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Survival of Planet Earth: Scientifico-Spiritual Analysis

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Interdisciplinary Coordination Committee

Survival of Planet Earth: Scientifico-Spiritual Analysis

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Interdisciplinary Engineering

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EXECUTIVE SUMMARY

The Author, who is a former Chairman of the Indian Railways and has served on the Boards of a number of infrastructure companies, discusses wide ranging issues pertaining to Ecological Destruction, Self-Organizing Earth (Gaia Theory), Environmental Ethics and Gandhian thoughts. Some major challenges of the 21st century like Climate Change, Poverty, Energy, Food Security, Financial Security and United Nation's agenda of Sustainable Development Goals have also been brought out.

This Monograph also talks about Science and Spirituality and the ever so important link between the two. It has been clarified that Spirituality is at the core of all Religions and it is not Religion specific. Further, even a Non-Religious person can be Spiritual. It is the considered view of the Author that the interdependence of Science and Spirituality is more relevant today in view of the desirability of the following:

1. Interdependent world for an inclusive sustainable growth.

2. Respecting our Planet Earth (The Gaia Theory) for the Mother Earth to care and bless us.

3. Mahatma Gandhi's thoughts on Ecology and Ethics and need for Gandhian Engineering, i.e., getting More (Performance) from Less (Resources) for More (People) not just for More Profit.

4. Unity of all creations for tackling larger issues impacting all humanity including but not limited to CoVID-19, since in the words of the Secy. General UN, "None is safe unless everyone is safe".

5. Putting a limit to one's Possessions and Consumption.

6. Paradigm shift in the Thinking and Value norms from Self-assertive to Integrative and in the approach which is basically based on Market Values to Social / Spiritual Values.

The author highlights that handling an interdependent world needs global cooperation for arriving at innovative systemic solutions. For this, there is a requirement of a fundamental shift in the Thinking / Value norms from Self-assertive to a more Integrative and collaborative approach. We have to adopt Systems and Technologies similar to nature's Ecosystems which are not in conflict with Earth's ability to Sustain Life. This also essentially involves respect for Earth, Water, Air, Fire and Akash – the five life sustaining elements.

The value of Gaia Theory, which posits Earth as a Self-regulating Super Organism, is very relevant in the realm of Spirituality. Caring and understanding of Mother Earth is required for our survival.

This fusion of Science and Spirituality needs to be done as a global cooperative effort between all the Nations after evolving a common approach. The Author feels that for the survival of Planet Earth this fusion can and will make this Planet a better place Culturally, Socially, Economically and last but not the least Ecologically as well.

A very comprehensive, well researched, unique and an interesting read. A judicious blend of Science and Spirituality.

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INTRODUCTION

We face environmental challenges unprecedented in the history of this planet today. The natural resources that sustain life on this planet – air, water, and soil – are being polluted or depleted at alarming rates. Human population has witnessed an exponential growth and the prospects of continued degradation and depletion of natural resources multiply with this population growth. Toxic wastes, that will plague future generations, continue to accumulate worldwide. The world's wilderness areas, its forests, wetlands, mountains, and grasslands, are being developed, paved, drained, burned, and overgrazed out of existence. With destruction of the ozone layer and the potential for a greenhouse effect, human activity threatens the atmosphere and climate of the planet itself.

Dr. Karan Singh mentions that during the last century three major threats looms large on the future of human race, namely, Nuclear Disaster, Population Explosion and Ecological Destruction, and according to him Ecological Destruction is the most lethal of the three in the long run. It has been argued by Dr. L. M. Singhvi that while we have a covenant for Civil and Political rights as well as a covenant for Social and Cultural rights, then why not a covenant against Ecocide? (Ref.: Samar Singh – 2007).

As the twenty-first century unfolds, it is becoming increasingly evident that the major problems of our time – the ecological destruction, climate change, poverty, energy, food security, financial security – cannot be understood/addressed in isolation. They are systemic problems, which mean they are all interconnected and interdependent. From the systems point of view, the only viable solutions are those that are sustainable.

The interconnected/interdependent problems of ecological destruction, climate change, poverty alleviation, population explosion and the like are staring at us. No single country or area can solve these problems in isolation and joint efforts on the part of world community are needed. Even though there is a growing realization the entire world over for joint efforts and some headway has also been made, but a concrete action plan is not yet available. To give example, efforts for containing Global Warming/Climate Change have been made since 1988 when Inter Governmental Panel on Climate Change (IPCC) gave its First Report followed by several conferences/meetings but, a fully agreed Plan is still to emerge. The world is still divided in groups (e.g. Developed vs Developing blocks; Rich vs Poor countries) and necessary 'faith' among them is lacking.

In the meantime, signs of distress are clearly discernible. Melting of icecaps at poles, rising of sea levels, water and power shortages due to shrinking of glaciers affecting perennial water streams, and food crisis due to changing climate pattern are all clearly visible. Pollution of air, water, soil and even 'space' is increasing; low lands are getting submerged due to rise in sea levels; frequency of floods and storms has increased; and natural disasters have intensified. The problem calls for an urgent action.

- To make matter worse, since December 2019 the Coronavirus (Covid–19) pandemic has engulfed the whole world in extreme fear, uncertain future, and severe financial breakdown (primarily due to lockdowns imposed) besides infections and deaths. Brunt is being felt by one and all irrespective of their caste, creed or economic status.

- The outbreak of Covid-19 could be traced back to December 2019 in Wuhan, China probably due to 'Bats' in their 'Wet Market' and till 8th July 2020 has infected about 12.0 million people and caused about 0.5 million deaths across 213 countries world-wide and the damage continues unabated. A strong message has gone down the world community that "None is safe, unless everyone is safe" in the words of U.N. Secretary General.

In this paper an effort has been made to examine this complex systemic problem holistically by combining the scientific and spiritual dimensions of ecology and ethics so that Gaia (The self organising Earth) continues to support Life.

ECOLOGY

Ecology is the branch of science that deals with the relationship living things have among each other and their environment. The world includes a myriad variety of living things, from complex plants and animals to simpler organisms, such as fungi, amoeba, and bacteria. Each depends in some significant way upon other living and non-living things and its surroundings. The study

of ecology increases our understanding of the world and its life. Our survival and well-being depends on ecological relationships and even changes in distant parts of the world and its atmosphere affect us and our environment.

Although ecology is considered a branch of biology, ecologists use knowledge from many disciplines including chemistry, physics, mathematics, computer science, climatology, geology, oceanography, etc. to learn about air, land and water environments and their interactions.

An ecosystem is the most complex level of organization in nature and is made up of a community and its physical environment, including climate, soil, water, air, nutrients and energy. A simplified ecosystem based on the flow of energy and nutrients could be as below:

"The sun provides the energy that primary producers (mainly green plants, such as grass and trees, which make food by the process of photosynthesis) utilize with the assistance of abiotic substances (like phosphorous and water) to grow. Primary consumers include mice, rabbits, grasshoppers and other plant eating animals. The foxes, weasels and other secondary consumers – or predators – eat animals. Decomposers, such as bacteria and fungi, break down dead plants and animals into simple nutrients which get absorbed back into the soil and are used again by plants."

All living things are composed of certain chemical elements and compounds, like water, carbon, hydrogen, nitrogen, oxygen, phosphorous, sulphur, etc. All these cycle through ecosystems again and again. The cycling of phosphorus provides an example of the process as all organisms require phosphorus. In natural undisturbed ecosystems, the amount of phosphorus remains fairly constant. But when an ecosystem is disturbed by human activity (e.g. replacing forest by farm land), the phosphorus often 'leaks out', reducing the ability of the ecosystem to support plants. Because of this depletion of phosphorus, farmers have to use costly fertilisers to recoup this element in the soil.

Ecologists are concerned about the rate at which people are depleting non-renewable resources like coal, gas and oil and about pollution caused by their extensive use. They believe that if human population continues to grow, such problems as depletion of fuel, air and water pollution, deforestation, congestion, poverty, and the disruption of climate will also worsen (Ref.: Agarwal – 2007).

GAIA – THE SELF ORGANISING EARTH

An attitudinal shift towards a more holistic perspective that could be called spiritual in nature is the Gaia Theory, which posits the Earth as a self-regulating super organism and parallels the beliefs of many ancient cultures and aboriginal faiths around the world. It was first scientifically formulated in the 1960s by an independent research scientist James Lovelock, as a consequence

of his work for NASA on methods of detecting life on the Mars. The Gaia Theory is based on the idea that the biomass self-regulates the conditions of the planet to make its physical environment (in particular temperature and chemistry of the atmosphere) more hospitable to the species which constitute its 'life'.

In James Lovelock's 2006 book, The Revenge of Gaia, he argues that the lack of respect humans have had for Gaia, through the damage done to rainforests and the reduction in planetary biodiversity, is testing Gaia's capacity to minimize the effects of the addition of green house gases in the atmosphere. This is likely to make most of the Earth inhabitable for humans and other life forms with a massive extension of tropical deserts. He, however, claims that Gaia's self-regulation is likely to prevent any extraordinary runaway effects that wipe out the life itself but humans will survive and be "culled and, I hope, refined".

After much criticism, a Modified Gaia Theory is now considered within Ecological Science basically consistent with the planet Earth being the ultimate object of ecological study. The Modified Gaia Theory has been called Global Ecology or Earth System Science, which takes into account the interventions between biota, the oceans, the geosphere, and the atmosphere. In view of the threats of Climate Change and other global environmental predicaments, the understanding of Gaia system is now not only a subject of great intellectual fascination, but has also become a matter of great urgency.

ENVIRONMENTAL ETHICS

Environmental ethics is a systematic account of the moral relations between human beings and their natural environment. It assumes that moral norms can and do govern human behaviour towards natural world. A theory of environmental ethics, then, must go on to explain what these norms are, and to whom or to what humans have responsibilities, and to show how these responsibilities are justified. Different theories of environmental ethics offer different answers to these questions:

- Some philosophers argue that our responsibilities to the natural environment are only indirect, that the responsibility to preserve resources, for example, is best understood in terms of the responsibilities that we owe to other humans. Anthropocentric (human centered) ethics hold that only human beings have moral value. Thus, although we may be said to have responsibilities towards the natural world, we do not have direct responsibilities to the natural world.

- An extension of anthropocentric ethics occurs by considering future generations of human beings as objects of our moral responsibilities. Such an approach basically remains anthropocentric but it extends our responsibilities to include some of the humans who do not yet exist.

- Other philosophers argue that we also have direct responsibilities to natural objects other than human beings. This non-anthropocentric ethics grants moral standing to such natural objects as animals and plants, and consequently requires further extensions and revisions of standard ethical principles.

- A more comprehensive outlook of environmental ethics focus on collections or "wholes" such as species, populations, or ecosystems. Holistic ethics hold that we have moral responsibilities to collection of individual living things rather than (or in addition to) those individual living things who constitute the whole.

- The Ethics of Deep Ecology propagated by Arne Naess focuses on two ultimate norms. These norms are ultimate in the sense that they are not derived from any further or more basic principles or values. They are the point at which ethical justification ends. These two ultimate norms of deep ecology are self-realization and bio-centric equality. Self-realization is a process through which people come to understand themselves as existing in a thorough interconnectedness with the rest of nature. Bio-centric equality is the recognition that all organisms and beings are equally members of an interrelated whole and therefore have equal intrinsic worth (Ref.: Jardins – 1997).

GANDHI ON ETHICS AND ECOLOGY

Mahatma Gandhi regarded human beings as trustees of all creation, animate and inanimate. He emphasized that, "It is an arrogant assumption to say that human beings are lords and masters of the lower creatures. On the contrary, being endowed with greater things in life, they are the trustees of the lower animal kingdom." His ideas of non-possession, minimization of wants and economic equality, his concern for hygiene and sanitation and against any wastage – even of a drop of water or a scrap of paper or a minute of time, and his whole lifestyle and life's values, made him an ideal environmentalist well before the environmental concerns became a common issue.

The following are some of his views relevant to the issue:

- ❖ "- - man has no power to create life, therefore, he has no right to destroy life."

- ❖ "Therefore, the ideal of creating an unlimited number of wants and satisfying them seems to be a delusion and a snare. - - - Man's happiness lies in contentment."

- ❖ "The earth provides enough to satisfy every man's needs, but not every man's greed."

- ❖ "A time is coming when those who are in the mad rush today of multiplying their wants, vainly thinking that they add to the real substance, real knowledge of the world, will retrace their steps and say: 'What have we done?'"

❖ The new environmentalism called 'Deep Ecology', propagated by Arne Naess, closely mirrors the Gandhian philosophy. According to Naess, "Gandhi's utopia is one of the few that shows ecological balance, and today his rejection of the Western world's material abundance and waste is accepted by progressives of ecological movement" (Ref.: Anand – 2002).

MAJOR CHALLENGES OF THE 21ST CENTURY

According to Sachs (2008), the defining challenge of the twenty-first century will be to face the reality that humanity shares a common fate on a crowded planet. This common fate will require new forms of global cooperation. While the challenge of the twentieth century was to handle a divided world, the challenge of the twenty-first century will be to handle an inter-dependent world.

In the last seventy-five years, most successful countries have gradually come to understand that their own citizens share a common fate, requiring the active role of government to ensure that every citizen has the chance and means to participate productively within the society, and to curb society's dangerous encroachments on the physical environment. Sachs (2008) observes that the challenges of sustainable development – protecting the environment, stabilizing the world population, narrowing the gaps between the rich and the poor, and ending extreme poverty – will need global cooperation. To find the way peacefully through these difficulties, we will have to learn, on a global scale, the same core lessons that successful societies have gradually and grudgingly learnt within their own national borders.

Four goals have been suggested by Sachs (2008) to overcome these challenges of sustainable development:

• Sustainable systems of energy, land, and resource use that avert the most dangerous trends of climate change, species extinction, and destruction of ecosystems.

• Stabilization of the world population at eight billion or below by 2050 through a voluntary reduction of fertility rates.

• The end of extreme poverty by 2025 and improved economic security within the rich countries as well.

• A new approach to global problem solving based on cooperation among nations and the dynamism and creativity of the non-governmental sector.

Attaining these goals on a global scale may seem impossible. Yet there is nothing inherent in global politics, technology, or the sheer availability of resources on the planet to prevent us from doing so. We need agreements at the global level and attitudes throughout the world that are compatible with meeting the global challenges.

UNITED NATIONS – SUSTAINABLE DEVELOPMENT GOALS (SDGS)

The Sustainable Development Goals (SDGs), officially known as Transforming our World: the 2030 Agenda for Sustainable Development, are an intergovernmental set of seventeen goals, namely,

1. No Poverty - End poverty in all its forms everywhere.

2. Zero Hunger - End hunger, achieve food security and improved nutrition and promote sustainable agriculture.

3. Good Health and Well-being - Ensure healthy lives and promote well-being for all at all ages.

4. Quality Education - Ensure inclusive and equitable quality education and promote life-long learning opportunities for all.

5. Gender Equality - Achieve gender equality and empower all women and girls.

6. Clean Water and Sanitation - Ensure availability and sustainable management of water and sanitation for all.

7. Affordable and Clean Energy - Ensure access to affordable, reliable, sustainable and clean energy for all.

8. Decent Work and Economic Growth - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

9. Industry, Innovation and Infrastructure - Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

10. Reduced Inequalities - Reduce inequality within and among countries.

11. Sustainable Cities and Communities - Make cities and human settlements inclusive, safe, resilient and sustainable.

12. Responsible Consumption and Production - Ensure sustainable consumption and production patterns.

13. Climate Action - Take urgent action to combat climate change and its impacts.

14. Life Below Water - Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

15. Life on Land - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

16. Peace, Justice and Strong Institutions - Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

17. Partnerships for the Goals - Strengthen the means of implementation and revitalize the global partnership for sustainable development.

SUSTAINABLE DEVELOPMENT

The Brundtland Commission (UN) in their Report (1987) defined sustainable development as "development that meets the needs of the present, without compromising the ability of future generations to meet their own needs". This broad definition however needs further elaboration as detailed below:

❖ A triple bottom line perspective, that considers environmental, economic and social aspects.

❖ A time dimension, which incorporates short term to long term, and considers impacts along the life-cycle, including impact on future generations.

❖ A resource context with respect to scarcity, over-abundance, or potential to disrupt resource availability in the future.

Sustainable development will be possible only when it is recognized that economic growth, social welfare and environmental issues are linked and have to be addressed together, rather than in a fragmented way as practiced currently. The figure below indicates the relationship among the three pillars of sustainability viz., economic, environmental, and social aspects.
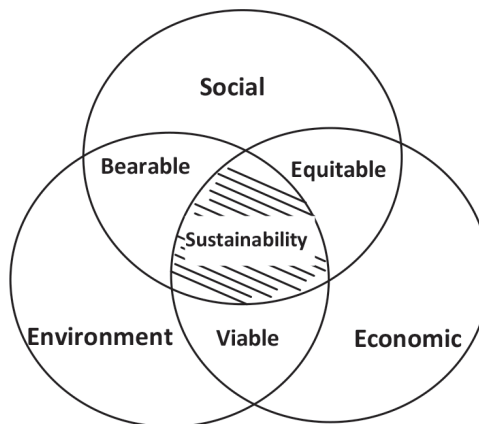
Three Pillars of Sustainability

ROLE OF TECHNOLOGY

Many thinkers believe that environmental problems center on technological problems and solutions. This view claims that we are victims of our success. We suffer from environmental problems because we have become rich and mobile so quickly that we have overwhelmed the technological systems that enabled these successes to occur. When few people had automobiles it did not matter very much that they were highly polluting. When everyone has an automobile it becomes an environmental problem. This holds true for many environmental problems.

The solution appears to be to do a new round of technological development. Previous generation of technologies were developed to solve problems and reduce labour in a world in which environmental costs were not significant. Now that they are important, a new generation of technology is needed that performs these labour saving functions but with much greater sensitivity to the environment.

Technological approaches are popular both with the politicians and with the public because they promise solutions to environmental problems without forcing to change values, way of life, or economic systems. However, the situation is rather vague about what these new technologies should be or what they might actually accomplish.

It has been mentioned by Collier (2010) that technology can turn nature into an asset by giving these natural assets the potential to become valuable to the society. However, for natural assets to be valuable instead of being dissipated in competitive struggle, their ownership and use must be regulated. Regulation requires good governance. Unregulated use of technology can turn nature nasty; the technology that has given us cheap energy has also given us carbon-dioxide that will over-heat the planet. The challenge of harnessing nature has been summarised by him as under:

(a)   NATURE + TECHNOLOGY + REGULATION = PROSPERITY

(b)   NATURE + TECHNOLOGY - REGULATION = PLUNDER

(c)   NATURE - TECHNOLOGY + REGULATION = POVERTY

In his book "Ten Technologies to Save the Planet", Goodall (2008) shows considerable optimism and mentions that each of the ten chapters of the book looks at a technology or technique that could reduce carbon dioxide emissions by at least 10 per cent of the annual world total. All these technologies are comfortably within our scientific and technological reach and so the author argues that we should be able to 'decarbonise the economy' at an affordable price. The importance of coil carbon has been especially highlighted as warming of planet can trigger speeding up the pace of climate change.

CHANGING ROLE OF ENGINEERING: NEED FOR ADDITIONAL INPUTS

Engineering is the profession that puts scientific knowledge to practical use. The word engineering comes from the Latin word ingeniare, which means to design or to create.

Engineers use principles of science to design structures, machines, and products of all kinds. They look for better ways to use existing resources and often develop new materials. Engineers have had a direct role in the creation of most of modern technology – the tools, materials, techniques, and power sources that make our lives easier.

The field of engineering includes a wide variety of activities. For example, engineering projects range from the construction of huge dams to the design of tiny electronic circuits. Engineers may help produce guided missiles, industrial robots, or artificial limbs for the physically handicapped. They develop complex scientific equipments to explore the reaches of outer space and the depths of the oceans. Engineers also plan our electric power and water supply systems, and do research to improve automobiles, television sets, and other consumer products. They work to reduce environmental pollution, increase the world's food supply, and make transportation faster and safer.

Tony Marjoram and Yixin Zhong (UNESCO Report – 2010) diagrammatically depicted the role engineering plays (using 'Theories' from 'Science' and 'Tools' provided by 'Technology') to provide 'Products and Benefits' to 'Society and Nature' keeping in view the 'Resources and Needs'.
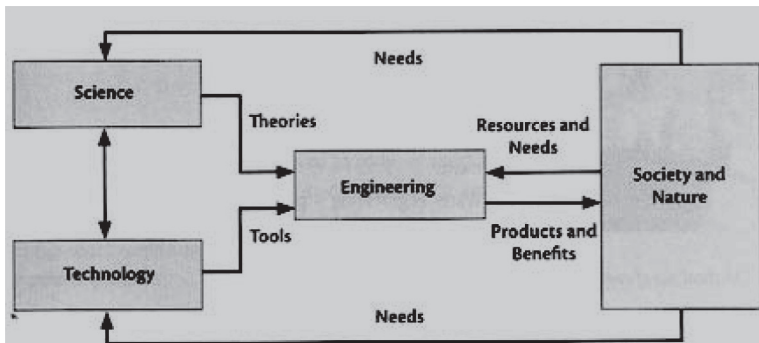
Tony Marjoram and Yixin Zhong (UNESCO Report – 2010) further elaborated that almost every area of human interest, activity and endeavour has a branch of engineering associated with it. They also provide an illustrative list of engineering branches mentioning various disciplines / sub disciplines (See Appendix A).

Unlike earlier periods when resources were in abundance and societal needs low, the current

situation is altogether different. The current needs are of a much greater order of magnitude; environmental constraints are dangerously close to being breached; worldwide competition for scarce resources could fuel international tensions and the freedom to power our way into the future by burning fossil fuels is denied.

Resolving these issues requires tremendous innovation and ingenuity by engineers, working alongside other technical and non-technical disciplines. It requires the engineer's ability to synthesize solutions and not simply their ability to analyze problems. Further, engineers need the ability to take a systems view at a range of scales, from devices and products through to the large-scale delivery of infrastructure services.

Society today is making ever-greater demands on engineering, ranging from those caused by exploding urbanization and by the endemic poverty of a quarter of world's population in the face of overall global affluence, to the mounting concerns about availability of critical resources, the consequences of climate change and increasing natural and man-made disasters. This confronts engineering and society not only with unprecedented technical challenges, but also with a host of new ethical problems that demand the development of Global Engineering Ethics. How far should engineering pursue the modifications of nature and what are its roles and responsibilities towards society? How should engineering address problems of equity in terms of the availability of resources and services of and between current and future generations? Should concerns about global warming take precedence over the urgent problem of poverty, or how can they be addressed together?

It is unfortunate that, under these circumstances of growing need for multi-talented engineers, the interest in engineering among young people is waning in so many countries. Awareness about the importance and the changing nature of engineering needs to be raised in circles of Government as well as amongst the general public. Basically, there is a need to reinvent engineering.

GANDHIAN ENGINEERING

Dr. R. A. Mashelkar in his Lifetime Contribution Award Lecture 2012 (INAE – April 2013) mentions two tenets propounded by Mahatma Gandhi:

    (i) 'I would prize every invention of science made for the benefit of all'.

    (ii) 'Earth provides enough to satisfy every man's need but not every man's greed'.

He further elaborates that the first tenet refers to affordability and the second tenet to sustainability.

He explains that industrial enterprises strive for getting more (performance) from less (resource) for more (profit) but the Gandhian philosophy of engineering has a different message. It means getting more (performance) from less (resource) for more (people), not just for more (profit).

Getting More from Less for More (MLM) strategy forces us to measure an opportunity by the ends of innovation – what people actually get to enjoy – as opposed to just an increase in their means. In important ways, this rationale invokes a return to the traditional case for innovation – its ability to produce breakthrough improvements in the quality of life – alongside the usual objective of competitiveness.

The objectives of MLM type of innovations would not be just to produce low performance, cheap, knock-off versions of rich country technologies so that they can be marketed to poor people. Rather, the objective is to harness sophisticated science and technology know-how to invent, design, produce and distribute high performance technologies at prices that can be afforded by majority of people.

Gandhian engineering perspective is all about getting more from less for more people – this MLM way of innovation is anchored on the solid foundation of affordability and sustainability. It will create a more equitable society and will also help us in designing a sustainable future.

ENERGY – A THEORETICAL PERSPECTIVE

While discussing "smart energy" Piccioni (2010) cites Einstein's most famous equation $e = mc^2$ and its implications for generating energy, namely that all useful energy ultimately comes from the conversion of mass into various forms of energy. If we convert 1 ton of mass into suitable energy and define it as '1 ton of energy' then Table below will indicate the current huge resource use (and consequent pollution) vis-à-vis the position if we are able to use hydrogen fusion. It has further been mentioned that providing the world's energy needs in 2004 would only have required converting six tons of mass into other forms of energy.

Process	Tons of Fuel Needed to Supply "1 ton of Energy"	Clean
Burn Coal	5,000,000,000	No
Burn Gasoline	2,000,000,000	No
Uranium Fission	50,000	No
Hydrogen Fusion	133	Yes
Mass → Black Hole	1	Yes

Sun uses hydrogen fusion to generate energy. Every second our sun 'burns' 574 million tons of hydrogen, creating 570 million tons of helium, and converting 4 million tons of mass into energy.

Michio Kaku (2011) mentions that by mid-century the new option of Hydrogen Fusion is very likely, giving us a permanent solution to the energy problem. While fission power relies on splitting the Uranium atom, thereby creating energy (and a large amount of nuclear waste), fusion power relies on fusing hydrogen atoms with great heat, thereby releasing vast amount of energy (with very little waste). fusion (not fission) is nature's preferred way to energise the universe. Fusion power lights up the sun and the heavens. The public has a right to be sceptical about fusion, since there have been so many hoaxes, frauds, and failures in the past more than 50 years. However, the advantages of fusion power are so great that many scientists are working on fusion related projects. In France, there is the International Thermonuclear Experimental Reactor (ITER) backed by the European Union, the United States, China, India, Japan, Korea and Russia. The ITER uses huge magnetic fields to contain hot hydrogen gas and is one of the largest international scientific projects ever attempted. It is projected to cost 10 billion Euros (At one Euro = Rs. 80 it will work out to Rs. 80,000 crore).

Our research activities must, therefore, be directed with a much greater vigour to use the energy from the Sun and also towards generating energy from 'hydrogen fusion'.

UNDERSTANDING SPIRITUALITY

Spirituality, which is at the core of all religions, is difficult concept to comprehend. Even a non-religious minded people can be spiritual. For our limited purpose we can define a spiritual person as the one who is highly refined in thought and feelings and habitually or naturally looks to things of spirit. As a man unfolds spiritually he feels his relationship to all mankind, and he begins to love his fellow-men more and more. It hurts him to see others suffering and when it hurts him enough he tries to do something to alleviate it. From the inner recesses of the soul comes a protest against the following of the lower animal nature and as it becomes more and more persistent he is forced to heed to it. He gradually becomes the master and controls his lower nature (See also Box 1).

Box 1: Spirituality versus Religion

A Learned, Noble personality was once asked to explain the difference between Religion and Spirituality... Some Responses:

1. *Religion is not just one, there are many.*
   Spirituality is one.

2. *Religion is for those who need someone to tell them what to do and want to be guided.*
   Spirituality is for those who pay attention to their inner voice.

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3. *Religion has a set of dogmatic rules.*
    Spirituality invites us to explore within and get attuned to the Universal Rules.

4. *Religion speaks of sin and guilt.*
    Spirituality leads us on the path of emancipation!

5. *Religion divides between us and them.*
    Spirituality unites.

6. *Religion follows the concepts of a sacred book.*
    Spirituality seeks the sacred in all books.

7. *Religion makes us to live in External Reality.*
    Spirituality lives in Inner Consciousness.

8. *Religion makes us renounce the world to follow a God.*
    Spirituality makes us live in God, without renouncing our existing lives.

According to Kaw, Science of Spirituality is conceived as a new discipline which encompasses religion, philosophy, and science and tries to harmonise the findings of all the three. It is called science because it relies on hypothesis, experimentation, verification and demonstration, i.e., it adopts the scientific method. It believes that truth is only one and different disciplines seem to give disparate versions because they look at the same facts from varying viewpoints. Science tells the truth of the physical world, philosophy sees the same truth in the intellectual world, and religion in the world of consciousness (Ref.: Kaw – 1988).

Those who advocate the spiritual method are sometimes criticised on the ground that there is no unanimity among the great religions and, therefore, one cannot arrive at a consensus with regard to the fundamental values that must be accepted and followed by all human beings. This criticism does not take into account the fact that each faith is composed of several layers. At the core of a religion is the science of spirituality, which states the nature of the individual being and that of the cosmos and tries to define the relationship between the two. This science is common to all religions. The second layer is that of the technology of spirituality, which lays down the particular rituals, ceremonies, meditational methods, words of prayer, incantations, etc. These differ from faith to faith, but do not affect the science in any way. The third layer is that of the commerce of spirituality, where an organised group takes charge of a particular creed and makes a commercial enterprise out of it. The fourth layer is the politics of spirituality, where ambitious people use faith as a weapon. Their desire for power is masked by the pretence of supporting a particular faith. In the evaluation of spirituality there has been an element of unanimity, across faiths and across countries. Generally, the disciples emphasise the technology, the priests exploit the commercial aspect, and the rulers go for the political angle (Ref.: Kaw – 2002).

MARKET/SOCIAL/SPIRITUAL VALUES

Value Chain Analysis for Market Values, Social Values, and Spiritual Values and the driving forces behind them are given below (Subhash Sharma – 2007). It can be seen from the same that global problems of our inter-dependent world cannot be solved through an approach where 'self-interest', i.e., market driven approach, is predominant. Higher values are the need of the hour.

Nature of Values	Illustrative Phrases & Expressions of the Value Chain	Driving Force
Market Values	Competition, Efficiency, Profitability, Survival of the fittest, Downsizing, Economic Value Addition (EVA), etc.	Self-interest
Social Values	Co-operation, Justice, Equity, Human rights, Gender equality, Social harmony, Pluralism, Workplace diversity, Empowerment of the Weakest, Bio-diversity and other Environmental concerns, etc.	Enlightened self-interest
Spiritual Values	Symbiosis, Helping others, Joy, Bliss & Peace, Beauty, Goodness & Truth, Symphony & Harmony, Survival of all & development of all, etc.	Enlightened collective interest

POINTS TO PONDER

Everything is Interconnected

Ancient Indian wisdom and yoga philosophy clearly enunciate that everything in the universe is connected to everything else and no part of it is fundamental. This shows oneness of all life and its thorough interconnectedness with the rest of nature. A renowned physicist and a spiritual thinker, Capra (1975), also states that the above Eastern view is also the finding of Modern Physics.

One cannot be truly human and civilized unless he/she looks upon not only all fellow men but all creation with the eyes of a friend. One can take from the earth and the atmosphere only so much as one puts back into them. This feeling of the oneness of all life is best expressed in the Atharva Veda compiled about four thousand years ago, translated excerpts from which are given below (Samar Singh – 2007):

We are birds of the same nest,

We may wear different skins,

We may speak different languages,

We may believe in different religions,

We may belong to different cultures,

Yet we share the same home – Our Earth.

For man can live individually,

But can survive only collectively.

Born on the same planet,

Covered by the same skies,

Gazing at the same stars,

Breathing the same air,

We must learn to happily progress together,

Or miserably perish together.

The Ethics of Deep Ecology propagated by Arne Naess also highlights this interconnectedness and recognises that all organisms and beings are equally members of an interrelated whole.

Unity of all Creation

The yoga philosophy holds (Yogi Ramacharaka – Period 1904-1907) that in the beginning, the absolute meditated upon the subject of creation, and formed a mental image, or thought-Form, of a Universal Principle of Mind. This Universal Principle of Mind is the Great Ocean of 'Mind-Substance' from which the entire phenomenal Universe is evolved. From this Universal

Principle of Mind, evolved the Universal Principle of Force or Energy and from the latter, evolved the Universal Principle of Matter. They are all governed by cosmic laws of nature and following the Laws of Involution reached the lowest point from where the reverse cycle of evolutionary unfoldment began. The present stage of human evolution has been possible only by the process of Metempsychois (commonly known as Re-incarnation or Re-embodiment). The yoga philosophy thus holds that mind is under, back of, and antecedent to all the work of evolution, and that matter is a 'by-product' of mind.

Matter was considered as indestructible till 1917 when Einstein proposed his famous equation $E = mc^2$. It may be noted that these lectures were delivered during the period 1904-1907 and are talking of conversion of mass into energy. These lectures further mention about conversion of energy into mind substance. Surprisingly, we are also observing a technology trend that points towards Thinking Energy.

Five Life Sustaining Elements (Panch Tattwas)

Ancient Yoga philosophy recognises five elements, viz., Earth, Water, Air, Fire (can also be taken as Energy) and Akash (Sky or even Space) from which Life has emerged and which sustain it. These five elements are deified (made god like or divine) as they are believed to be protectors of life. However, they will protect or bless us only when we give them due respect and care.

The ancient spiritual approach was to treat Earth as our mother and to see rivers, mountains, trees, etc., as deities/divine spirits. Praying to rivers (like the sacred river Ganges) and offering respect/gratitude to food/water before eating were common features.

The current environmental problems which plague us and are threatening the very survival of humanity are the result of misuse / overuse of nature and its resources. Growing 'ecological footprint' of Earth, deforestation, growing water and air pollution, indiscriminate use of fossil fuels for energy (causing increase in green house gases) are all there to see.

To solve the environmental problems we have to recreate the respectful attitude towards nature. The five life sustaining elements can only help/bless us provided due concern/respect is shown to them.

Spiritual Solution to Problems (Ref.: Agarwal – 2009)

One of the mantras of Bhagwan Mahavira to solve problems was based on the principle of bringing harmony between the extremes. He said, "One who is cognisant of the intrinsic is cognisant of the extrinsic; one who is cognisant of the extrinsic, is cognisant of the intrinsic." Here the intrinsic correlates with the spirituality, while the extrinsic with the external or physical conditions (Economic Times, New Delhi, 20th April 2009).

There are some people who assert that spirituality holds the key to all problems, while others insist on bringing about a change in the external conditions for solving all problems. In fact, a holistic approach would be that it is imperative to change the external conditions as well as the internal ones.

The two great challenges of the present day world are unlimited wealth and unlimited consumption. On account of limitless individual possessions, one section of the society is becoming more and more affluent, whereas another section is becoming deprived and is reeling under the agony of extreme poverty and hunger. Further, the primary cause of environmental pollution is over-consumption or unnecessary consumption.

For solving these two prime challenges (Extreme poverty & Environmental pollution) two mantras enunciated by Bhagwan Mahavira can prove extremely effective:

  (i)   Putting a limit on one's possessions

  (ii)   Putting a limit to one's consumption.

In this regard the following can be suggested:

  (a)   Most of the countries do fix a minimum wage/income. It may be desirable to ensure a maximum limit for the income also, either through legislation or through taxation. Further, all those below the minimum wage/income levels, must be supported by the Society/Government. This will ensure reduced disparities and will avoid extreme hunger and poverty.

  (b)   While a culture of austerity must be developed wherein one acts to get his needs fulfilled (and not the greed). Individual governments, within an overall accepted world norm, must fix per capita consumption limits for certain critical items. Controlled levels of consumption coupled with technological inputs should ensure that what we take from nature is duly returned to make the ecological cycle sustainable.

Water Responds to Thoughts (Ref.: Masaru Emoto – 2004)

Ancient wisdom was to consider water as precious. Religious ceremonies were not complete unless water was used or offered to deities. Rivers were considered sacred and divine. The River Ganges is considered holy and its water pure. A mere dip in the water of River Ganges is supposed to cleanse one of all his/her sins.

Masaru Emoto (Doctor of Alternative Medicine and a Researcher studying frozen water crystals using High Speed Photography – 2004) discovered that crystals formed in frozen water reveal changes when specific, concentrated thoughts are directed towards them. He found that water

from clear springs and water that has been exposed to loving words shows brilliant, complex, and colourful snowflake patterns. Response was even better when 'love and gratitude' were shown vis-à-vis 'love'. In contrast, polluted water, or water exposed to negative thoughts, forms incomplete, asymmetrical patterns with dull colours.

Masaru Emoto (2004) further mentions that water of a lake became clearer as the priest prayed and after incantations (for about 15 minutes) the results were clearly visible. Photographs of the crystals for the water before and after incantations showed remarkable changes, the latter being complete and grand. A prayer affects water and improve its quality concludes Masaru Emoto.

It may be so that our sacred rivers like the Ganges have a distinguished water purity due to millions of people offering prayers to it. And our earlier systems of praying before eating food and drinking water also had a purpose, and that a matter like water (considered inanimate by modern science) has life and responds to positive thoughts and emotions.

Healing Power of Water (Ref.: Masaru Emoto – 2007)

Masaru Emoto in his earlier Book titled "The Hidden Messages in Water" (2004) had showed at length that water in the frozen crystal form showed us its true nature and that water responds to thoughts.

Masaru Emoto is a Doctor of Alternative Medicine. For many years he has been studying the healing power of water and has used water which was charged with "healing" information to cure people. He mentions that water has a memory. Each molecule of it carries some information, and when we drink it, that data becomes part of our body.

Concept of Morphogenetic Field

The morphogenetic field, or morphic resonance, is a name given to a form of action at a distance proposed by Rupert Sheldrake. However, the idea that vision is a two-way process has been held by a great many minds in the past. The theory states that things of the same "form" tend to "resonate" with each other, so that, for example:

> *"When crystals of a newly synthesized chemical substance, for example a new kind of drug, arise for the first time they have no exact precedent, but as the same compound is crystallized again and again, the crystals should tend to form more readily all over the world, just because they have already formed somewhere else (Rupert Sheldrake, The Presence of the Past, HarperCollins, 1988)."*

This concept defies, among other things, the theory of special relativity – all crystals, all over the world, regardless of distance in space/time, will be affected.

An example of this is the phenomenon of the hundredth monkey, as first observed in the late 1950s on a northern Japanese island. A group of behavioural scientists observed that monkeys on the island would wash their potatoes before they ate them. It's likely that one of them started it by chance, and then others copied its behaviour. They must have found out that the taste of a washed potato was far better than one that hadn't been cleaned. Eventually, there were 100 monkeys on that island who were eating in this fashion. Then something fascinating happened: Suddenly, monkeys on another island started to wash their potatoes; but they didn't start one by one, as had been the case on the first island, but all at once, as if the animals, on the first island had told them about their discovery. However, there had been no contact between two groups.

This phenomenon can be used to explain the theory behind the morphogenetic field. Through the behaviour of the first group of monkeys, a field of vibrations was created that contained the information "Washed potatoes taste good." At a certain critical mass (the hundredth monkey), the field developed an intensity that allowed others to have a share in this information.

When we're thinking a thought and give it energy by imagining it as real or speaking it, we're storing the pattern of vibration in the water of our bodies, and it shows as the corresponding vibration all around us and further out, beyond our physical selves. In this way, we influence our surroundings and others react to it, and we receive the appropriate feedback that again reinforces both our vibrations and the morphogenetic field. This shows how important it is to think and speak with purity of intent.

One of the most important messages that we receive from the water crystals is that each of our thoughts, words, and actions represents information that we send out. Our consciousness has a real influence on water, which becomes particularly powerful when many of us become one and aim for the same goal. In this lies the power of joint prayer. Let's use this energy to give love and gratitude to water. This in turn will benefit the individual, society and nature.

Masaru Emoto firmly believes that it's our duty as human beings to contribute to the healing of the earth and its waters. For many of us this has been a need for a long time. Now we also know that together we can make big things happen, as the law of the hundredth monkey teaches us.

Need for Mutual Faith

Confucius, when asked about the greatest necessities in a good government, replied that the ruler should be able to provide enough food to its subjects, should have enough weapons for their protection and people should have faith in the ruler. When further asked about the priorities of these necessities, he mentioned, "Weapons are the last priority. If we choose between the remaining two, food can be dispensed with, for one must die one day. But if the people do not have faith in their ruler, they cannot exist". What is true of Rulers / Administrators is equally true for Leaders and Managers.

Faith primarily relates to the emotional/intellectual/spiritual planes and not to the physical plane. One develops faith in an individual/organization based on his personal contact as also the image or the reputation of the concerned individual/organization. Any act resulting in breach of faith results in a situation where its restoration becomes extremely difficult and invariably takes a long period of time. If one wants to enjoy the reputation of being a 'gentleman' he has to be continuously considerate to others.

In the present day environment 'faith' is fast depleting and has more or less disappeared. People's faith in their leaders is an essential need. May be very strict moral norms for leaders are the need of the hour. Any act or action on the part of leaders which affects the mutual faith between them and the people should be punishable by law. Currently, most of the activities of leaders are available on media, especially in visible form, and so comparisons with the past could be made easily to pin point untruth / contradictions.

Need for Changed "Thinking"

Edward De Bono, author of the Book "Think!: Before It's Too Late", is a doctor by profession and has worked in the field of medicine for 48 years and had teaching positions at the Universities of Oxford, Cambridge and Harvard. He also graduated separately in Psychology. He has been Da Vinci Professor of Thinking at the University of Advancing Technology in Arizona and also Professor of Thinking at four other universities. Very few universities have a Faculty of Thinking. Some of his observations are:

❖ Our existing thinking methods are excellent when applied to certain areas, and inadequate (or even useless) in other areas. We need to supplement the existing thinking methods with creative thinking, design thinking and perceptual thinking (among other things).

❖ 'Think green' is important. Climate change is a legitimate problem. But there is a bigger and more urgent danger than climate change and that is the danger of poor quality of human thinking. Perhaps there should be an even more important slogan 'think grey'. The grey refers to our grey matter, or brains. Most of the problems, conflicts and fights in the world are caused by poor thinking. If we get our thinking right then it becomes easier to solve not only environmental problems, but other problems too.

❖ Arguments, truth, and logic proved so excellent in science and technology, that we came to consider this thinking as perfect, complete and beyond any need of change. In human affairs there are interactive loops and things change. The perception is thus far more important than logic in human affairs but has been totally neglected.

❖ It is perceptions that control emotions and emotions control behaviour. Changes in perception will change emotions and therefore behaviour. If your perception changes, you have no choice: your emotions and behaviour change too.

Creativity

Human brain is not designed to be creative. It is designed to set up routine patterns and to use and follow these patterns. We know very well that progress is due to creativity: to looking at things in a different way; to doing things differently; to putting things together to deliver new value. The word 'creative' does not distinguish between artistic creativity – as we understand it and idea creativity, which helps with our thinking. It is always worth investing in creativity even if the outcome cannot be guaranteed. It should also be remembered that one of the main uses of creativity is to simplify operations.

Knowledge and Information

The belief is that all you need is knowledge and then you can do anything. This is the 'road map' approach. Once you have such a map, it is assumed that you can get to wherever you want. All you need is a good road map – even if you have not learned to drive!

Information is essential, and there is no way that one would seek to diminish the key role of information. It is excellent but not enough. We need thinking to extract value to put information together in order to design the way forward.

Shift in Norms for Values / Thinking

During the Industrial Revolution of the seventeenth century, values were separated from facts, and ever since that time scientists tend to believe that scientific facts are independent of our values. Thomas Kuhn exposed the fallacy by showing that scientific facts emerge out of an entire constellation of human perceptions, values and actions – out of a paradigm – from which they cannot be separated. Although much of our detailed research may not depend explicitly on our value system, the larger paradigm within which this research is pursued will never be value-free. As scientists, therefore, we are responsible for our research not only intellectually but also morally (Ref.: Capra & Luisi – 2014).

Further, the broader paradigm shift also needs corresponding changes of values. And here it is interesting to note a striking connection between the change of thinking and change of values. Both of them may be seen as a shift from self-assertion to integration. These two tendencies – the self assertive and the integrative – are both essential aspects of all living systems. Neither of them is intrinsically good or bad. What is good, or healthy, is a dynamic balance; what is bad, or unhealthy, is imbalance – overemphasis on one tendency and neglect of the other.

Thinking		Values	
Self Assertive	**Integrative**	**Self Assertive**	**Integrative**
Rational	Intuitive	Expansion	Conservation
Analysis	Synthesis	Competition	Cooperation
Reductionist	Holistic	Quantity	Quality
Linear	Non-Linear	Domination	Partnership

When we look at our modern industrial culture, we see that we have overemphasised the self assertive and neglected the integrative tendencies both in our Thinking and in Value systems (Ref.: Capra & Luisi – 2014).

Epidemics, Germs & Fears – Shri Aurbindo and the Mother (Dr. Alok Pandey, Pondicherry, March 6, 2020)

The world has faced several kinds of menaces and attacks from physical and occult forces. In fact according to Sri Aurobindo and the Mother behind the physical entities there is always a play of occult forces, especially elemental energies that are thrown out of the dead. It is quite likely, as is being already proposed, that this viral illness and some previous ones originate when animals are kept in miserable conditions prior to slaughter and later killed inconsiderately, possibly violently. In such conditions, the atmosphere of an animal throws out a lot of fear and rage which settles into the atmosphere and environment of such places where these animals are sold or slaughtered. It is this 'amorphous and dark vital soup' that helps breeds what we later recognise as a virus. It then throws itself with as much violence upon human beings, almost like a crystallised fury. The attack also throws into the human system a lot of fear leading to a cascading effect. Nature supports this backlash of the animal kind upon a greedy humanity that has gone on a rampage to destroy all kinds of life for its own petty satisfaction. After a while the 'fury' abates and the recovery starts. Behind these movements of nature there is almost invariably the force of 'Kali' at the level where the drama is unfolding. But what we should remember is that she too is the Mother and if we remain unperturbed by her dangerous dance then we will remain untouched even in the midst of the worst.

This is the inner reason for the epidemic. Well, the first thing to remember is that fear attracts the feared. It acts like a magnet to draw the thing that is feared. While it is reasonable to take suitable precautions such as washing our hands and avoiding crowded places both of which are in any case breeding grounds for forces of illness, fear and panic are to be specifically avoided. Staying away from crowded places such as a bazaar where people gather centered around 'desires' is anyways a good idea as it opens doors within us to all kinds of dark forces. On the other hand to remain in a state of inner quietude, cheerful trust in the grace, filled with optimism and positivity

is one of the best ways to keep all such forces of illness away from the occult point of view. A good psychological state reinforces the subtle envelope which is the body's natural protection against attacks from illnesses etc. On the other hand it helps boost our immune system which greatly benefits if we are in a cheerful state and goes down when we are depressed.

To this a yogin or a sadhaka adds an implicit and unfailing trust and confidence in the divine, an absolute possible surrender to her will. Without fear of any kind from this or any other worlds he/she goes about doing the work given by the Mother fully assured of her protection and her unfailing grace. All other things will come and go but this abides forever and it is on these things that are of eternal value and abiding truth that we must remain concentrated upon rather than on passing transient appearances that come and go according to an inner logic of creation. Life and death weave the chequered march of man but to those who have turned towards the divine, both of them are part of a single plan and eventually instruments of a higher will and wisdom that uses all things, even the most seemingly contradictory and shocking to our limited sensibility for the greater divine purpose in creation. We have to look beyond both and see in the bright and the dark, the glad and the terrible, the one face we love, the face of our Divine Mother in countless forms.

LESSONS ON SUSTAINABILITY FROM THE ECOSYSTEMS

How to achieve the goal of sustainable development is a major problem staring at us. The authors (Capra and Luisi – 2014) suggest that to achieve sustainable human communities we can model them after nature's ecosystems which are sustainable communities of plants, animals and microorganisms. Further, the sustainable human community be designed in such a manner that its way of life, businesses, economy, physical structures, and technologies do not interfere with nature's inherent ability to sustain life.

In our endeavour to understand how nature sustains life, we need to understand the organisational principles that ecosystems have evolved to sustain the web of life. Some of these are discussed below along with the lessons for the human community:

1. The first of these principles is interdependence. All members of an ecological community are interconnected in a vast and intricate network of relationships, the web of life. The success of the whole community depends on the success of its individual members, while the success of each member depends on the success of the community as a whole.

   A sustainable human community has to be conscious of the multiple relationships among its members, as well as the relationship between the community as a whole and its natural and social environment.

2. Being an open system, all organisms in an ecosystem produce wastes, but what is waste for one species is food for another, so that the ecosystem as a whole remains without solid wastes. Communities of organisms have evolved in this way over billions of years, continually using and recycling the same molecules of minerals, water and air.

   Lesson for the human communities here is obvious. Sustainable patterns of production and consumption need to be cyclical, imitating the cyclical processes of nature.

3. Solar energy, transformed into chemical energy by the photosynthesis of green plants, is the primary source of energy driving the ecological cycles.

   For sustainable human communities the solar energy in its many forms – sunlight for solar heating, photovoltaic electricity, wind and hydropower, biomass etc. – is the only kind of energy that is renewable, economically efficient, and environmentally benign.

4. The cyclical exchanges of energy and resources in an ecosystem are sustained by pervasive cooperation. Partnership is an essential characteristic of sustainable ecological communities.

   Sustainability is not an individual property but a property of an entire web of relationships. It always involves a whole community.

5. The flexibility of an ecosystem is a consequence of its multiple feedback loops, which tend to bring the system back into balance whenever there is deviation from the norm due to changing environmental conditions. All ecological fluctuations take place between tolerance limits. There is always the danger that the whole system will collapse when a fluctuation goes beyond those limits and the system can no longer compensate for it.

   In human communities, ethnic and cultural diversity may play the same role. Diversity means many different relationships, many different approaches to the same problem. A diverse community is a resilient community, capable of adaption to changing situations. However, diversity is a strategic advantage only if there is a truly interconnected community, sustained by a web of relationships.

THEORY OF EVERYTHING

The Greeks had a beautiful word, Kosmos, which patterned whole of all existence, including the physical, emotional, mental, and spiritual realms. Ultimate reality was not merely the Cosmos or the physical dimension, but the Kosmos or the physical and emotional and mental and spiritual dimensions altogether.

'An Integral Vision' – or a genuine 'Theory of Everything' attempts to include matter, body, mind, soul, and spirit as they appear in self, culture, and nature. It is a vision that attempts to be comprehensive, balanced and inclusive. A vision that therefore embraces science, art, and morals; that equally includes disciplines from physics to spirituality, biology to aesthetics, sociology to contemplative prayer; that shows up in integral politics, integral medicine, integral business, in integral spirituality. An integral vision invites us to be a little more whole, a little less fragmented, in our work, our lives and our destiny.

Ken Wilber believes that the world in general and our generation in particular, is now on a branch point : we can continue the road of scientific materialism, fragmented pluralism, and deconstructive post-modernism; or we can indeed choose a more integral, more embracing, more inclusive path to travel.

The growth and development of mind as a series of unfolding stages or waves (or memes) can be seen in Box No.2. Ken Wilber mentions that with less than 2 percent of the population at second-tier thinking, the second tier consciousness is relatively rare and it is now the "leading edge" of collective human evolution Ken Wilber (2001).

Box 2 : The Spiral of Growth / Development of Mind

	Stages / Waves of Unfoldment	Colour of Each Stage (Meme)	Brief Description	Approx. Percentage of World Population
Second Tier	9	Coral	Slowly emerging	-
	8	Turquoise	Synergise and macro-mange	0.1
	7	Yellow	Integrate and align systems	1.0
First Tier	6	Green	Explore inner self, equalise others	10
	5	Orange	Analyze & strategise to prosper	30
	4	Blue	Find purpose, bring order, insure future	40
	3	Red	Express impulsively, break-free, be strong	20
	2	Purple	Seek harmony & safety	10
	1	Beige	Sharpen instincts & innate senses	0.1

Notes:

1. Stage 1 to 6 – Subsistence Levels – First Tier Thinking
   Stage 7 to 9 – Being Levels – Second Tier Thinking

2. Up to Stage 6 (Green Meme) each wave goes beyond (transcends) its predecessor and yet it includes or embraces it in its own make-up.

3. With the completion of the Green Meme (Stage 6), human consciousness is poised for a quantum jump into 'second tier thinking'.

4. 'Second tier awareness' thinks in terms of overall spiral of existence, and not merely in terms of only one level. In other words, the second tier thinking is instrumental in moving from relativism to holism, or from pluralism to integration.

CONCLUSIONS

Major problems of our time – the ecological destruction, climate change, poverty, energy, food security, financial security – are all interconnected and interdependent. They cannot be addressed in isolation. They are systemic problems and the interconnected System has to be examined as a whole. This needs active cooperation amongst world nations and poses a major challenge of handling an interdependent world.

If one looks at the efforts / resources needed to address the problem of Climate Change or implement four goals suggested by Sachs (2008) or to execute UN's Sustainable Development Goals (SDGs), one is overawed to see the large number of interconnected / interdependent areas and issues to be tackled, on a long time frame, also requiring the willing cooperation of world nations which is a near impossible task. We have to look for innovative solutions.

From the Systems point of view, the only viable solutions are those that are sustainable. Here ecological cycles of Earth can guide us. To achieve sustainable human communities we can model them after nature's ecosystems which are sustainable communities of plants, animals and microorganisms. Further, a sustainable society should be designed in such a way that its ways of life, business, economy, physical structures and technologies do not interfere with the nature's inherent ability to sustain life.

We need a gradual shift in our values and thinking norms from 'self-assertive' towards 'integrative' tendencies; from an approach basically based on 'market values' to 'social values' to 'spiritual values'; and from an ethos of 'self interest' to 'enlightened self interest' to 'enlightened collective interest'. We have to use the dictates of science and spirituality together. Such an approach can only change the prevailing 'perception of mistrust' and create better bond / faith amongst citizens / nations so very essential for a meaningful co-operation. This will not only

help in developing mutual respect amongst citizens / nations but will also result in a caring and respectful attitude towards nature.

Further, gradual understanding that the core of all religions is the spirituality (spirituality is not religion specific) is likely to create the desired harmony and cooperation amongst world religions and citizens.

Although the major problems are all interconnected / interdependent but the 'ecological destruction' is the most lethal in the long run. Ancient Yoga philosophy recognises Earth, Water, Air, Fire and Akash as the five life sustaining elements. To solve the environmental problems we have to recreate a respectful attitude towards nature. Caring for Mother Earth has not only a 'spiritual' dimension but is essentially needed for our survival.

Role played by engineering will have to change markedly. No longer will it be using the 'Theories of Science' and 'Tools provided by Technology' to provide 'Products / Benefits' to 'Society' alone but will also have to take care of 'Nature'. The burgeoning demands of 'Society/ Nature' will have to be kept in focus coupled with the 'Paucity of Resources' and appropriate 'Technologies' developed and used. A look on the illustrative list of Engineering Branches in Appendix 'A' will amply demonstrate that engineering encompasses all walks of human activity. Further, the approach of Gandhian Engineering (Mashelkar–April 2013) will make it affordable also, in addition to fulfilling the sustainability norms.

Recent studies on 'water' by Masaru Emoto (2004 & 2007) have demonstrated the 'Thinking' and 'Healing' power of Water. Since about 70% of our body is water, our 'thinking and speaking with purity of intent' has not only lot of benefits for us as individuals but the 'resonance' from a number of such persons will favourably affect a large body of individuals, society and nature.

The current outbreak of Coronavirus (Covid-19) has brought to fore the extreme sufferings of animals and also humans in our System. Yuvah Noah Harari, in his recent book 'Sapiens', has also given a detailed account of atrocities and sufferings of domestic animals. Extreme poverty and suffering of large numbers of humans is known to one and all. Current handling of poor migrant labourers and their sufferings in our own country could be cited as another example.

Some people are spiritual by nature and possess inherent compassion. Some more are likely to develop compassion when they see the suffering of animals and humans and we can term it as 'acquired compassion'. Some more citizens who see the linking of their own fate (No one is safe unless all are safe) are likely to develop 'compulsive compassion'. If their numbers become large enough to cause 'resonance' (Masaru Emoto – 2007) the balance will also develop compassion which we can term as 'resonant compassion'. In this way the whole of humanity can develop compassion i.e. become spiritual.

While the Gaia Theory (formulated by NASA Scientist, James Lovelock), which posits the Earth as a self-regulating super organism, is considered in the domain of spirituality. A Modified Gaia Theory is now considered within Ecological Science and has been termed as Global Ecology or Earth Science. This takes into account the interventions between biota, the oceans, the geosphere and the atmosphere. Understanding Earth (Gaia) and caring for it is a matter of great urgency and is essentially needed for our survival.

REFERENCES / SELECTED READINGS

1. Agarwal, Vijai Kumar: "Environment, Energy and Ecology: Mankind's Most Serious Concern Today", RITES Journal, August 2007.

2. Agarwal, Vijai Kumar: "Globalised Interdependent World: Issues and Options" RITES Journal (July 2009).

3. Agarwal, Vijai Kumar : "Planet Earth : Spiritual Development Essential for the Survival of Humanity" – Paper presented at the International Seminar on Science & Spirituality held at Sri Sathya Sai International Centre for Human Values, New Delhi, 31st July – 1st August 2010.

4. Agarwal, Vijai Kumar: "Ecology and Ethics – Valuing the Earth", RITES Journal, July 2016.

5. Anand, Y. P.: "Ethics and Values: Lessons from Gandhian Philosophy for Management and Leadership", RITES Journal, September 2002.

6. Capra, Fritjof : "The Tao of Physics – An Exploration of the Parallels between Modern Physics and Eastern Mysticism" – Fontano/Collins, 1975.

7. Capra, Fritjof : "The Web of Life – A New Synthesis of Mind and Matter" – Flamingo, 1997.

8. Capra, Fritjof and Luisi, Pier Luigi: " The Systems View of Life – A Unifying Vision", Cambridge University Press, 2014.

9. Collier, Paul: "The Plundered Planet", Allen Lane, 2010.

10. Edward De Bono: "Think – Before it's Too Late" – Vermilion, 2009.

11. Goodall, Chris: "Ten Technologies to Save the Planet", Green Profile, UK, 2008.

12. James Lovelock: "The Revenge of Gaia", Basic Books, 2006.

13. Kaw, M. K.: "The Science of Spirituality" – D. K. Publications, 1983.

14. Kaw, M. K.: "Education in Human Values" – RITES Journal, September 2002.

15. Ken Wilber – "A Theory of Everything – An Integral Vision for Business, Politics, Science and Spirituality" – Gateway (2001).

16. Masaru Emoto: "The Hidden Messages in Water" – Atria Books, 2004.

17. Masaru Emoto: "The Healing Power of Water" – Hay House, 2007.

18. Mashelkar, R. A.: "Annals of the INAE – Volume X – Lifetime Contribution Award Lecture titled "Gandhian Engineering: More from Less for More", April 2013.

19. Michio Kaku: "Physics of the Future – How Science will Shape Human Destiny and Our Daily Lives by the Year 2100", Allen Lane, 2011.

20. Piccioni, Robert L.: "Einstein for Everyone" – Jaico, 2010.

21. Sachs, Jeffrey D.: "Common Wealth – Economics for a Crowded Planet", The Penguin Press, New York, 2008.

22. Samar Singh (Ed.): "Ecological Security: The Foundation of Sustainable Development", Shipra and India International Centre, New Delhi, 2007.

23. Sharma, Subhash: "New Mantras in Corporate Corridors – From Ancient Roots to Global Routes" – New Age International Publishers, 2007.

24. UNESCO Report – "Engineering: Issues, Challenges and Opportunities for development", 2010.

25. Yogi Ramacharaka : "Fourteen Lessons on Yogi Philosophy And Oriental Occultism" – Taraporevala (1966) – (These lessons formed the Correspondence Class Course of 1904).

26. Yogi Ramacharaka: "Advanced Course in Yoga Philosophy and Oriental Occultism" – Taraporevala (1974) – (The twelve lessons forming the Book were issued as monthly lessons from October 1904 to September 1905).

27. Yogi Ramacharaka: "Gnani Yoga – The Yoga of Wisdom" – Taraporevala (1974) – (The twelve lessons forming the Book were issued as monthly lessons from October 1906 to September 1907).

28. Yuval Noah Harari: "Sapiens: A Brief History of Humankind", 2015.

Appendix A

Appendix A: Illustrative List of Engineering Branches

Agricultural Engineering

Engineering theory and applications in agriculture in such fields as farm machinery, power, bio-energy, farm structures and natural resource materials processing.

Chemical Engineering

Analysis, synthesis and conversion of raw materials into usable commodities.

Biochemical engineering – biotechnological processes on an industrial scale.

Civil Engineering

Design and construction of physical structures and infrastructure.

Coastal engineering – design and construction of coastline structures

Construction engineering – design, creation and management of constructed structures.

Geo-engineering – proposed Earth climate control to address global warming.

Geotechnical engineering – behaviour of earth materials and geology.

Municipal and public works engineering – for water supply, sanitation, waste management, transportation and communication systems, hydrology.

Ocean engineering – design and construction of offshore structures.

Structural engineering – design of structures to support or resist loads.

Earthquake engineering – behaviour of structures subject to seismic loading.

Transportation engineering – efficient and safe transportation of people and goods.

Traffic engineering – transportation and planning.

Wind engineering – analysis of wind and its effects on the built environment.

Computer and Systems Engineering

Research, design and development of computer, computer systems and devices.

Electrical Engineering and Electronic Engineering

Research, design and development of electrical systems and electronic devices.

Power systems engineering – bringing electricity to people and industry.

Signal processing – statistical analysis and production of signals, e.g. for mobile phones

Environment Engineering

Engineering for environmental protection and enhancement.

Water engineering – planning and development of water resources and hydrology.

Fire Protection Engineering

Protecting people and environments from fire and smoke.

Genetic Engineering

Engineering at the biomolecular level for genetic manipulation.

Industrial Engineering

Analysis, design, development and maintenance of industrial systems and processes

Instrumentation Engineering

Design and development of instruments used to measure and control systems and processes.

Integrated Engineering

Generalist engineering field including civil, mechanical, electrical and chemical engineering.

Maintenance Engineering and Asset Management

Maintenance of equipment, physical assets and infrastructure.

Manufacturing Engineering

Research, design and planning of manufacturing systems and processes.

Component engineering – assuring availability of parts in manufacturing processes.

Materials Engineering

Research, design, development and use of materials such as ceramics and nanoparticles.

Ceramic engineering – theory and processing of oxide and non-oxide ceramics.

Textile engineering – the manufacturing and processing of fabrics.

Mechanical Engineering

Research, design and development of physical or mechanical systems such as engines.

Automotive engineering – design and construction of terrestrial vehicles.

Aerospace engineering – design of aircraft, spacecraft and air vehicles.

Biomechanical engineering – design of systems and devices such as artificial limbs.

Mechatronics

Combination of mechanical, electrical and software engineering for automation systems.

Medical and Biomedical Engineering

Increasing use of engineering and technology in medicine and the biological sciences in such areas as monitoring, artificial limbs, medical robotics.

Military Engineering

Design and development of weapons and defence systems.

Mining Engineering

Exploration, extraction and processing of raw materials from the earth.

Naval Engineering and Architecture

Research, design, construction and repair of marine vessels.

Nanotechnology and Nanoengineering

New branch of engineering on the nanoscale.

Nuclear Engineering

Research, design and development of nuclear processes and technology.

Production Engineering

Research and design of production systems and processes related to manufacturing engineering,

Software Engineering

Research, design and development of computer software systems and programming.

Sustainable Engineering

Developing branch of engineering focusing on sustainability and climate change mitigation.

Test Engineering

Engineering validation and verification of design, production and use of objects under test.

Transport Engineering

Engineering relating to roads, railways, waterways, ports, harbours, airports, gas transmission and distribution, pipelines and so on, and associated works.

Tribology

Study of interacting surfaces in relative motion including friction, lubrication and wear.

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