Think sustainably and act frugally to live more Eco-friendly

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Abstract **- Engineering and technology has played remarkable role in the development of world. But at the same time it has done more damage to the environment. There is a need to think sustainably and act frugally in sustainable development prospective by protecting the natural ecosystem, by stopping the over extraction from oceans and land resources and by making the society as inclusive society. Frugal engineering approach has substantially established by its innovations and products worldwide that it has potential to make the world to live more eco-friendly. This paper tried to explain how frugal engineering innovation and products matches the resource use to guide economic and physical development, within the perspective of long view thoughts about environmental and social wealth to align with sustainability with some of the frugal engineering products. Now it is the responsibility of every one of us to think sustainably and act frugally.**

1.INTRODUCTION

Sustainable development is need of the hour. With the present developmental practices, humans are completely living beyond their ecological means and dealing with the physical earth in unmatched ways [1]. We are actually changing the climate, changing the chemistry of oceans, changing the safety of air, changing the asses and availability of fresh water and changing what species survived on the planet. The climate change has already started in a quite serious way: more frequent droughts, less reliable rainfall, more intense rainfall, more extreme weather events [2]. It is an interesting and unprecedented situation. It will be challenge for coming generations. If, we do not think and act towards the sustainable development today, our future generations will blame us as selfish generations.

Frugal innovation has arisen not from the writings of academics or experts but out the quest of gross root innovators from Bottom of pyramid (BOP) sections to fulfill their basic needs and to taste the benefits of modern prosperity, and also out of the management responses to unique economic, social and competitive challenges faced by firms in developing countries. There are no or simple rules for all to follow on how frugal innovation can materialize into any perceived or promised results. Frugal innovation, as it stands, seems to be complex, multifaceted, and can be interpreted and applied in a number of ways in different firms [3, 4].

2. SUSTAINABLE DEVELOPMENT TO LIVE MORE ECO-FRIENDLY

Sustainable development requires meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life [1]. In the last century Sustainable Development has come out as the appropriate model of resource use to guide economic and physical development, within the perspective of long view thoughts about environmental and social wealth. Sustainable Development requires enhanced management of the capital resources we have in our society and on the earth. The three types of capital are Natural capital, Economic capital, and social capital.

The term Sustainable Development' is coined in a report called "Our common future", published by the world commission on environment and development in 1987. This report is also called as Brundtland report. Sustainable Development is defined as "development that meets the needs of present without compromising the ability of future generations to meet their own needs".

The natural environment is very giving, it provides for us is high-quality raw materials that we can use to fulfill our needs, such as oil or coal or rich deposits of minerals and also fresh air, food and clean water [5]. When humans take only what they need, nature replenishes these resources and makes them sustainable. However, if natural environment is

pushed beyond its limits in the pursuit of more economical and social prosperity, then the nature has hard time to keep in pace. This is a tremendous challenge because population is growing fastest in the poorest countries-many of which are suffering from environmental degradation, food and water shortages, and HIV/AIDS [6].

The world population of 7.2 billion, and over the last half century, world population has more than doubled, from 3 billion in 1960 to 7 billion in 2011[7]. "Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature"[8]. Most people wants to preserve all that is good in the natural environment, so that their children and grand children can take benefits from its rich natural resources. According mahatma Gandhi's quote "The earth provides enough for every man's needs but not every man's greed.", It's looks like a very simple concept, if every human being only consumes what he or she needs for his survival then natural environment can keep giving back, and essentially humans and environment can live in harmony for many generations to come.

However the concept becomes complex, when we consider the fact that life is only not about survival, there are economical and social needs that must be met. And these needs impact the environments ability to sustain itself. This is because the environment provides raw material such as food, clean air and fresh water as well natural recourses like wood and as fossil fuels. The economy, society and the environment must work together and they have done so for centuries, however due to increase in social and economical domains, there are ever increasing demand placed on the environment that is stretching the environmental limits of our planet. The environmental limits can be defined as the point or range of conditions beyond which the benefits derived from a natural resource system are judged unacceptable or insufficient [9].

The rising global population is one increasing demand that is pushing the environment to its limit. The steadily increasing number of people that have on the planet presents the growing demand for goods and services from industry and business. This in turn leads to the depletion of recourses increase in pollution and destroy the natural eco systems, making it more difficult for natural environment to sustain itself. The goal of sustainable development is to ensure that our economy and society work within the limits of natural environment, so that human needs can be met not only in the present but also in the future generations.

Worldwide, Scholars, technologists, policymakers, and communities face the challenge of meeting human development needs while protecting the earth's life support systems. Many people think that science and technology (S&T) can play a bigger role in sustainable development. Many people think that science and technology (S&T) can play a bigger role in sustainable development. The role of frugal engineering is substantial in development of products and processes for sustainable development.

3.FRUGAL ENGINEERING TO LIVE MORE ECO-FRIENDLY

Frugal Engineering is a concept that has emerged in the last few years to describe how the product/process/service development process must be completely rethought and rebuilt in order to design, develop and deliver innovative solutions to customers at the Base-of-the-Pyramid. Instead of attempting to re-engineer products originally designed for wealthier markets, Frugal Engineering targets development of products that begin with the BOP population as the primary target customer. BOP customers have unique needs that must drive the product innovation process.[10].

Carlos Ghosn, the Chief Executive Officer of Nissan and Renault, is credited with the first use of the term Frugal Engineering (11). Frugal engineering is also sometimes referred as frugal innovation. Frugal innovation has arisen not from the writings of academics or experts but out of management responses to unique economic, social and competitive challenges faced by firms in developing countries. "Frugal innovation opens potentially vast new markets, particularly at the bottom of the pyramid, which refers to an estimated four billion people living on less than US$2 a day, mostly in Africa, Asia and Latin America" [12]. Te quest for such new markets has become more intense as the population of the wealthy world, Europe, Japan and North America either stagnates or declines. The ultimate goal of frugal engineering is to provide the essential functions people need at a price they can afford. Critical attention to low cost is always accompanied by a commitment to maximizing customer value.

4.THINK SUSTAINABLY AND ACT FRUGALLY TO LIVE MORE ECO-FRIENDLY

Frugal innovation considers many topics based on the aspects of strong sustainability to live more Eco-friendly. As it is preservation oriented, it strongly and effectively addresses the aspects of sustainable development [13].One definition of frugality is "characterized by or reflecting economy in the use of resources." Frugality is conservation oriented, which is precisely what sustainability addresses: saving something for future generations. Sustainability is a broad concept with many definitions and interpretations. The most common is the Brundtland definition. A conceivably more useful concept is that of a sustainability transition in which poverty, hunger and disease are systematically reduced, while preserving the life support processes of the planet[14]. "India is home to 18 percent of humanity and contributes about 6 percent of global GDP. Due to its demography, it will remain one of the youngest nations in the world for decades to come. The youth of India represents ambition, aspiration, creativity, skills, and also a growing challenge of creating livelihoods" [15]. Frugal innovation necessitates a mentality that considers opportunities rather than limitations, and frugal innovators should concentrate on 'value innovation' rather than scarcity. [16]. Frugal innovations that characterize the art of improvising effective solutions using limited resources have been the characteristic of the emerging economies, to do more for less, to cater to broader markets.

Some of the frugal engineering innovation that matches the resource use to guide economic and physical development, within the perspective of long view thoughts about environmental and social wealth are given bellow and illustrated how they are aligned with the objective of this paper "think sustainably and act frugally to live more Eco-friendly"

4.1 Umshiang Double-Decker Root Bridge"in Meghalaya, India:

The root bridges, some of which are over a hundred feet long, take ten to fifteen years to become fully functional, but they're extraordinarily strong and support the weight of 50 or more people at a time. The bridges are alive and expanding, and some of the ancient root bridges used daily by the inhabitants of the villages around Cherrapunji may be over 500 years old. This is an excellent example of long-term growth. [17].

4.2. Mitticool refrigerator and other products for daily use in kitchen, developed by Mr. Manshuk Lal Prajapati, Gujarat, India:

A traditional clay craftsman, Mansukhbhai Prajapati, has created an entire line of earthen goods for everyday use in the kitchen. Water filters, refrigerators, hot plates, cookers, and other everyday items are among these products. [18].

4.3. Liter of Light Project, Filipino:

Liter of Light Project Illuminates Thousands of Filipino Homes with Recycled Bottles. These makeshift solar lamps basically act as sky lights and reflect and amplify the rays of the sun during daylight hours – effectively performing the work of indoor light bulbs but without using any electricity at all.[19]

4.4. A billboard that can generate water from nothing but air,Lima, Peru:

About 1.2 million residents of Lima lack running water entirely, depending on unregulated private-company water trucks to deliver the goods — companies that charge up to 30 soles (US $10) per cubic meter of water. The billboard is located in Lima, Peru, and it produces around 100 liters of water a day (about 26 gallons) from nothing more than humidity, a basic filtration system and a little gravitational ingenuity [20].

4.5. Solar kits with a Pay-As-You-Go model (PAYG), Africa:

Solar power is a promising alternative, but it often costs too much for African families to buy outright – which is why companies like Azuri Technologies, Angaza Design and M-KOPA have come up with a Pay-As-You-Go model (PAYG) for solar kits. The PAYG model allows customers to pay an up-front fee of around $10 for a solar charger kit that includes a two- to five-watt solar panel and a control unit that powers LED lights and charges devices like mobile phones. Energy is then paid for as and when it's needed, either in advance each week, or when families have enough money to spare. It normally takes about 18 months to pay off one of the solar kit, after which the electricity is free to the new owner [21].

4.6. Telemedicine projects in the developing world:
Information and communication technologies (ICTs) have great potential to address some of the challenges faced by both developed and developing countries in providing accessible, cost-effective, high-quality health care services. Telemedicine makes use of information and communication technologies (ICTs) to overcome geographical barriers and improve access to health care services. This is especially helpful for rural and underserved communities of developing-countries, which usually experience lack of access to health care [22].

4.7. Portable infant warmer, at Stanford University, California, USA:
A portable warmer developed by two Indian students and their classmates at Stanford University is helping premature babies survive This Incubator is small and light, making it easy and inexpensive to transport to rural villages. The entire sleeping bag can be sanitized in boiling water. It's much easier to use than conventional incubators, and it fits in nicely with the recommended practise of "Kangaroo Care," which involves a mother holding her baby against her skin. T he cost of Embrace incubator is just $25, compared to $20,000 for a conventional incubator.[24].
These baby warmers have their origins in a classroom at Stanford University, California. With the help of venture capitalists , four alumni Jane Chen, Rahul Panicker, Naganand Murty and Linus Liang have turned their classroom concept into a commercial product, sold under the brand name Embrace Nest. The Economist has named the four colleagues winners of its award for social and economic innovation. Previous winners include Sam Pitroda and N.R. Narayana Murthy[25]. Embrace has already negotiated partnerships with multinational pharmaceutical and medical device companies such as GE Healthcare. Finally, Embrace is putting its infant warmer to the test at Stanford University's Lucile Packard Children's Hospital: the entrepreneurs think there is a large market for Embrace's product in the USA, where infant mortality rates are among the highest in the developed world.

4.8 Jaipur Foot, Rajastan,India:
Jaipur Foot's $45 ultramodern prosthetic is simply unmatched when compared to a similar $12,000 limb produced in the United States. The Jaipur Knee is both flexible and robust, because it is made of self-lubricating, oil-filled nylon. Comparable devices produced in other countries generally include a titanium replacement which can cost $10,000 or more. What sets Jaipur Foot's products apart is their lightness and mobility and those that wear the limbs can even run, climb trees and ride bicycles. The new knee replacement was developed in cooperation with Stanford University and costs a mere $20. For this great achievement, the Times Magazine named it one of the 50 best inventions in the world. "Too often, the NGO sector relies solely on sentiment," says Devendra Raj Mehta, team leader of the Jaipur Foot team. We need to unite emotion and science," they say, and they are certainly successful in doing so. [26].

4.9. GE Healthcare's MAC 400 Electrocardiogram (ECG) machine, India:
GE Healthcare's MAC line of electrocardiogram (ECG) systems is a success story of innovation in India, for India and the world. The MAC 400, an ECG machine designed to extend the capability of a traditional ECG to a largely rural and poor population. While embodying the engineering excellence that GE is known for, the MAC 400 is designed for developing market conditions. It is highly portable and can be easily carried to a patient's home, it has an easy two-button operation that makes training faster, and it can operate on battery. Above all, the MAC 400 costs around $800, compared with other hospital-class units from GE Healthcare that range from $2,000 to $10, 000 [27].

5. CONCLUSION

Frugal engineering products have proven their affectivity with less cost and more value with better quality. Frugal engineering approaches have substantially established by its innovations and products world wide that it has potential to make the world sustainable to live more Eco-friendly. The examples given in this paper matches the resource use to guide economic and physical development, within the perspective of long view thoughts about environmental and social wealth to align with sustainability. Now it is the responsibility of every one of us to think sustainably and act frugally.

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