamboo mat veneer composites, fiber reinforced polymer boards, bagasse boards are useful eco materials. Coir composites boards, Finger pointed timbers board, recycled laminated tube boards, aluminum Foils, papers, plastic composite boards are also very effective in wood working.

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	Water proofing Materials	Water based chemicals should be preferred over solvent based chemicals; e.g., epoxy resins are very useful.
	Paints	The decision to employ the materials must be based on embodied energy, material life cycle and energy cost in terms of environment performance, mitigated degree of impact on environment. The life cycle would depend on the characteristics of the materials, local availability, recyclability, reusability, durability, life cast impact and energy efficiency embodied energy. Nanopaints containing TiO_2 pigments have been widely used. They offer durability and self-cleaning effect [15-17].

The applications of nano ecofriendly materials would open a new era of green, friendly housing for healthy live, free from diseases and adverse impact of degradation of material with self-cleaning glasses, eco-friendly nano-coating, photocatalytic materials for inter air cleaning and use of nano membrane system for harvesting water from rain.

One of the attractive features of the green eco friendly housing is the independent supply of drinking water harvested from rain using nanotechnology. Figure 8 showsa complete system installed on a house roof. The system comprises of gutters reservoirs a water treatment unit based on filtration by cramb rubber which provides high filtration rates and a lower head loss with significant removal of turbidly.

The filtered water is further treated by a pectocatalyst using TiO_2 before being further treated by ultraviolet rays. The dual treatment completely ensures killing of all pathogenes. The water produced is in full compliance with WHO standard. The technology is applicable to hilly areas in South East Asia with abundant rain but scarce ground water supply. With all ingredients of nano technology, green nanotechnology and green engineering the eco-friendly houses present good prospects for communities in hilly area of south India to open a new and healthy area of living.
A serious drawback is the cost of materials which is to be resolved by local government. The construction of eco-friendly houses and buildings in developing countries is proceeding with a brisky pace. The developing nation need new policies, regulating and international cooperation of assistance of non-governmental agencies for implementation.

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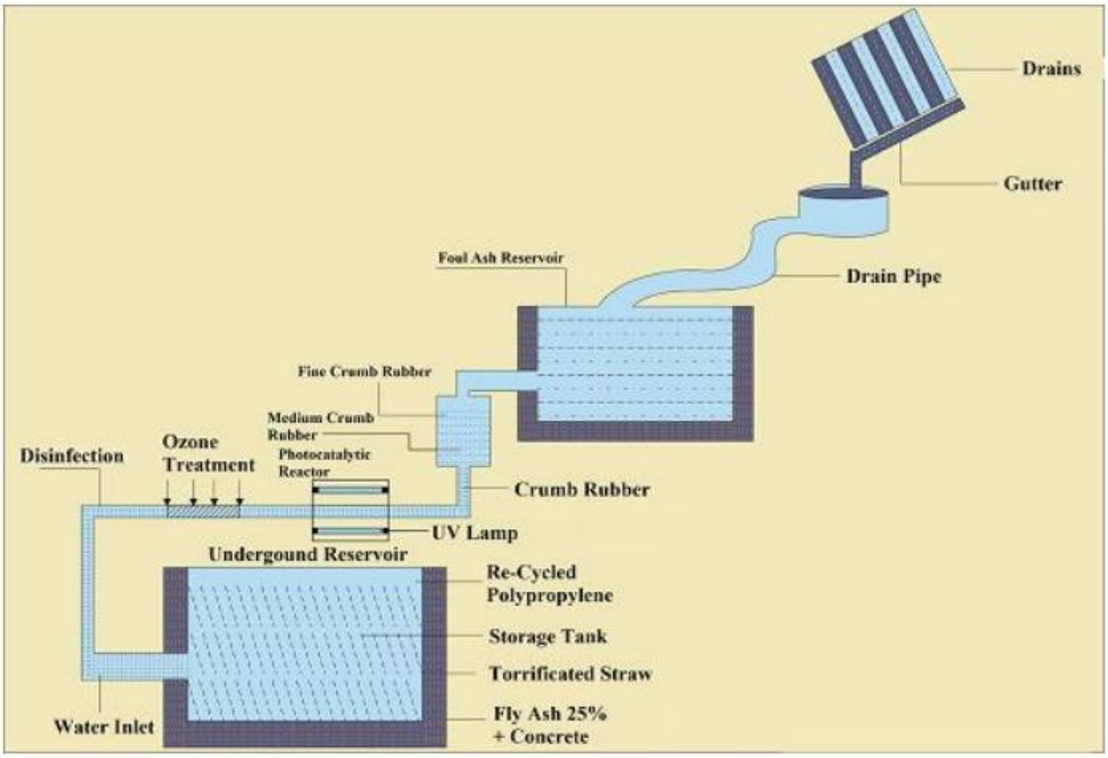

Figure8- A New Design for rain harvesting from roof (Courtesy: Prof. Zaki Ahmad, COMSATS Institute of Information Technology, Lahore, Pakistan)

13.0 Nano technology in context of Human Values

Every fifty year or hundred years the world transforms and the society arranges its paradigm, its basic human, ethical cultural and economic values and a new world emerges with changed values, fifty or hundred years later. Despite the technical revolution like information technology, increasing distance, between human beings are being created, family structures disintegrated, unhealthy life style, have exposed the people to risk of diseases, stresses, and loss of productivity. People live longer albeit afflicted and chronic diseases. The big reason in the technologies, which transformed the living style, was the embedding of human values in technologies.

A look at Figure (9a and 9b) show a model of relation between ten motivational values.

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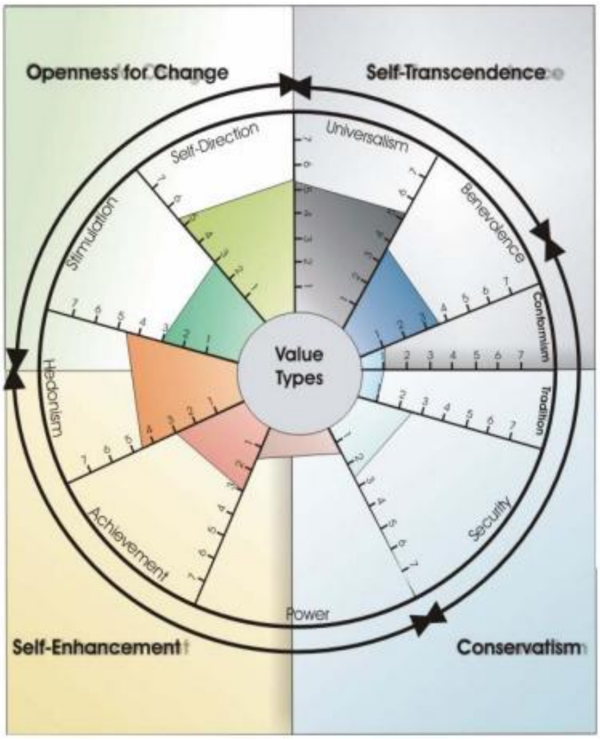

Figure 9a – Relation between Motivational Values

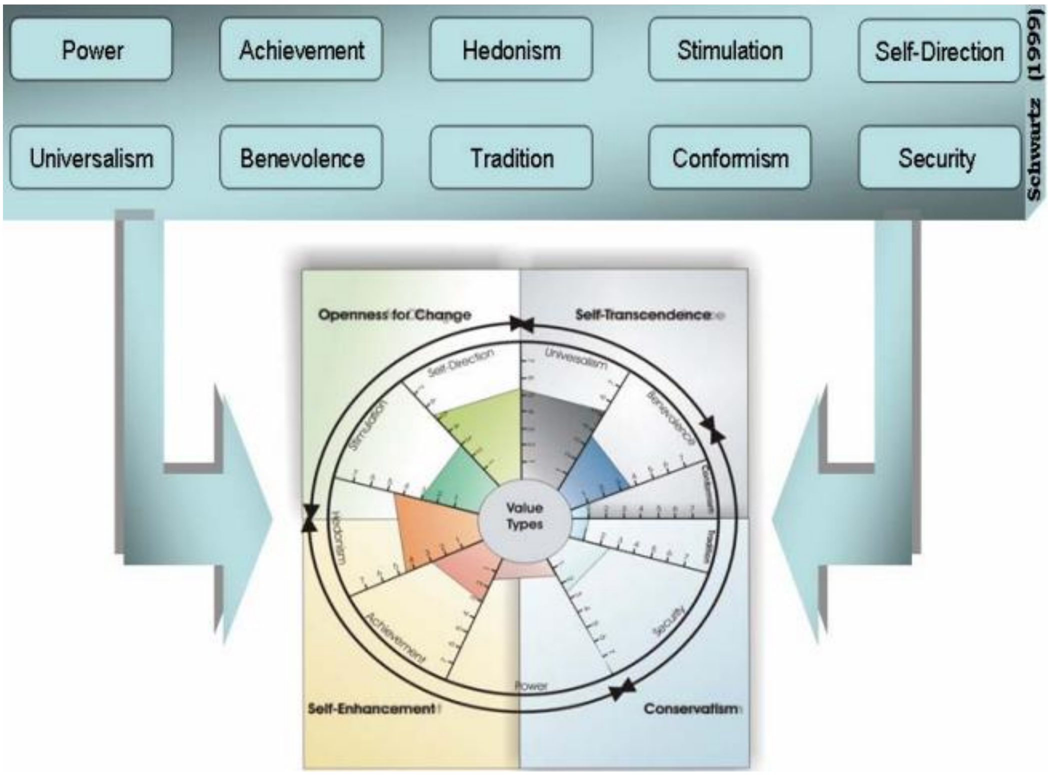

Figure 9b- Integration of human values

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Integration of self-enhancement openness to change and self-transcendence are the three major binders of the constituents of human values in ten universally accepted values. Some new elements like ecological wisdom, de-centralization, diversity and sustainability, near to be closely associated with universalism and benevolence. The impact of emerging technologies on human lives is to be analyzed on the basis of accepted human values. Two major indices human value indices (HVI) and human development indices (HDI) need to be incorporated in the policy and practice related to need technologies.

The human value indices are based on education as human capital, health, income per capita, life expectancy and education. The Human Development Index (HDI) is a more reliable indicator of the satisfaction of a citizen in his living conditions. It takes into consideration the expectation on birth, income per capita, education and living conditions. Table 4 shows the list of top ten countries in terms of human development index (HDI).

The following are the top ten countries with HDI:

Top Ranking Countries in HDI

Country	**HDI (Human Development Index)**
Norway	0.943
Australia	0.931
Switzerland	0.916
Netherlands	0.915
USA	0.912
Germany	0.915
New Zealand	0.991
Canada	0.901
Singapore	0.899
Denmark	0.990

These values are shown to co-relate the relationship between the growth of nanotechnology, types of emerging technologies, human development Index and human values.

On the other hand there is another index, freedom from corruption index, (COR). It is basically a corruption perception index constructed by transparency international (81).In the above work, countries are divided into four clusters in a diagram. The CPI is on 0-10 range with zero meaning the most corrupt country and 10 the least corrupted. The COR is obtained by multiplying CPI by 10. The cluster of countries is based on COR as shown in Figure 10.

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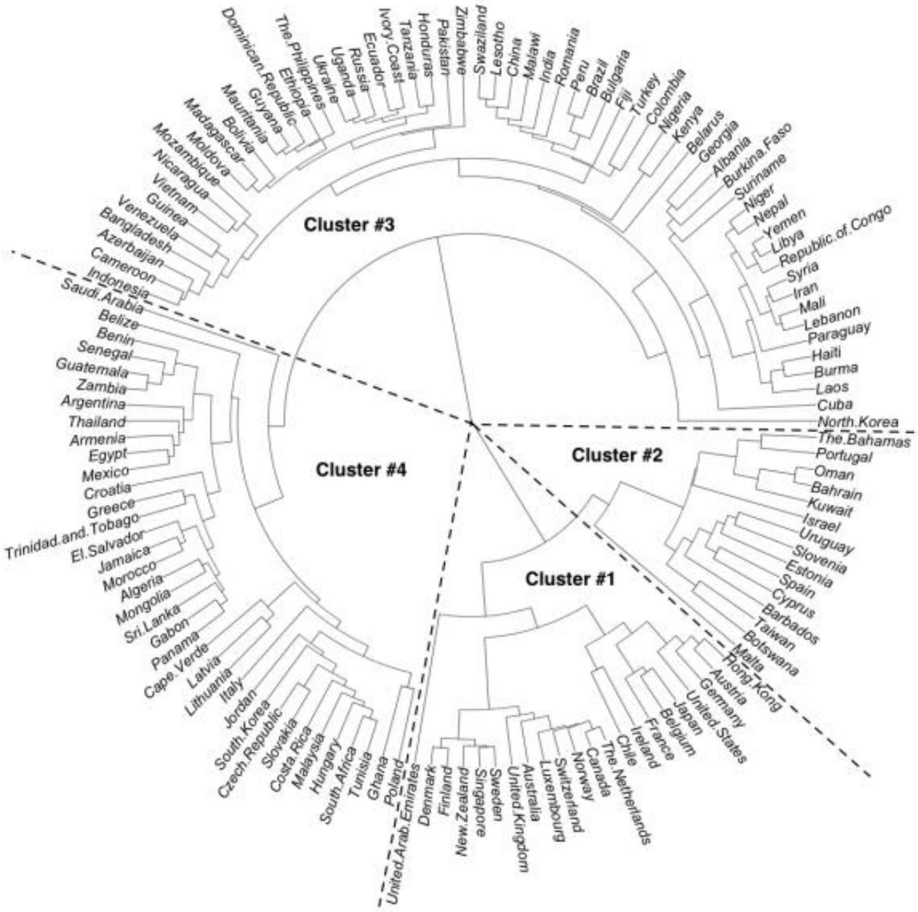

Figure 10 – Corruption Cluster (Courtesy: Micheal Palalus, Institute of Economic Studies, Charles University, Opletelova, Czech Republic, 2015)

Cluster 1 is composed of countries like USA, Japan, Western States, European Union, Hong Kong, Singapore, Australia and New Zealand. The average COR value is 82.02$\pm$1.00. Cluster 4 shows the highest level of corruption and includes countries, Bulgaria and Rumania, China, India and many African countries. The Human Values Index (HDI) and Human Development Index (HDI) provide a strong co-relationship with the development of nanotechnology and mega nanotechnology funding countries and corporate organizations. In these countries including USA, Japan, Germany, China, France, South Korea, Switzerland, Sweden and Israel, USA is on the top of the list and its spending is above 4,000 million dollars.

Countries with high impact factor in nanotechnology include countries, U.S.A, China, Russia, Germany, Japan and European community. Increasing impact is being shown by India, UK, Taiwan, China, US, Japan, E.C, Germany, Russia, South Korea, US Taiwan, and India. The

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emerging spending trend in Asia over the year is very significant (81).The fast moving sectors in nanotechnology are shown in Table (5).

Table 5 – Fast Moving Sectors in Nanotechnology

Type of technologies	Examples
Semi conduction	Organic Semi Conductions CMOS, Sensors Photonics
Display Technologies	Organic electroluminescent, electronic paper
Memory as storage	Magnetic head, optical pickete, AFM, based memeory, CNT base Memory, Molecule memory
Optical Photonics	Adotonic Crystals, Fyber optical wave guides, optoelectronic IC
Energy technology	Fuel cell, Li-Lon Battery, Electrical double layer capacity thin films, solar cells, Dye-synthesized solar cell
Health Technologies	Drug Delivery, Tissue regeneration, Aids/HIV diagnosis, Bio Sensors
Agriculture	Encapsulates controlled time release crop protection media, nanosensor for crop health detection. Enhance crop yield by nanofertilizer.
Water	Nano-filtration, photocatalysis, Nano-membranes, CNT enhances de-contamination
Textiles	Dust, water repellent textile, anti-germicide, breathable and anti-static textile
Construction	Nano-gypsum nano cement, photocatalytic tiles, self-cleaning windows and tiles, Nanofinished plumbing system.
Nano-Paints	n-Tio_2 based nanopaints for longer life and oil transportation pipeline.
Super hydrophobic glass	For anti-fogging and self cleaning

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Although, nanotechnology and green engineering technology are the focus of attention in this paper, most of the emerging technologies related to communications, informatics, medicines, health, construction, pharmaceuticals, sensors, optoelectronics, are compatible with NVI, HDP, GDP, GPI, and CPI, reported earlier in the paper. These ten top countries mentioned above are also largest spender in nanotechnology both in government funding and corporate funding. Majority of these countries are also leaders in production of patents, ICT, biotechnology and nanotechnology in the world. Surprisingly most of these countries are also leaders in top fifty technologies which are changing the human society and creating a big impact on socio-economic culture of the society as shown from the web of fifty top technologies. Although human capital index has not been discussed fully in this paper, the top countries in the list of human index, also top leading countries in nanotechnology and other emerging technologies which shows a linear relationship. It may be re-called that the human capital index is based on four pillars of education, health and well-being, work force and employment, and enabling environment. The values in human index range from 1.456 to 0.900 for top countries.

The Human Capital Index incorporates 51 indicators, 12 in education, 14 in health, 16 in workforce and nine in enabling environment. The Human Capital has a direct relationship with other human values.

Civilizations have flourished, reached their peaks and perished, no matter it was an Indus valley or Nile valley civilization. The root cause of the disintegration was the disintegration of human values which blocked their progress in science and technology. History clearly shows that more powerful conquered the weaker, because of their superiority in science and technology which stood on the ten pillars of human values. Reverse of human values, reverse the scientific and technical progress. The wining of the allied forces against the Nazis was a clear demonstration of the relationship between human values and technology advancement. Nanotechnology, biotechnology, green nanotechnology, and all other new and emerging technologies are societal-value based technologies as shown by ten countries on the top of the list as shown above.

To increase technical development strength, human values strength need to be strengthened and the frightening element of corruption as shown by the corruption perception index need to be altered to narrow the big divide in technology between the developed and developing nations.

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The Impact of Nanotechnology on Human Values

Nanotechnology refers to a wide-range of technologies that measure, manipulate, or incorporate materials and/or features with at least one dimension between approximately 1 and 100 nanometers (nm). Such applications exploit the properties, distinct from bulk/macroscopic systems, of nanoscal components. Nanotechnology encompasses nanoscale science, engineering and technology which involved imaging, measuring, modelling, and manipulating matter at nano-scale.

This is incidentally coincides what Einstein once said before the emerging of nanotechnology "It is easy for any foolish to make things bigger but it takes a genius to make things smaller" (Albert Einstein)

Significant developments are taking place in medicine, agriculture and renewable energy which have high potential to close the gap between rich and poor countries and a high impact areas directly affecting human survival. Some high impact areas are described below.

Medicine

Nanotechnologies are being used to bring formidable gains in the targeted drug delivery and for early detection of deadly diseases such as AIDS/HIV, cancer, malaria, and tuberculosis. In 2010, 34 million people died from HIV/AIDS.

The invention of a nanowire based biosensor has helped to detect malarial parasites and it also detects drug resistance. Qanta MDX devices can also diagnose tuberculosis and other diseases. Attempts have been made to develop a new generation of cytocompatible bone and cartilage susbstitutes. Nanofibrous and nanotubular scaffolds have been fabricated to mimic collagen fibres in bones. The nano-enabled research on cytocompatible bones is paving the way to increase the life of implants to almost the life time. Research is in progress on vascular graftsto replace damaged blood vessels. Nano-enabled designs have also shown the improved performance of neutral cells and tissue repair. Nanotechnology is paving the way to repair the body damage which was until recently beyond the reach of conventional medical research. The contribution of nanotechnology would certainly revolutionized the medical field and bring a miraculous change in the health of society in years ahead (83-86).

Agriculture

About 15% of the world population is undernourished in majority of developing countries. Nanotechnology has made an impressive progress in the area of nano-encapsulation of herbicides and pesticides which are encapsulated and released at pre-set times, thus allowing continuous monitoring and maintenance of the crop health.

New biocides containing nanoparticles have been developed. The nanoparticles of silver are contained in these biocides which are more effective than the conventional biocides. Nano fertilizers are the focus of attention of scientists because of their effectiveness as shown by time release studies of encapsulated nitrogen where it is directly internalized by the plant. This technique has shown a high promise of improved yield in crops.

The development of nano bactericides TiO_2 a high degree of effectiveness in killing of bacteria. Titanium Oxide has been used in the development of photocatalytic reactors for water remediation. Nanotechnology applications have the potential to increase the crop yields, control plant pathology and increase the nutritional benefits. Nanotechnology has the potential to revolutionize agriculture and boost farmers confidence in developing countries (87-89).

Nanotechnology and Renewable Energy

The new developments in photovoltaic energy and nano wire array based solar cells have shown outstanding results and they are making a high impact as highly efficient materials. Carbon nano tubes have been extensively employed to build highly active solar panels. Nanotechnology is also actively contributing to the development of fuel cells.

A thirty nm thick gold mesh has been used to increase the efficiency of solar cells. It is a big breakthrough as the efficiency of the solar cells is increased by 175%. These developments show a highly promising potential to produce cheap and efficient solar energy. Solar panels coupled with LEDs can become the centralized light sources for future and raising the living conditions in developing countries.

Bridging the Gap or Increasing the Gap between Developed and Developing Countries

In reality each down increase the distance between the developed and developing nations. Despite global efforts to reduce imbalances, deep disparities, are caused by hunger, poverty, diseases, wars, terrorism, corruption and dictatorship thereby increasing the rich and poor nations divide. At least 15% of the world population is undernourished which poses a serious challenge to international community. Many indices such as Gross domestic product (GDP), Gross National Income (GNI), Human Development Index, Human Value Index (HVI), Corruption Perception Index have been developed to assess that rich and poor divide behavior the development and developing nation. An analysis of HDI (an index based on life expectancy, years of education, life expectancy years of education, life expectancy and GDP shows that the HDI in the countries within the Economic Cooperation Development was 0.888 in 2012 compared to the world average of 0.694, whereas the HDI of African are Sub-section states law of HDI 0.475. The least developed countries showed a Gross National

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Income (GNI) per capital of 100 dollars or loss, whereas the developed countries showed a GNI of 12,271 US Dollar. Countries like Brazil, China, Russia, India and South Africa can be rated as middle income economies. Nanotechnology is a promising technology which offers the hope of bridging the existing divide by the impact of nanotechnology on GNI, HDI, and HVI (human value index). The HVI includes factors net included by HDI, such as human welfare and environmental well being as long as these values can be measured over a large spectrum of countries. It takes into account utility shared expectation at birth (82)

Cumulative Impact of Human Development Index, Human Value Index, Corruption Perception Index, Human Values and Nanotechnology

The ten basic values can be integrated with a close relation between openness to change, self-transcendence, self-enhancement and conservatism. These values directly co-relate with HDI and HVI. The magnitude of Corruption Perception Index shows the consequences of violation of the principles involved in human values. The table 6 below shows the list of countries with HVI, HDI and GNP, above 90, 0.537 and 25620 respectively.

TOP RANKED COUNTRIES IN GNP, HDI AND HVI

Country	GNP Capital	HDI	HVI
RAI	86440	0.81	177.2
LUX	64200	0.807	128.2
NOR	64400	0.943	122.0
SGP	50380	0.806	118.3
KWT	53720	0.70	112.4
CHE	52570	0.933	165.5
BRN	49910	0.838	102.1
USA	48820	0.91	100
ARZ	578w	0.840	97.9
GNQ	25620	0.537	91.2

European countries fall in the range 70-80, with Korea and New Zealand in the range of near sixty. The leading countries in nanotechnology from the point of view of investments and from achievements are USA, Japan, Russia, Germans, France, China, South Korea and Netherland in the decreasing order. The US investment exceeds US 3,000 millions dollars. India, China, Iran, Brazil in Russia and South Africa are fastly emerging in nanotechnology which coincides with their emergence in GDP, HDI and HVI. The facts shown above suggest that nanotechnology closely follows the economic and human value patterns. Figure 11 shows the relationship between the growth of nanotechnology HVI, HDI and overall index. A linear relationship is observed between the growth of technology in the top ten countries and

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the above values which reflect the strong relationship of human values and technology growth. Twenty two countries active in nanotechnology have a CPI index of 82.92$\pm$1.92 with the emerging countries falling in the range of 21.150$\pm$0.780. Figure12 shows the corruption perception and the clusters of countries according to the Corruption Perception Index (CPI) it may be noted that the countries with largest Corruption Perception Index (lowest corruption) are most active in nanotechnology and other emerging technologies.

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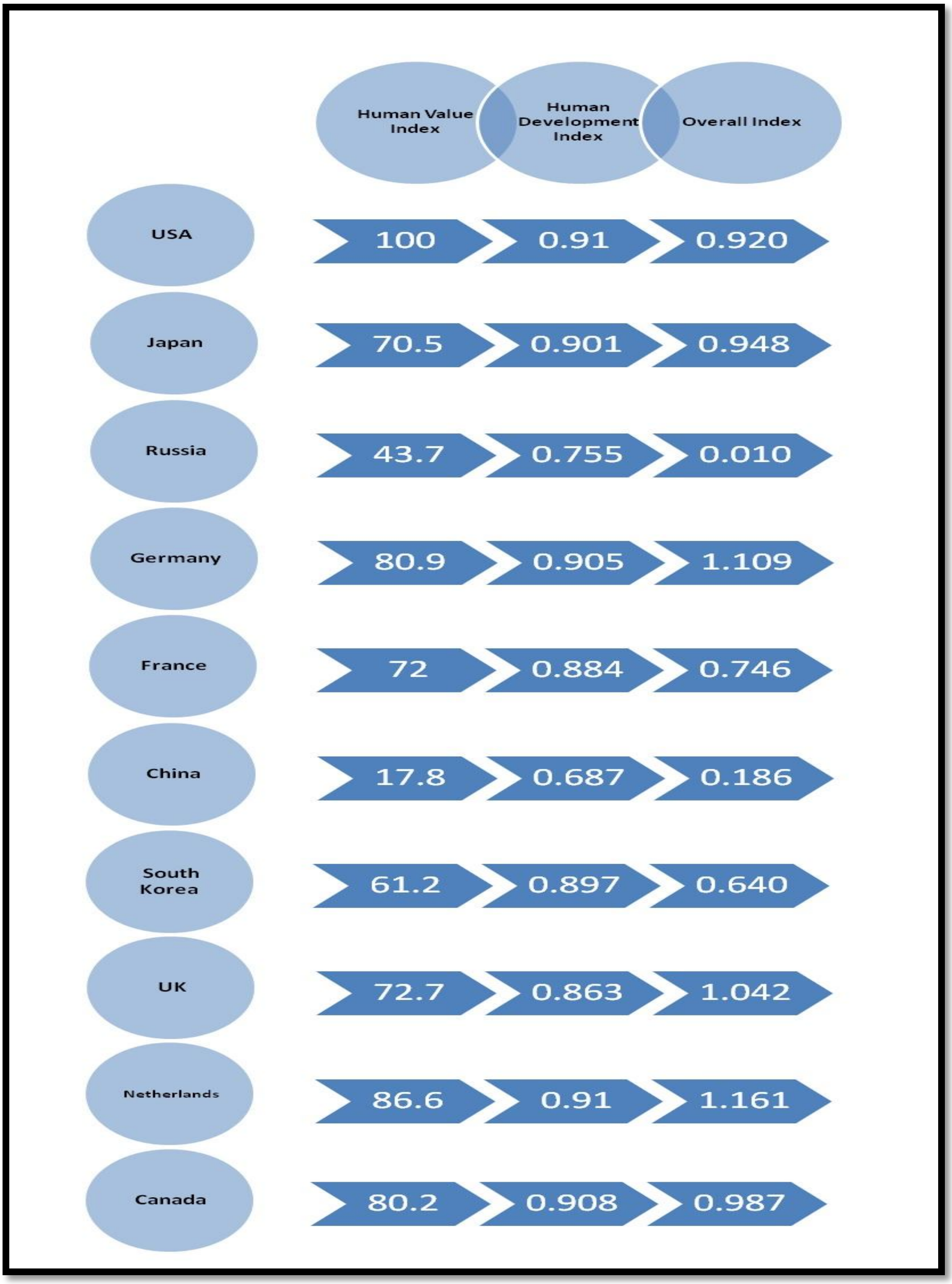

Figure 11: Relation between HVI, HDI and overall index

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Nanotechnology activities are on the rise as shown in figure 12. USA occupies the ivory tower place followed by countries like Germany, Japan, South Korea, China, France and others.

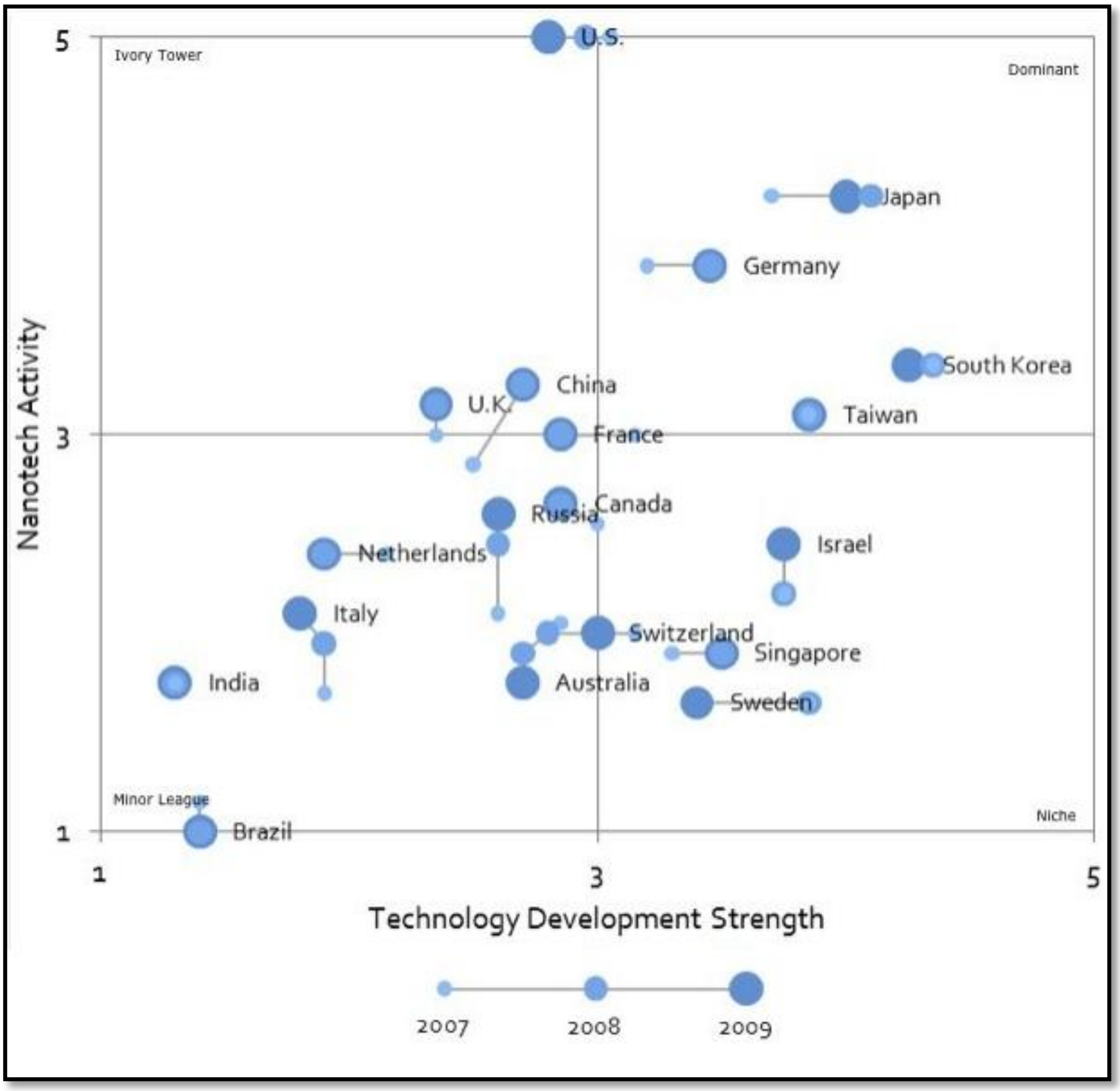

Figure 12: Technology Development Strength

Activities in India, Netherlands and OEC countries are on the rising spending in nanotechnology by Government and corporate organziations as shown in figure 13.

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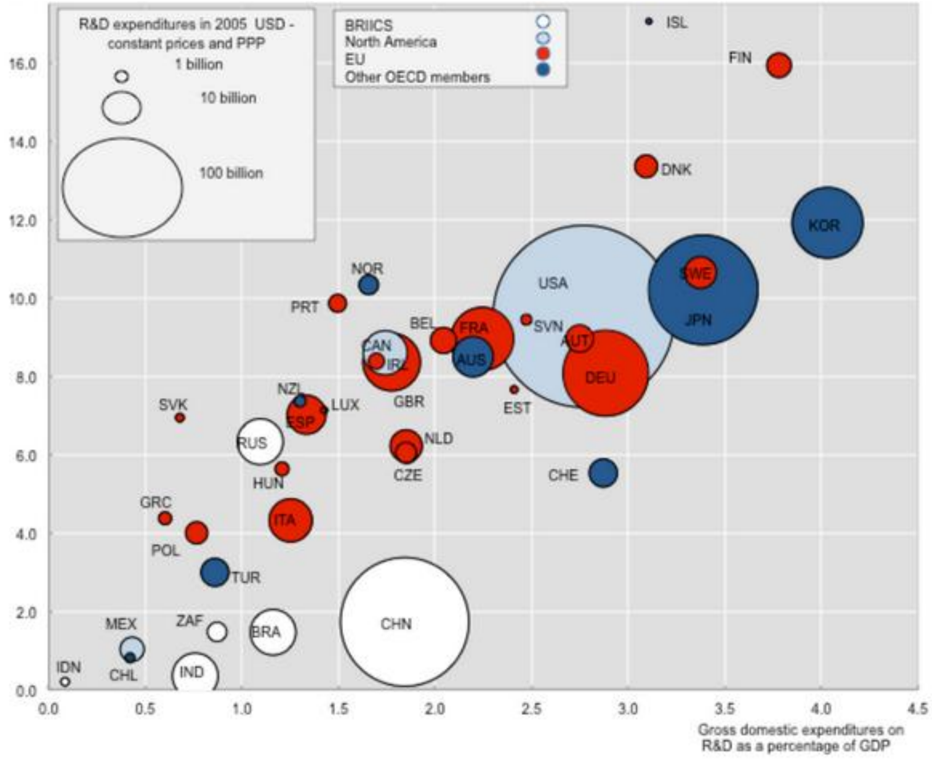

Figure 13 : Growth of Nanotechnology in OECD countries

The development of technology in OECD countries is shown in figure 14.

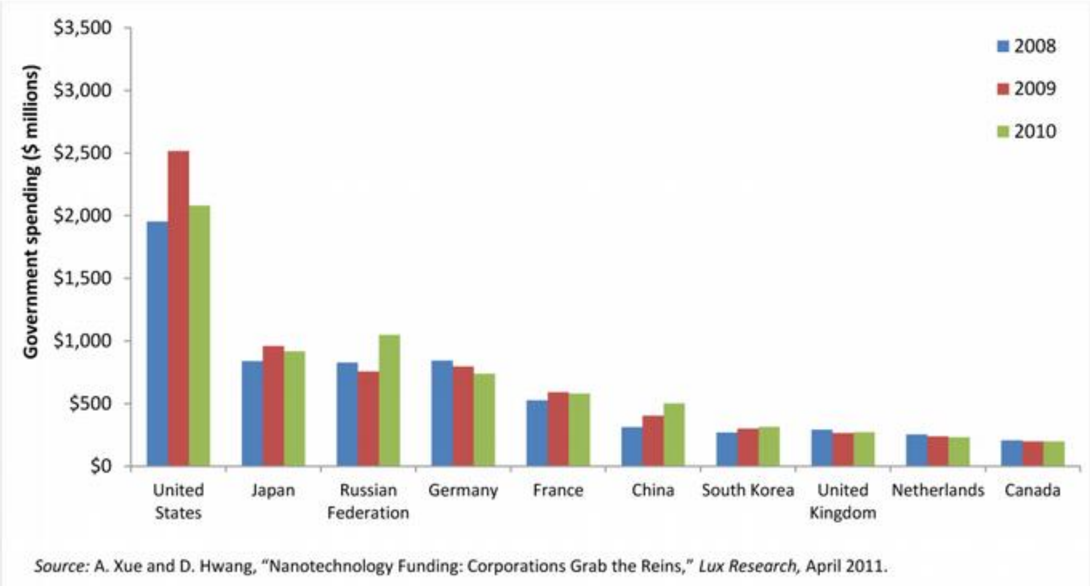

Figure 15 (a) shows the countries with maximum government spending

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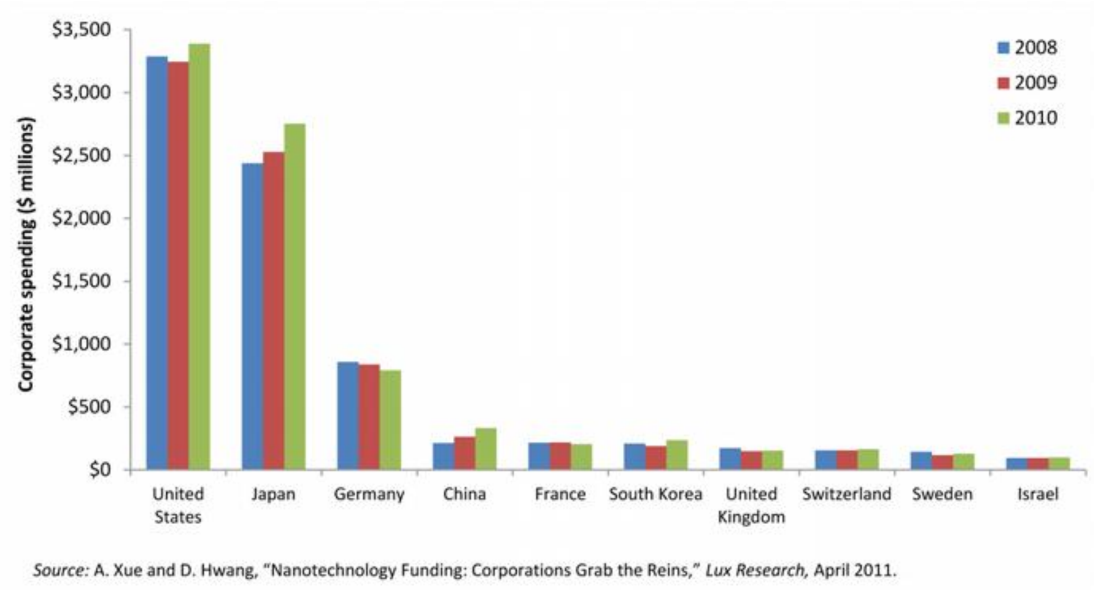

Figure 15 (b) shows the countries with maximum corporate spending

The indices mentioned above clearly indicates a big development gap between the developed and developing countries. The rich-poor divide become very clear if the GNI per capita of countries within OECD (12,276 US Dollars) is compared to the GNI of 1,005 for least developing countries. In between the two extremes, the developed and developing countries and economies of Brazil, India, China, and South Africa are emerging. The big question is how the emerging technologies are targeting poverty, education, reducing child mortality rate, combating Aids/ensuring clean emotional and inspiring and harvesting the human values the bridge the rich poor divide.

Focusing on only nanotechnology, it is can be observed from the discussion above that nanotechnology in clearly making significant contribution. Providing clean, health, Water by employing nano technology, harvesting water from air, (Fog, dew and humidly), and saving the lives of millions infected from water bone disease. Nanotechnology is playing a key role of cleaning of globe and providing a pollution free environment to the mankind by devising new method of production, minimizing wastage, increasing use of recyclable materials and using sustainable resources. The green nanotechnology is then providing sustainable and green materials for construction, textile, communication and industrial needs. It is playing a novel role in increasing crop yields and control of plant diseases by nano-encapsulated time controller release of the protective agents for the crop. Nanotechnology has shown a high progress in diagnosis and treatment of Cancer, HIV/Aids, and other epidemics, which takes a very heavy toll of human lives. The nano-medicines are reaching a level of cure unknown to mankind before. In brief, nanotechnology is serving the basic needs of mankind in all over which improve human living and human values. All these contribution are reducing rich and poor divide. Several issues such as patent rights, monopolies, corruption, discrimination, religious extremism and technology transfer are to be addressed to bridge the divide and bring the benefits to a common man in developing countries. Sharing of common values brings the rich and poor nation on one platform and leads to the opening of an era of partnership, progress and peace. Nanotechnology has the novelty of producing technologies which directly alleviate the sufferings of mankind.

Most of the negative impacts so often publicized by writers, media and a certain section of researchers are hypothetical and engineered. A technology in always like a two edge sword, and with the focus of the world leaders on keeping the globe free from pollution and wars, nanotechnology offers a big hope for future generation with at least in one dimension. Nanotechnology has made a heavy impact on human values and human development by narrowing the rich-poor divide and if the new technologies are diverted to this end, a new era of universalism, security, and benevolence would pave the way for global peace.

Conclusion

Nanotechnology is one of the benevolent technologies, which can be utilized to foster peace. What Mahatma Gandhi once said has now become a reality. He quoted 'Things undreamt of are daily being seen. The impossible is ever becoming possible. We are constantly being astonished these days at the amazing discoveries in the field of violence. But I maintain that far more undreamt of and seemingly impossible discoveries are made in the field of nonviolence'. Nanotechnology and green engineering are the new discoveries, which are transcending cultural, political, economical difference and opening a new horizon of understanding, sharing and narrowing rich poor divide and positively affecting our communities and eco-system.

World peace is a nebulous concept, meaning different concept to different thinkers. The best ways to achieve world peace is by minimizing the involuntary suffering of the people and reduce structural violence caused by systematic destruction of economical, human and cultural values in developing countries. The ranking of developing countries is judged in terms of Human Value Index (HVI), Human Development Index (HDI), Human Capital Index (HCI) and GDP.

The development of new technologies had a serious impact on human values and history is a witness to the suffering caused by major engineered disasters bought by innovations in

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weaponry. The technologies developed in the past brought a greater divide between developed and developing nations. Structural suffering have been mainly driven by political or communitarian factors, however in the recent decade emerging technologies, such as nanotechnology, communication, computing and biotechnology, have offered new approaches to sharing the ways in which people relate to each other and offer a unique approach to establish world peace, a process which could not beat traditionally achieved.

One of the most prominent technology of the decade, nanotechnology, has been focused to show what unique advantageous solutions it has brought to alleviate human sufferings in the most needed areas of clean water, remediation of environment, treatment of AIDS/HIV, Malaria, Regeneration of tissues, Increase of Crop Yield, Healthier living in Eco-Friendly houses, utilizing Green Materials and wearing bio-inspired healthy clothing, hitherto unknown. The advantages offered above are bringing the developed and developing nations together in sharing common values to address human suffering and there by narrowing rich-poor divide and elevating human value indices to a level achieved by developed nation. Benefits resulting from nanotechnology and green nanotechnology should be shared by society as whole relation with the development nations.

What is needed is a new approach to decentralization policy on emerging technologies for fair sharing to enhance different human values related indices, and integrate them with technologies such as nanotechnology to close the rich-poor nation divide gap. Minimizing structural violence caused by monopoly and centralization and promoting innovation would circumvent social, political to oppositions to obviate the divide, thus leading the divided society to a common goal of maintaining world peace through disruptive and creative technologies.

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