Prof. Dr. Prabhu Kandachar

Beyond Design
Inclusive innovations and well-being

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Faculteit
Industrieel Ontwerpen

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Challenge the future

Beyond Design

Inclusive innovations and well-being

Uittreerede

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door

Prof. Dr. Prabhu Kandachar

aan wie met ingang van 1 januari 2012 eervol ontslag is verleend.

Mijnheer de Rector Magnificus,
Leden van het College van Bestuur,
Collegae Hoogleraren en andere leden van de universitaire gemeenschap.
Zeer gewaardeerde toehoorders.
Dames en heren.

SUMMARY

During the last 50 years, the notion of sustainable development has developed, matured and is now in the mainstream. In 1992 UN Earth Summit placed worldwide conventions on climate change and biodiversity, as well as commitments on poverty eradication and social justice. Earlier, in April 1987, the Brundtland Commission, had published its ground-breaking report, "Our Common Future" - which brought the concept of sustainable development into the public discourse. Since then, however, global emissions have risen by 48%, agreed target in reduction of biodiversity loss by 2010 has not been met, the population has increased by 1.6 billion people, and the global use of natural resources has risen by over 40%. Despite a reduction in poverty, over a billion people still live in poverty and one in six are malnourished. While world's governments have again promised "a pathway for a sustainable century" in the June 2012 Rio+20 Earth Summit, a part of the world is getting more affluent leading to an explosion of consumption and a drastic increase in eco footprint, while the resource strain is in the horizon. The outcome of efforts towards sustainability *(People, Planet and Profit)* so far has been disappointing. Where is the promised *Common Future*? The current financial crises of the past five years in the West have in the meanwhile rekindled the interest to inquire whether economic growth can be automatically regarded as a self-evident good, with debates and measures focussed solely on the best means to achieve it. Business as usual focussing on economic growth is not leading to desired outcomes. A transformative change at the systemic level is urgently needed, at scale, involving multiple stakeholders: consumers, businesses, government, etc. Redefining progress, rethinking of economic growth and redirecting our attention towards increasing quality of life of people need to be on the agenda. To continue to provide a high quality of life for a predicted nine billion people on our planet, without exhausting the Earth's resources or irreparably damaging its natural systems, radical solutions and responsible innovations are needed. At the same time, the paths to arrive at are not straightforward. They are complex and wicked and the remedies are not clear. Sustainability at the global level continues to be the urgent need of the day, while a radical shift in the focus is also essential. Focus on social and ecological sustainability, especially well-being of all the people on this planet should be the priority, paving way to redefine progress. Innovations need be

inclusive, not excluding anyone. Design being one of the key disciplines to address such issues, the current world context provides excellent opportunities for designs and innovations. Developing countries and emerging markets are fertile grounds for innovations due to enormous constraints, and provide extensive opportunities to learn from. Design as a discipline is itself maturing and developing beyond the classical notion of designing artefacts, the challenge lies in addressing much larger issues such as social innovations. Designers ought to be aiming at *well-being* of *people and planet*.

1. INTRODUCTION

This document consists of 4 core chapters. Chapter 2 describes the challenges our world is facing, now and in the coming years. Chapter 3 is about the opportunity such a challenge offers for everyone. Chapter 4 describes the developments in the fields of designs and innovation and indicates how these developments provide unprecedented opportunities for designers and innovators to address these world challenges. Chapter 5 is about what needs to be done and how. This document ends with conclusions and references.

2. CONTEXTUAL CHALLENGE – WORLD CHALLENGES

2.1 The notion of Sustainability

Way back in 1962 Rachel Carson wrote a book: *Silent Spring* (Carson 2002) raising widespread public concerns with the environmental pollution due to pesticides. She was perhaps the first one in modern times to attract attention to environmental issues. The Royal Society for the Protection of Birds had reported that more than 6,000 birds were dead in UK. USA was noticing a drastic reduction in numbers of birds, including America's national bird, the bald eagle. Bird eggs were often not being laid while many laid ones were not hatching. The birds of the western world were facing danger. Many scientists were puzzled. Why is this happening– poison, viruses or other sources? The biologist Rachel Carson came up with her answer: synthetic insecticides such as DDT were poisoning food chains, from insects upwards. Her conclusions about DDT have often been contested as DDT kills insects and therefore saves people. The application of DDT has been controversial. It was widely applied in the United States and Europe to end malaria by killing the mosquitoes that carry the disease. Rachel Carson's book ultimately led to banning of DDT in the United States and many other countries. This ban has led to two opposing camps: pro-DDT because it does not harm humans and anti-DDT because it damages the environment. The controversy is continuing even today (DDT Controversy, 2012).

Another seminal work, the Club of Rome's: *The Limits to Growth* (Meadows et al, 1972), which appeared in 1972, received international attention. It showed by mathematical modelling the consequences of unchecked economic and exponential population growth with finite resource supplies. At some point in time, humanity's ever-increasing resource consumption will meet the very real limits of a planet with finite natural resources, this book warned (Heinberg 2010). Meadows even indicated that technological measures do not resolve the world's central problems and instead tended to intensify them (Howaldt and Schwarz 2010).The basic thinking behind this book is very much relevant in current times. Our world has gone through in recent times unprecedented economic growth, making growth even the sole parameter of national economic performance and has led to rapid shifts in the relative positions of different countries and regions. The benefits of associated with economic growth are evident: (a) higher Incomes, enabling consumers to purchase more goods and services (b) lower unemployment (c) lower Government borrowing , etc. Such a world context would obviously not welcome a doomsday scenario as thought by *The Limits to Growth*. In fact some economists, scientists and politicians criticized this report, refuting the methodology, questioning the foundation of the data, the conclusions, the rhetoric and the people behind the project. However, after about 40 years there is an increasing realization that the reality seems to be following closely the predictions that the scenarios of *The Limits to Growth* had generated (Bardi 2011).

In the mid 70's, Fred Hirsch explored, the other limits. In his book: *Social Limits to Growth* (Hirsch, 1977), he examined why the promise of economic growth is reaching an impasse. He argued that the causes of this are essentially social rather than physical. Affluence brings its own problems. As societies become richer, an increasing proportion of the extra goods and services created are not available to everybody. Material affluence does not make for a better society, argued Hirsch. In fact way back in 350 BC, Aristotle made a statement: *Wealth is only a means to an end*, not an end in itself (Aristotle, in Politics 1.8-9). The current financial crises of the past five years in the West have rekindled the interest to inquire whether economic growth can be automatically regarded as a self-evident good, with debates and measures focussed solely on the best means to achieve it. For instance, in a recent book, *How Much is Enough?* (Skidelsky & Skidelsky, 2012) an economist and a philosopher have reminded that society is much more than economic growth alone.

Perhaps the most cited definition of Sustainability is from the report of UN-sponsored World Commission on Environment and Development report (Brundtland Commission, WCED 1987), *Our Common Future.* This report

defines sustainable development as the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". From the same definition the least cited part - especially the first bullet - is perhaps:

- The concept of "needs," in particular the essential needs of the world's poor, to which overriding priority should be given; and
- The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

Of the three pillars of Sustainability - Social, Environmental and Economic, environmental pillar of sustainable development has received considerable attention, leading to a common, but mistaken, perception of 'environmental sustainability' as synonymous with 'sustainable development'(Dalal-Clayton and Bass, 2002) . Attention to social sustainability (and socially responsible design) has hardly taken place, although the Brundtland Commission emphasized the strong linkage between poverty alleviation, environmental improvement, and social equitability through sustainable economic growth.

Such global visions stimulated a discussion regarding the necessity of an alternate life and economy, particularly in affluent industrial economies. More than 178 Governments and many non-governmental organizations (NGO's) from all over the world took part in this discussion [Earth Summit] in Rio de Janeiro Brazil, 3 to 14 June 1992, at UN Conference on Environment and Development (UNCED) and adopted a document entitled: *Agenda 21*.

Departing from a purely technology-driven growth, *Agenda 21* formulated objectives for an alternative form of development that was sustainable from three perspectives: social, ecological and economic. *Agenda 21* was also a plan of action to be executed globally, nationally and locally by organizations of the United Nations System, Governments, and major groups in every area of human impacts on the environment. The UN even placed landmark conventions on climate change and biodiversity, as well as commitments on poverty eradication and social justice.

Poverty eradication is one of the major issues of sustainable development, triggered by the disparity, between the poor and the rich part of the world, which continues to be very large.

Fig 1. Millennium Development Goals [Source: healthpolicyinitiative.com]

About two thirds of the world's population of 7 billion people spend their lives searching for food and shelter, fighting for physical survival, and fearing for the future. These are the individuals who earn less than few dollars per day: the people living at the economic Base of the Pyramid (BoP). Poverty continues to be a tough nut to crack.

Motivated to take action, at the Millennium Summit in September 2000 the largest gathering of world leaders in history adopted the UN Millennium Declaration, committing their nations to a new global partnership to reduce extreme poverty and set out eight concrete measurable targets with a deadline of 2015, which have become known as the Millennium Development Goals (Fig 1).

The Millennium Development Goals (MDGs) are the world's time-bound and quantified targets for addressing extreme poverty in its many dimensions - income poverty, hunger, disease, lack of adequate shelter, and exclusion - while promoting gender equality, education, and environmental sustainability. Also included are basic human rights - the right of each person on the planet to health, shelter, and security and there are specific aims at combating child mortality, AIDS, Malaria and other diseases.

The MDGs are an agreed set of goals that can only be achieved if all actors work together and do their part. Poor countries pledged to govern better, and invest in their people through health care and education. Rich countries pledged to support them, through aid, debt relief, and fairer trade. United Nations Secretary General Ban Ki-moon declared: "Looking ahead to 2015 and beyond, there is

no question that we can achieve the overarching goal: we can put an end to poverty. In almost all instances, experience has demonstrated the validity of earlier agreements on the way forward; in other words, we know what to do. But it requires an unswerving, collective, long-term effort."

2.2 Looking back: from Rio (1992) to Rio+20 (2012)

20 years after the Earth Summit in 1992, it is time to look back. The UN self did it. The United Nations Conference on Sustainable Development (also called Rio+20 or Rio Earth Summit 2012) was held in Rio de Janeiro, Brazil on June 20-22, 2012. This summit attracted 172 governments, with 108 sending their heads of state or government. Some 2,400 representatives of non-governmental organizations (NGOs) also attended, with 17,000 people at the parallel NGO "Global Forum" (a.k.a. Forum Global), who had Consultative Status.

Global Sustainability - Objectives

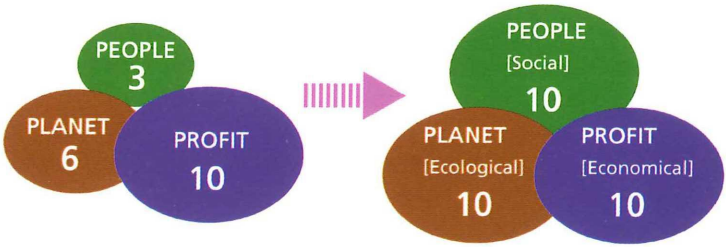


Fig 2. Need for a balanced attention to all the elements of sustainability. The numbers are author's own scorecards.

The summit emphasized a holistic, equitable and far-sighted approach, with a concept of green economy focussing on primarily the intersection between environment and economy. The main question: can the world prosperity continue to grow and at the same tome earth can still be still spared? Is there a balanced attention? (Fig 2).

The outcome of this conference was a document, entitled "*The Future We Want*," which world leaders approved. The response on this summit and the document has been mixed, with more disappointments than jubilations. There

was a general feeling that Rio+20 did not produce the response we need to safeguard people and the planet. Gro Harlem Brundtland, former Prime Minister of Norway and Chair of the UN commission that brought the concept of sustainable development to global attention 25 years ago, said: *"The Rio+20 declaration does not do enough to set humanity on a sustainable path, decades after it was agreed that this is essential for both people and the planet"*. Mary Robinson, former President of Ireland and former UN High Commissioner for Human Rights, said *"This is a 'once in a generation' moment when the world needs vision, commitment and above all, leadership. Sadly, the current document is a failure of leadership."*

In concrete terms, since the 1992 Earth Summit, global emissions have risen by 48%, 300m hectares of forest have been cleared and the population has increased by 1.6 billion people, agreed target in reduction of biodiversity loss by 2010 was not met, and the global use of natural resources rose by over 40 per cent (Watts, J and Ford, L 2012). Of the three pillars of Sustainability - Social, Environmental and Economic, social sustainability (and socially responsible design) is least addressed (Fig 2), although the Brundtland Commission emphasized the strong linkage between poverty alleviation, environmental improvement, and social equitability through sustainable economic growth.

While world's governments have again promised "a pathway for a sustainable century" in the June 2012 Rio+20 Earth Summit, a large part of the world is getting more affluent leading to an explosion of consumption and a drastic increase in eco footprint, while the resource strain is in the horizon. Where is the promised *Common Future*? Recent research indicates that even in affluent countries, greater income or consumption is not contributing to objective indicators of population health or to subjective wellbeing.

Currently our world is facing many challenges to strive for global sustainability. Many parts of the world are going through a period of rapid economic growth and entering a transitional phase between developing and developed status, although the gap between wealthy and poor has kept widening (Kandachar and Halme, 2008). This growth would also mean, if the traditional developmental models continue to be followed, an increasing, and increasingly affluent global population results in an increased consumption. McKinsey estimates that by 2025, the annual consumption of all products together will reach $ 30 trillion in emerging markets, almost same as the richer part of the world (McKinsey, 2012). There is a difference however. Today, inhabitants of industrialised countries use 4 to 8 times more resources than people living in agricultural societies and 15 to 30 times more resources than people in hunter-gatherer societies (SERI,

2009). This would result in an enormous increase in environmental impacts in the nearby future as well as a rapid depletion of material resources.

The resources being finite on this planet, the need to address the link between population growth, economic growth and affluence, resource use and the enlarging ecological footprint in our societies, is becoming urgent. The current model of economic growth depends on high and growing levels of continuous consumption. Urgent and fundamental questioning of the current models of economic development followed by adequate policy measures are needed both in developed and in developing countries.

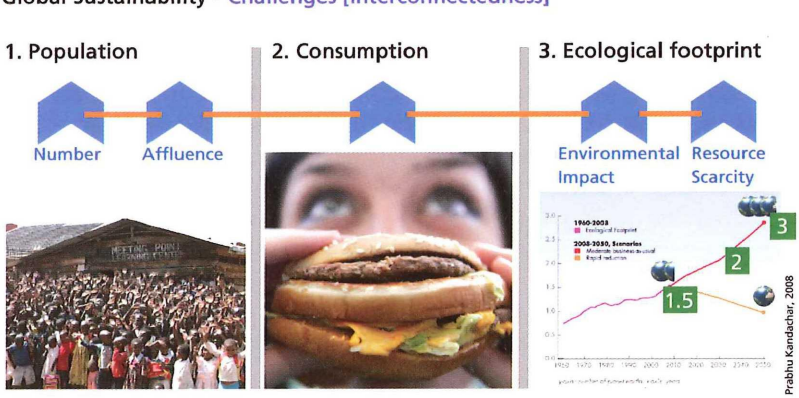


Fig 3. Challenges to achieve global sustainability. Population growth, consumption and ecological footprint - are interdependent and are interconnected.

With the world population expecting to reach 9 billion (with some predictions putting the population in 2050 as high as 11 billion) from the current 7 billion, consequences of current lifestyle can be extrapolated. It is becoming clear that the world challenges are three-fold: population growth, consumption and ecological footprint, and they are interdependent and are interconnected (Fig 3).

2.3 Population

Estimates and predictions of world population vary. The United States Census Bureau (USCB) has estimated that the world population exceeded 7 billion on March 12, 2012, while according to the United Nations Population Fund, this happened earlier, and on October 31, 2011. In the year 2050, the world population is expected to be anywhere between 8 and 11 billion people, see Fig 4.

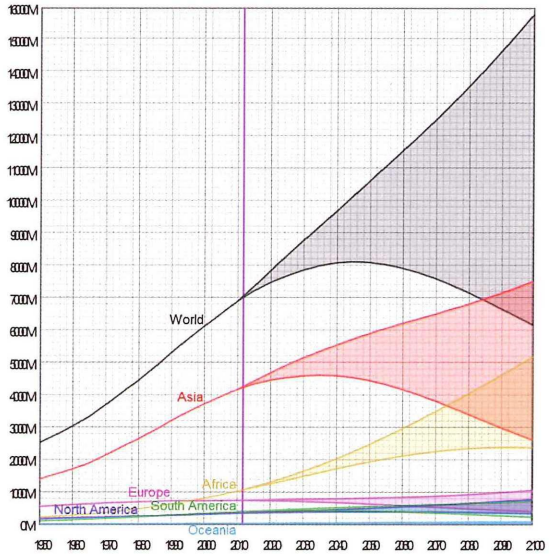


Fig. 4. Estimated total world population, spread over different world regions, till 2100. The shaded regions correspond to the range of projections, after 2010, by the United Nations Department of Economic and Social Affairs.

Asia and Oceania region has the largest population, Africa is the fastest-growing and most youthful region, and Europe and North America have the slowest growing populations and the highest proportion of elderly.

2.4 Poverty, affluence and inequality

We all have an idea what poverty means. Yet there are many ways to approach in understanding it, which may to some extent influence how one makes sense about the most relevant ways of poverty eradication. We shall first take look at some poverty statistics, and after that highlight poverty from a different perspective: what it means to be a poor individual.

2.4.1. Poverty in Numbers

A global examination of the performance of the developing countries during the past 60 years provides a reasonably optimistic picture, with many of them bravely trying to extricate themselves from the grips of poverty, with improvement in health conditions and food production, as well as becoming world players in manufacturing production and exports. (Table 1).

Metrics	1950-60	1981	2000-05
GDP per capita (1990 PPP$), 1950, 2003	854.9		3645.6
Food production per capita (1980 = 100)	88.0		147.0
Manufactured exports as % of commodity exports	6.0		53.0
Life expectancy at birth, years	40.8		65.4
Child mortality by age 1 (per 1000 births)	180.0		65.0
Child mortality by age 5 (per 1000 births)	281.0		95.0
Gross Enrolment Rate primary education *	75.8		103.9
Gross Enrolment Rate secondary education *	15.7		58.3
Gross Enrolment Rate tertiary education *	2.1		13.0
Net Enrolment Rate primary education **	48.1		82.0
Net Enrolment Rate secondary education **	35.0		45.0
Percentage of population, with less than 1 dollar a day		40.4	21.1
Number of persons with less than 1 dollar a day (millions)		1481.8	1092.7
Percentage of population, with less than 2 dollars a day		66.8	52.9
Number of persons with less than 2 dollars a day (millions)		2449.8	2735.5
NOTE * The number of students enrolled per educational level regardless of their age, as percentage of the number of persons in the relevant age bracket. The age brackets for educational levels differ per country. Percentages over 100 per cent indicate that persons outside the relevant age bracket can also be enrolled. ** Percentage of persons enrolled			

Table 1: Changes in the Developing World 1950-2005 (Szirmai 2008)

There are also reasons for concern, see table 2, which compares the rich part of the world with the poor. At a global level there is an increasing inequality of per capita incomes.

Indicator	Rich Nations	Poor Nations
Population (billions)	1.0	2.3
GDP (Gross Domestic Product) per capita	$30,000	$2,100
Human development index	High	Low
Annual population growth rate (percent) : 1966–2004	0.8	2.4
Annual growth rate of GDP per capita (percent): 1966–2004	2.4	1.8
Total fertility rate	1.8	3.7
Adult literacy (percent)	>95	58

Female literacy (percent)	>95	48
Index of government corruption	Low	High
Life expectancy at birth (years)	78	58
Under-5 mortality (per 1,000)	7	120
Rural population (percent of total population)	20	70
Agriculture's share in GDP (percent)	5	25

Table 2: A Rough Comparison of Rich and Poor Nations
Source: World Development Indicators (World Bank 2005). After Dasguptha.

A macro view of the whole world is shown in Fig 5 which briefly describes the differences between the affluent part (top of the pyramid) and the poorer part of the world.

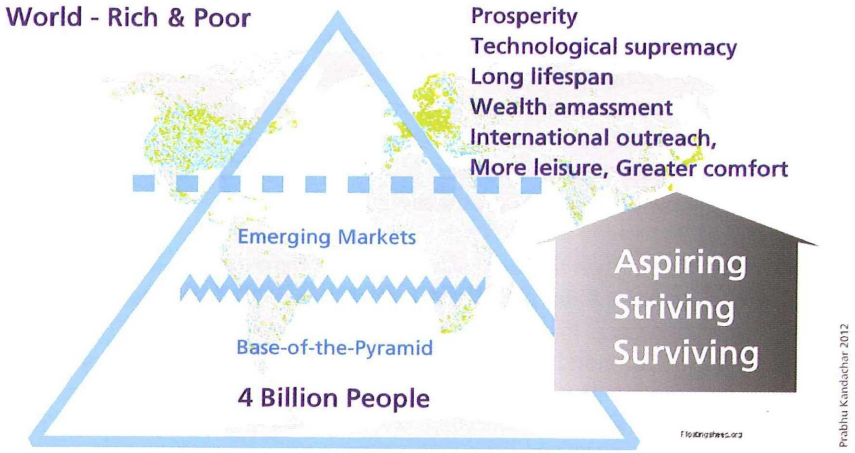


Fig 5. The affluent part (top of the pyramid) and the poorer part of the world.

A closer look at all developing countries shows a great disparity amongst the developing regions and countries. A study of World Resources Institute and International Finance Corporation shows that the 4 billion people with income less than $3,000 per year in local purchasing power (which corresponds to less than $2.11 per day in China and $1.56 in India), is the largest in Asia (2.86 billion people, 83% of population). Africa has 486 million people at the Base-of-the Pyramid (BoP, 95% of the region's population), South America 360 million (70 % of population), and Eastern Europe has 254 million at BoP (64% of population) (Hammond et al. 2007).

Economic growth in countries like China, India, and Brazil is improving the economic lot of many in these countries. The number of poor people worldwide declined by 120 million in the 1990s and by nearly 300 million in the first half of the 2000s, according to OECD statistics According to a World Bank analysis, the share of China's population earning less than $1.25 a day (in 2005 prices) dropped from 84 % in 1981 to 16%in 2005. In Brazil the figures were 17% and 8%, and in India 60% to 42%.

The OECD notes, nevertheless: "The contribution of growth to poverty reduction varies tremendously from country to country, largely due to distributional differences within them. In many cases, growth has been accompanied by increased inequality." (Renner 2012).

Halfway through the Millennium Development Goals (MDG) set in 2000, the progress in some of the goals in certain regions has been poor. The Goals set out time-bound and measurable targets for reducing poverty, increasing school attendance, promoting gender equality, averting maternal and child deaths, improving health care, combating major diseases and achieving environmental sustainability, show mixed results. Sub-Saharan Africa, Eastern Asia and Oceania have been low performers. Healthcare (goals 4, 5 and 6) and Environmental Sustainability show poor results practically in all regions.

Behind these macro-level figures is the fact that most people at the base of the economic pyramid have significant unmet needs, they are dependent on informal or subsistence livelihoods and they are impacted by the so-called poverty penalty (Hammond et al. 2007). Actually, a key issue to understanding poverty is informality. This means that most individuals at the BoP have no access to *formal* water and sanitation services, electricity, basic health care or financial services. Due to the informality traps, the poor also end up paying higher prices for their products and services than wealthier consumers. For example, the lack of access to piped water means that the poor often have to buy water from mobile vendors. According to a study covering 47 studies, mobile water distributors charge prices up to 10 times the price of piped water (Hammond et al. 2007). Inability to access a bank account or other formal financial services means exorbitant rates of loans (by informal sector money lenders) or of remittances from relatives abroad. Many live in informal settlements, with no formal title to their dwelling. Informality also means that many BoP individuals have no choice but to sell their labour or produce (e.g. crops or handicraft) to local employers or middlemen who often exploit them because informality leaves them without protection.

2.4.2 What it means to be Poor

An extensive study as part of a global research effort in the late 1990's entitled *Consultations with the Poor,* led by Deepa Narayan the World Bank's Poverty Group, involving more than sixty thousand poor men and women from over fifty countries, has analysed poor people's experiences with poverty and is struck by the commonality of the human experience of poverty across countries. From Georgia to Brazil, from Nigeria to Philippines, similar underlying themes have emerged: hunger, deprivation, powerlessness, violation of dignity, social isolation, resilience, resourcefulness, solidarity, state corruption, rudeness of service providers, and gender inequity, with a varying degree of manifestation. Three major conclusions of the study, called *Voices of the Poor,* emerged (Narayan 2000). See also Boguslaw and Boyle, 2008:

1. For the poor, the good life or well-being is multidimensional with both material and psychological dimensions. Well-being is peace of mind; it is good health; it is belonging to a community; it is safety; it is freedom of choice and action; it is a dependable livelihood and a steady source of income; it is food. Poverty is therefore much more than income alone.
2. By and large poor people feel they have not been able to take advantage of new economic opportunities because of lack of connections and lack of information, skills and credit. The poor need opportunities and institutional structures that increase social, economic, and personal security.
3. The poor survive by means of informal networks and have mixed assessments of the governments as well as the NGOs intended to help them. The report suggests that, poor people seek institutions that are "effective".

Building upon such evidence and translating into BoP strategy, Boguslaw and Boyle note that although income is important, as are material goods and opportunities for work, they are the proverbial "band-aids" that do not cure the deeper problem at its source. An agenda to reduce poverty requires an understanding that the poor are more than simply income poor, they are asset poor and therefore require investments beyond the consumption/production cycle if they are to move out of poverty.

Vandana Shiva, a physicist and environmental activist and a prolific author, questions the underlying thinking behind the concept of "Development". She makes a distinction between culturally perceived poverty and real material poverty. For instance sustenance economies, which satisfy basic needs through self-provisioning, are not poor in the sense of being deprived. The ideology of

development declares them so because they do not participate overwhelmingly in the market economy, and do not consume commodities produced for and distributed through the market even though they might be satisfying those needs through self-provisioning mechanisms (Shiva 2005).

Sustenance, as culturally perceived poverty, does not necessarily imply a low physical quality of life. On the contrary, because sustenance economies contribute to the growth of nature's economy and the social economy, they ensure a high quality of life measure in terms of right to food and water, sustainability of livelihoods, and robust social and cultural identity and meaning.

Her statements resemble to those of *Voices of the Poor* (Narayan 2000): "People do not die for lack of incomes. They die for lack of access to resources". The indigenous people in the Amazon, the mountain communities in the Himalaya, peasants whose land has not been appropriated and whose water and biodiversity has not been destroyed by debt creating industrial agriculture are ecologically rich, even though they do not earn a dollar a day, notes Vandana Shiva. She adds further, that on the other hand, even at five dollars a day, people are poor if they have to satisfy their basic needs at high prices.

2.5 Consumption

During the 20th century, global economic output grew more than 20-fold, while materials extraction – needed for production of goods for consumption - grew to almost 60 billion tonnes per year. This level of materials consumed by the human population is of the same scale as major global material flows in ecosystems, such as the amount of biomass produced annually by green plants While consumption and production appear to have stabilized in developed countries, in emerging economies such as Brazil, China, India, and Mexico, resource use per-person and associated environmental impacts have increased since 2000. The less developed countries are just beginning the transition towards higher consumption levels. If the global economic development continues in a business as-usual mode and population projections persist through 2050, another sharp rise in the level of global resource use is likely (Levy and Morel 2012).

Many world regions (also termed emerging economies) are showing rapid economic growth, entering a transitional phase between developing and developed status. In the transitional economies such as India and China vast number of people are moving out of poverty into an income range of $2-13 a day per person. In India, numbers rose between 1990 and 2005 from 147 million to 264 million. Within the context of developing economies, a substantial

part of these people can be considered middle class. The consumption patterns of these people and the related environmental pressures are growing fast due to the combined effect of increase in disposable income and accessibility of everyday life goods and services. The need for more sustainable products and services becomes manifest when looking at the basic characteristics of such global consumption patterns.

It is useful to conceptualize the middle class not in absolute monetary standards, but on the basis of context-dependent, economic and sociological characteristics. One characteristic is the possession of a significant part of income (e.g. 30%) for discretionary spending. Another characteristic of middle classes is a proactive attitude towards investing in long-term prosperity. Such a long-term cultural outlook fits in a broader set of positive attitudes towards education, status, and long-term improvement of living conditions.

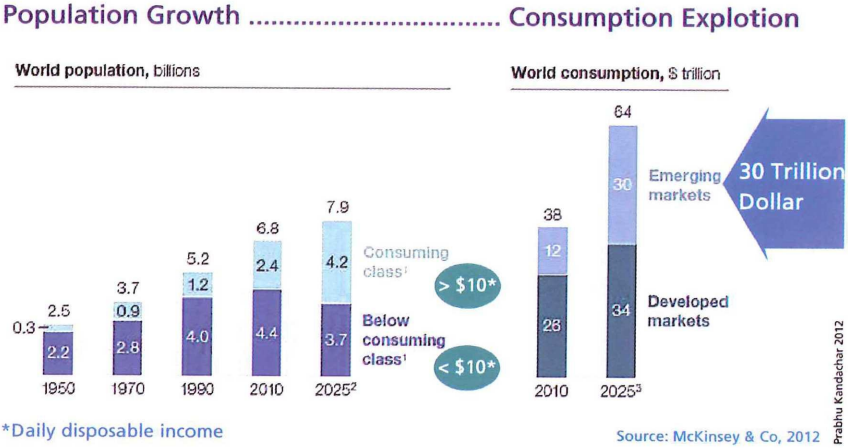


Fig. 6 Estimate of increase in global consumption (Source: McKinsey & Co)

World Bank economist Branko Milanovic and Hebrew University professor Shlomo Yitzhaki, have proposed a measure of middle class in 2002, by counting people with daily incomes between about $10 and $50 a day, as middle class (after adjusting for purchasing-power parity). According to this measure, there are an estimated 369 million people in the developing G-20 economies -- Argentina, Brazil, China, India, Indonesia, Mexico, Russia, South Africa, and Turkey -- who qualify as "middle class". This class in the developing world is increasing in size very fast (Fig. 6). While about 85% of world population resides in developing countries, they accounted for only 18% of global consumer spending just a

decade ago; today, this figure is nearly 30%. Consumer spending in developing countries has been increasing at about three times as fast as in rich countries (Ali and Uri, 2012).

The middle classes have the potential of putting an enormous additional pressure on global sustainability because of the economic volumes they represent and the rapid growth of consumer markets that might be triggered due to their consumption behaviour (Jackson, 2009). However, the members of the middle classes also appear to show a greater commitment to environmental and climate issues when compared to the lower income categories (PEW 2009). Because of their discretionary power, their long-term social outlook, their emerging commitments to sustainability and their potential for embracing more sustainable life-styles, the middle classes in emerging economies are of key importance when it comes to designing more sustainable products and services.

2.6 Ecological Footprint

The consequences of rapidly increasing human population on the size of the global ecological footprint are exceptionally large. The ecological footprint is a measure of human demand on the Earth's ecosystems. Global Footprint Network (Ewing et al 2010) has devised a standardized measure of demand for natural capital that may be contrasted with the planet's ecological capacity to regenerate. They note that human demand on ecosystem services continues to increase, and there are indications that this demand is outpacing the regenerative and absorptive capacity of the biosphere.

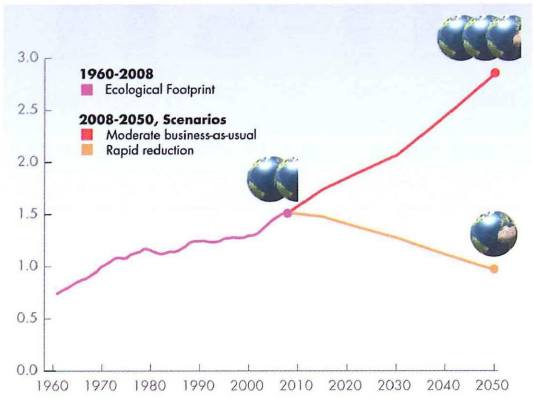


Fig.7. Number of Planet Scenarios 2008 (Source: www.footprintnetwork.org)

This global assessment estimates how many Earths are needed to meet the resource requirements of humanity for each year. Resource demand for the world as a whole is the product of population times per capita consumption, and reflects both the level of consumption and the efficiency with which resources are turned into consumption products. Resource supply (bio-capacity), however varies each year with ecosystem management, agricultural practices ecosystem degradation, and weather. An analysis based on data from 2008 (Fig 7) suggests that the world is currently using the equivalent of 1.5 planets to provide the resources needed and absorb the waste being produced. In other words, it takes the Earth one year and six months to regenerate what we use in a year. Further analysis based on moderate UN scenarios suggest that if current population and consumption trends continue, an equivalent of two Earths is needed to support the world population by the 2030s, and about 3 Earths in 2050.

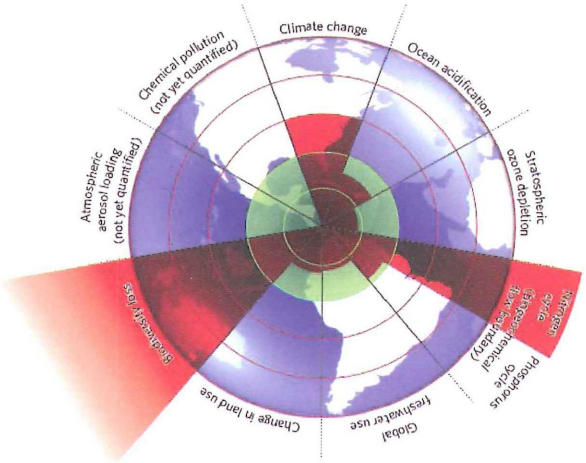


Fig 8 Planetary boundaries (Source: Rockström, et al 2009, Nature, Vol 461,24 September 2009). The inner green shading represents the proposed safe operating space for nine planetary systems. The red wedges represent an estimate of the current position for each variable. The boundaries in three systems (rate of biodiversity loss, climate change and human interference with the nitrogen cycle), have already been exceeded.

This result is due to humanity's actions resulting in nine critical environmental thresholds have been crossed or are on track to be crossed (Fig. 8), threatening to destabilize ecological functions on which economies, societies, and indeed all life on Earth critically depend, a recent study on "planetary boundaries" shows (Rockström, et al 2009). Never before has this happened on a planetary scale.

Increasing demand for resources are due to (a) growing population in developing countries (b) more affluent consumers, primarily in OECD countries, but increasingly also in emerging economies such as China, Brazil and India. Some examples of increased demand for key resources between now and 2030 include (Evans, 2011):

- Demand for food will rise by 50% by 2030, and for meat by 85% by the same year. Global food consumption outstripped production in seven of the eight years between 2000 and 2008.The food outlook is further complicated by potential constraints on the availability of land.
- Oil demand will rise from 85 million barrels a day now to 105 mb/d in 2030, with all of the growth in demand from non-OECD sources
- Global water use will rise by 32% between 2000 and 2025; it has been growing nearly twice as fast as population for over a century, and will continue to do so. Current rates of water extraction are already unsustainable in many parts of the world. 1.2 billion people live in water basins in which the physical scarcity of water is absolute; by 2025, the figure is projected to rise 50% to 1.8 billion, with up to two thirds of the world's population living in water-stressed conditions (mainly in non-OECD countries).

In the past century the increase in demand for metal and mineral resources has been met by an increased mining and extraction processes, exploration of new locations and technological innovations. It is unlikely these would continue to meet the demands in the 21st century as well (Wouters and Bol, 2009).

2.7 Sustainable Development is More than Economic Development

Sustainable development is often interpreted as sustainable economic growth, which is an oxymoron. No form of economic growth can be continued indefinitely. Furthermore, practically all economic growth (profit) contributes towards environmentally degradation. Are there ways to look at progress other than economic growth (for instance Gross Domestic Product, GDP) alone?

In February 2008, the President of the French Republic, Nicholas Sarkozy, unsatisfied with the present state of statistical information about the economy and the society, asked, Joseph Stiglitz (President of the Commission), Amartya Sen (Advisor) and Jean Paul Fitoussi (Coordinator) to create a Commission, subsequently called "The Commission on the Measurement of Economic Performance and Social Progress" (CMEPSP). The Commission's aim has been to identify the limits of GDP as an indicator of economic performance and social

progress. The commission presented her report on 14 September 2009 (Stiglitz et.al,2009).

This assessment of how and whether our economy is serving the needs of our society showed that GDP overlooks economic inequality (with the result that most people can be worse off even though average income is increasing); and does not factor environmental impacts into economic decisions. One of the authors, noted economist and Noble Laureate Amartya Sen was commenting in Feb. 2011 that, for instance, India's growth story will be incomplete without improving social indicators like literacy, health and women's participation in economic activities. Joseph Stiglitz, the Nobel Prize-winning economist, even argues that a single-minded fixation on growth masked the warning signs of the financial crisis.

Peter Victor in his book, *Managing without Growth*, also challenges the priority that rich countries continue to give to economic growth as an over-arching objective of economic policy. Overcoming our addiction to economic growth is one of the most important challenges for the 21st century, according to this economist, environmental studies professor. He has made a critical analysis of the literature on environmental and resource limits to growth, on the disconnect between higher incomes and happiness, and on the failure of economic growth to meet other key economic, social and environmental policy objectives (Victor 2008).

2.8 Social Sustainability

Although sustainable development means covering all three dimensions, namely social, ecological and economic (People, Planet and Profit), the social aspect of sustainable development (people) has hardly received attention in the past few decades. Of the three pillars of Sustainability - the environmental pillar has received some attention, leading to a common, but mistaken, perception of 'environmental sustainability' as synonymous with 'sustainable development' (Dalal-Clayton and Bass, 2002). Attention to social sustainability (and socially responsible design) has been minimal, although the Brundtland Commission (Brundtland, 1987) emphasized the strong linkage between poverty alleviation, environmental improvement, and social equitability through sustainable economic growth.

What is social sustainability? While the three pillars of sustainable development are interdependent, it is particularly difficult to realize and operationalize social sustainability (Boström, 2012). According to Bebbington & Dillard (2009) the

reasons for this difficulty are: "Social sustainability appears to present different and more severe challenges in specification, understanding, and communication than environmental sustainability because there is no widely accepted scientific basis for analysis, unlike the ability to debate population ecology, acceptable levels of toxicity, or acceptable concentrations of green-house gases in the atmosphere. Nor is there a common unit of measure such as monetary units with the economic dimension of sustainability".

While quantitative methods for measuring and reporting on the social sustainability of an organization are being developed (McElroy,et.al. 2007), an attempt has also been made to visualize what social sustainability often refers to, both in terms of the improvement of conditions for living people and future generations and in terms of the quality of governance of the development process. This study has published examples of substantive (What) and procedural (How) aspects of social sustainability. They include:

1. *Substantive aspects: What social sustainability goals to achieve?*

a) Basic needs such as food, housing, and income and extended needs such as recreation, self-fulfilment
b) Employment and other work-related issues, facilitating for local small and medium enterprises
c) Security (e.g., economic, environmental)
d) Health effects among workers, consumers, and communities
e) Quality of life, happiness, and well-being

2. *Procedural aspects: How to achieve sustainable development?*

a) Proactive stakeholder communication and consultation throughout the process
b) Empowerment for taking part in the process (e.g., awareness, education, economic compensation)
c) Participating in the framing of issues, including defining criteria, scope, and subjects of justice
d) Social monitoring of the policy, planning, and standard-setting process
e) Accountable governance and management of the policy, planning, and standard-setting process

The table in this study (Bebbington & Dillard 2009) is much larger than the one shown here. Even in this limited section it can be seen that it is difficult to assign quantitative and measurable criteria for these factors.

2.9 Happiness and Income

Many researchers and debaters of public policy, since 1970s, have been stressing that economic growth and wealth are not the sole determinants of human happiness and well-being. It is illuminating to examine a few lessons from studies that have compared happiness across the countries of the world. These comparisons indicate that we should not assume a direct correlation between ability to consume and happiness.

The first observation from the happiness comparison (Fig. 9) is that people in richer countries are generally somewhat happier than poorer ones. We also have evidence that when poor countries like India, Mexico, the Philippines, and Brazil that have experienced economic growth, their average level of happiness has risen. The reason is obvious: extra income is really valuable when it lifts people from sheer economic poverty (Layard 2005). Up to here it is easy to nod – this we take for granted. But, more surprisingly, in less wealthy countries such as Indonesia, Colombia, or Mexico people report nearly as high average percent of happiness as their counterparts in much wealthier countries. Secondly, comparing countries in the cluster of rich countries, we can see that income does not correlate with the level of happiness. People in the richer USA are on average less happy than in the less wealthy Netherlands, Ireland, or the Nordic countries.

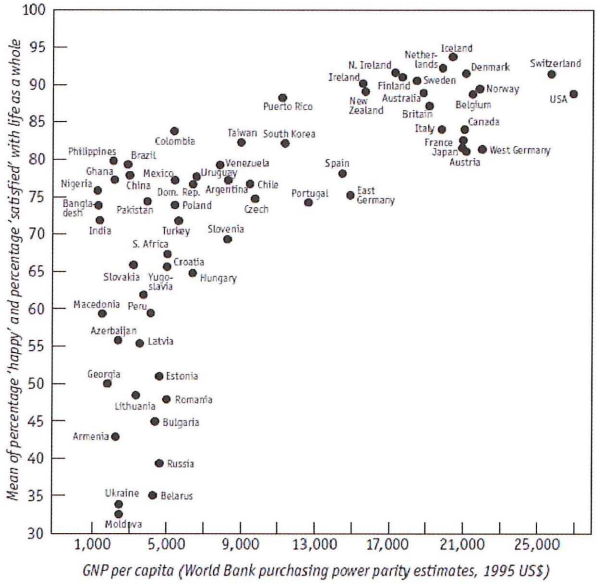


Fig 9 Income and happiness (Source: Layard 2005).

Thus one of the important messages of the happiness comparison is that plenty of other things than income influence the level of people's happiness. Some of those relate to individual psychological features, some to social relations such as family and friends. Some influencing factors are public, such as the societal system and governance (Layard 2005). While we are not offering great solutions here, we wish to make a note that there is yet much to understand in the BoP knowledge area. While products and innovative technologies may be an important part of that, it would be wise to consciously bear in mind the ultimate aims of capabilities, wellbeing and happiness.

2.10 Development & Responsible Innovations

The obsession with economic development, all over the world, brings us to focus on understanding what exactly "development" is. There are countries considered as "developed" have European features, like Japan in Asia, Canada, United States, Australia, New Zealand etc. Many other regions of the world have shown rapid economic growth, during the last few decades, entering a transitional phase between developing and developed status. Examples of such emerging markets include Argentina, Brazil, Chile, China, Colombia, India, Mexico, Peru, much of Southeast Asia, countries in Eastern Europe and in the Middle East, and parts of Africa and Latin America. A scale of development is automatically implied as between extremes those who are developed and those who are not developed. Without explicitly defining the term development, it also refers to differences of values, systems, brain power, ability, capacity, etc. (Saunders, 2008). A more anthropocentric perspective identifies the purpose of development as that which includes enlarging people's choices, valuing achievements that may or may not be measurable, access to knowledge, issues of nutrition and health services, social stability, security against crime and violence, leisure, freedoms and community participation. The United Nations captures development in the context of people as the real wealth of nations. "Development is thus about expanding the choices people have to lead lives that they value."

Prof Amrytya Sen has been interested in these choices. The capability approach (CA) introduced and developed by him sees development as a process of expanding the real freedoms that people value or enjoy. Many researchers feel that the CA provides a more complete picture of poverty and deprivation, because it takes into account all dimensions of human well-being The CA makes a clear distinction between what people are free to do to improve their well-being ('capabilities') and what they actually choose to do ('functionings').

By looking at capabilities, value is given to the free choice that people have. Examples of capabilities are: the freedom to move freely anywhere you want, the freedom to receive education, and the freedom of speech among others (Mink, et.al. 2011).

Such thinking can lead to responsible innovations, which can be considered as a result of concerted efforts to achieve a social (community) and/or environmental benefits. These designs and innovations meet people's needs as well as expand their capabilities (Public Progress Report 2012).

3. BIG OPPORTUNITY

The current state of the world with interconnected and interrelated sets of challenges: population growth, consumption explosion and drastic rise in ecological footprint is an opportunity for every one on this planet to set right the path towards global sustainability. As a consequence of a dominant focus on economic sustainability and relatively little attention towards social and ecological sustainability, the resultant skewed context offers great opportunities for correction.

The route to be followed is not new and has been many times affirmed. The goal therefore should be: provide quality of life [well-being] to an increasing global population while at the same time reducing the ecological footprint.

This process requires redefining progress and re-examining the economic growth as a sole means to achieve progress. Perhaps the key postulates of Manfred Max-Neef, father of Barefoot Economics are very difficult to accept for the rich world. Based on his observations and study of the wisdom and creativity that exists amongst the poor he postulated: 1. The economy is to serve the people not the other way around. 2. Development is about people and not about objects. 3. Growth is not the same as development and development does not necessarily require growth. 4. No economy is possible in the absence of care for ecosystem 5. The economy is a subsystem of a larger system the biosphere hence permanent growth is impossible.

An alternative approach called 'green economy' – propagated in the Rio+20 summit (in June 2012) - using market forces to help nations achieve sustainable development looked like a compromise. UNEP defines a green economy as one that results in "improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities". In a green economy,

growth in income and employment are driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services (UNEP 2011). Critique followed immediately after the Rio+20 summit. British Deputy Prime Minister Nick Clegg blamed developing countries for being "antagonistic to our European ideas on the green economy." Brazilian delegate and Senator Eduardo Braga said, "Europe is too absorbed by its economic problems". But there is also a note of optimism and hope on *Green Economy* to harness market forces to turn economies onto a green track (Pearce 2012).

4. RESPONSE OF DESIGN & INNOVATION TO CHALLENGES

The current contextual world challenge is a great opportunity for designers. Together with businesses and their innovations, designers' contributions are essential for the building of a more socially responsible world. The challenges are equally applicable to science and research in the twenty-first century: excellence and depths are needed in science and research in disciplinary fields, but there is also need to pursue excellence and breadth in cross-disciplinary capabilities.

As far as designers are concerned, this is a personal challenge for designers themselves. As Margolin puts it, the designer's mission should be "to seek autonomy and use it, if possible, for socially and environmentally productive ends. They must confront a world that is becoming increasingly polarized: wealth versus poverty; fundamentalist religion versus secular humanism; environmental sustainability versus ecological destruction; and technological utopianism versus technological resistance". This is not easy as this "requires an intensive reflection on one's own values, goals, and social concerns. It also calls for an operational strategy to align one's self with other social actors and institutions, whose concerns are compatible with one's own." (Margolin, 2007).

Designers have demonstrated that they can rise to the occasion, the most prominent example being Victor Papanek (1926-1998) who was widely admired for his advocacy of socially responsible design. In his famous and widely read book, *Design for the Real World*, (Papanek, 2005) first published in 1971, and in the meanwhile translated into 23 languages, he strongly recommended the necessity for designers to adopt a morally responsible and holistic approach, adapting technology to the individual's real needs and tapping into the wisdom and experience of other societies, particularly those of the developing countries. Papanek himself described design as: "The only important thing about design

is how it relates to people". He also saw that 'All men are designers. All that we do, almost all the time, is design, for design is basic to all human activity.' In the 70's, he also gave lectures at the Faculty of Industrial Design Engineering at Delft. His book is a source of inspiration for the Design for Sustainability programme at this Faculty, under the leadership of Prof Han Brezet. The design community, as a whole, has not adopted environmental and social sustainability as a core ethos, but many individual designers have. The worldwide design community has yet to generate profession-wide visions of how to address its potential can be harnessed for social ends (Margolin, 2007).

4.1 Time is ripe for Design & Innovation

Several new insights are being generated in the disciplines of design and innovations, making them ripe for application to address the world challenges (Kandachar, 2010).

Design Breadth

Design was always a broad discipline and is being increasingly broadened. Starting with function and form, it got input from other professionals, such as engineers, scientists, accountants, manufacturers etc. Further design has been extended from the details of daily objects to cities, landscapes, nations, cultures, bodies, genes, etc. (Latour 2008). Further new notions and methodologies, such as open design (design and development through use of publicly shared information), and meta design (a framework to create social, economic and technical infrastructures to address the impending ecological catastrophe). are adding to the breadth of design discipline.

Design Maturity

Problems, which the designers are professionally trained and experienced to solve, are themselves maturing. Problem definition is itself subjective as it originates from a point of view, therefore all stakeholders' points of view are equally knowledgeable (or unknowledgeable) whether they are experts, designers or other actors (Fuad-Luke,A 2009). There is an increasing realization that the current problems the world faces are much more than simple. They are complex (rather than complicated, Design Council 2006) and wicked.

Wicked Problems

The term "wicked problem" was first coined in the 1970s, when a new class of problems arising from inter-related issues such as extreme degrees of uncertainty, risk, and social complexity is recognized (Rittel and Webber 1973).

This is a problem that is difficult or impossible to resolve because of incomplete, contradictory and changing requirements that are often difficult to recognize. Not only were there no clear remedy for issues such as crime, poverty, and racial segregation in 1950s and 60s; there wasn't even a clear consensus of where the problems lay. The current global issues like poverty, sustainability, HIV-Aids, etc. can be considered as wicked problems. Approaching such problems requires, according to Rittel, designing together because people have to dialogue, agree on how to frame the problem, agree goals and actions, and this argumentative process is inherently societal. Guy Bonsiepe, who studied at Ulm School of Design, and who established a Master of Design study program at Universidade do Estado de Rio de Janeiro has similar thoughts. If sustainability is the most challenging wicked problem of the current era, then participation in design, as a means to effect deep, transformative, socio-political change, seems essential (Fuad-Luke,A 2009).

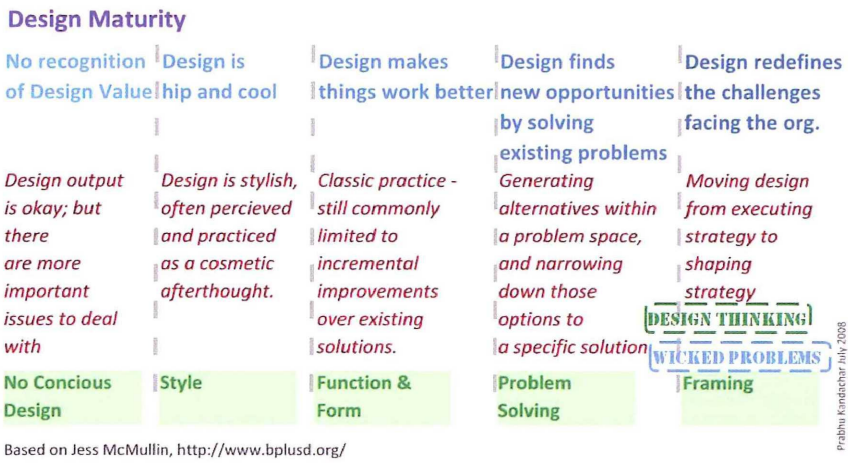


Fig 10: Design maturity (after Jess McMullin, http://www.bplusd.org/ Accessed 15 Aug 2010)

A theoretical framework based on complexity science – focused on organisational and second order cybernetics – is being explored to approach sustainability (Espinosa, et.al.. 2008). Unpacking wicked problems requires perhaps investing in radical innovations as well.

Termed "Transformation Design", the national strategic body for design in the UK (Design Council 2006) is exploring a new emerging design discipline to handle complex problems. Building on traditional design skills to address social

and economic issues, using the design process as a means to enable a wide range of disciplines and stakeholders to collaborate, this discipline is applying design in new contexts. One of the characteristics of this emergent discipline is that it results in non-traditional design outputs. Recent transformation design projects have resulted in the creation of new roles, new organisations, new systems and new policies.

Designers have the potential to address these complex and wicked problems, as design itself is also maturing (Fig. 10), advancing through several stages and getting ready to resolve wicked problems with a Design Thinking approach.

Design Thinking

Design thinking is close to systems thinking which, like design, is also a problem-solving approach focussing on how an issue being studied interacts with the other constituents of the system-a set of elements that interact to produce behaviour-of which it is a part. The systems approach can integrate the analytic and the synthetic method, encompassing both holism and reductionism. By this approach, it can sometimes result in strikingly different conclusions than those generated by traditional forms of analysis. The challenges of BoP are dynamically complex and have a great deal of interaction with several interdependent factors, offering a good opportunity for systemic thinking. The synthesizing mindset of designers and their capability to deal with complex, fuzzy and ill-defined tasks would be useful in searching for sustainable solutions at the BoP.

For instance, IDEO defines the characteristics of design thinkers as having the ability to imagine the world from different perspectives (empathy) and having the ability to think deeply thus enabling integration. In addition they are optimistic, willing to experiment and enthusiastic collaborators. With these aspects in mind IDEO has also developed a toolkit-called the Human Centred Design toolkit-which is a free innovation guide for social enterprises and NGOs worldwide (IDEO 2010).

Addressing two of the Millennium Development Goals, initiated in 2000: #4, namely, *Reduce by two thirds the mortality rate among children under five,* and #5. *Reduce by three quarters the maternal mortality ratio,* after 8 years of efforts, World Health Organization (WHO), is also into system thinking. WHO has proposed to narrow the intolerable gaps between aspiration and implementation. WHO thinks that purely concentrating on mother and child health is not enough, but it has to deal with the health of everyone in the community.

Design thinking has however been applied by the business world, according to Nussbaum, as a linear, static, and a planning-and-control methodology, and has doomed it to result in incremental change at best (Klaassen and Neicu, 2011).

Co-creation and Co-design

Sanders and Simons (2009) define "co-creation as any act of collective creativity that is experienced jointly by two or more people... It is a special case of collaboration where the intent is to create something that is not known in advance. The concept of co-design is directly related to co-creation (Fig. 11). By co-design we refer to collective creativity as it is applied across the whole span of a design process. By these definitions, co-design is a specific instance of co-creation"

For instance, homecare design and development in ageing societies, require a socio-technical system which needs to be a 'co-design' between the research & development team and end users (elderly, social network and healthcare providers) and a triple-helix network including academic researchers, companies and (community) government. It is important for co-design for home care technology development to also co-design with the patient and his social network. Eventually, depending on the ensuing challenges a parallel

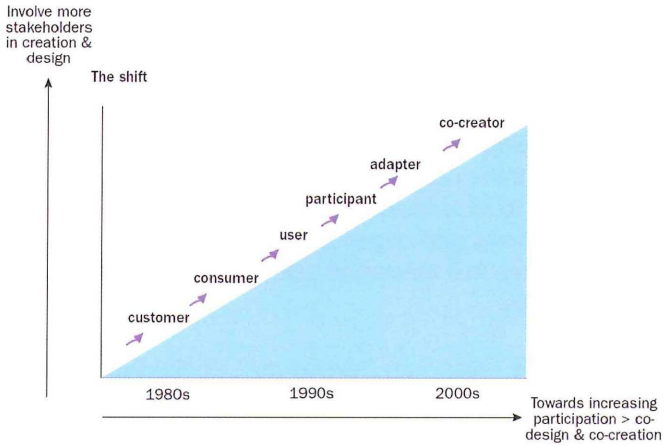


Fig 11: Shift from designing for users to designing with users (Source: Fuad-Luke,A 2009).

line of medical investigations and a parallel line of community development are needed. As an iterative approach gradually lessons learned can be accumulated.

Inclusive Innovations

What are inclusive innovations? There are several definitions. In the western part of the world, Inclusive Innovations (also the terms 'Design for All', or 'Universal Design') are frequently interpreted as a euphemism for 'designing for the disabled'. In the context of this document, the term "Inclusive Innovations" is seen as much larger application domain. A definition used by World Bank is: "Inclusive innovation is as knowledge creation and absorption efforts that are most relevant to the needs of the poor" (Utz and Dahlman2007).

The definition by Centre of Excellence for Sustainable Development (Joshi 2010) details the characteristics of what it calls Sustainable and Inclusive Innovations:

- Such innovations add value to the life of the people much beyond the immediate use of the product or service;
- Such innovations create a product or service of an uncompromising quality at a price that is affordable;
- Such innovations address the challenge of resource use efficiency to manage drastically low cost structures; and
- Finally, such innovations are scalable and replicable to suit requirements of local circumstances and complexities.

These characteristics are based on several examples (Malhotra et al 2010) that have succeeded in the market in terms of their impact on human lives, especially the poor. They include: a hepatitis B vaccine that is 1/40th the cost of traditional vaccines but nevertheless meeting UNICEF's quality requirements; cataract surgeries, performed on 300,000 patients annually by a single hospital, at a cost that is just 1/100th of that charged in other countries but still meeting the global quality standards, mobile banking, including financial services, that takes such services into the hitherto inaccessible rural areas, Nokia's affordable mobile phones equipped with flashlights (helping finding ways in dark streets) and with multiple phone books (assisting several different users typical of the poor populace), etc.

These examples are based on successes on a large scale. There are also less well known examples of innovations at grassroots level with a potential to become successful.

Grassroots innovations are local innovations across the developing world needing support (Dickson 2012). Thought of by locals under extreme constrains they have the capacity to promote sustainable development. Though many of such

innovations can make great impact, their diffusion remains limited. Research is needed on scaling up of grassroots innovation. Certain innovations, because of their origin and growth in a constrained environment, have the potential to contribute to environmental sustainability even in richer part of the world.

Innovations of a different kind, especially inspired by the combination of low development costs, advances in technology and large markets typical of emerging markets with an emphasis on affordability, is reverse innovation.. General Electric's Mac 400, for example, is a handheld electrocardiogram (ECG) unit, which is a design developed in a poor country turning out to have broad application in the developed world as well (Immelt 2009).

As far as technology is concerned, there is scope for all technologies, including advanced ones to meet the needs of the poor. The NGO Practical Action is using nanotechnology to purify drinking water, for instance in Peru (Practical Action 2007).

4.2 Globalization and Innovation Shift

The period between 1870 and 1914 has been marked as the first wave of globalisation (Baldwin & Martin 1999). Industrial revolution and major technological innovations in manufacturing, especially in the textiles and iron industries marked this period, leading to mechanisation, specialisation and the division of labour. While one part of the world (currently termed as "Rich World" or "Western economies") led to industrialisation, the other part (variously known as "Poor World" or "Third World " or "Developing economies" or recently "Base-of-the-Pyramid",(Prahalad & Hart 2002) was accompanied by de-industrialisation.

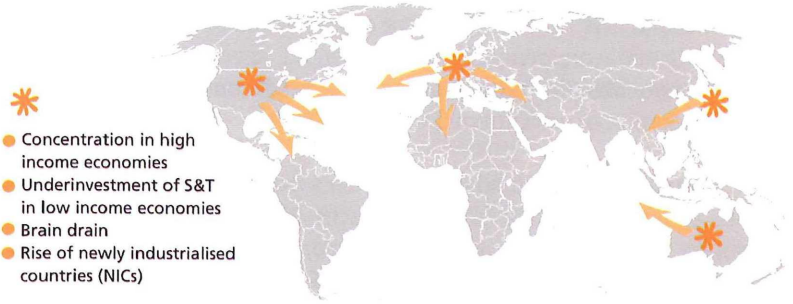
The second wave of globalisation, beginning in 1960, was a period where the world was sharply divided between rich industrial nations and poor ones that relied heavily on primary sectors. Cost reduction - in transport costs, in communication costs, etc. - was the focus, leading to growth of financial services, foreign direct investment (FDI) and service industries.

This period saw the emergence of the newly industrialised countries (NICs), a term used by political scientists and economists to describe a country whose level of economic development was somewhere between the developing and first-world. These countries have moved away from an agriculture-based economy and into a more industrialized, urban economy.

20th Century Innovations

Trickle Down

1



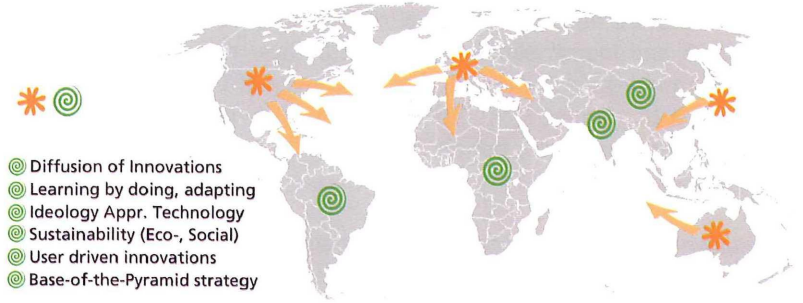
- Concentration in high income economies
- Underinvestment of S&T in low income economies
- Brain drain
- Rise of newly industrialised countries (NICs)

Prabhu Kandachar 2010

From 20th to 21st Century - Transition

Capacity Building

2



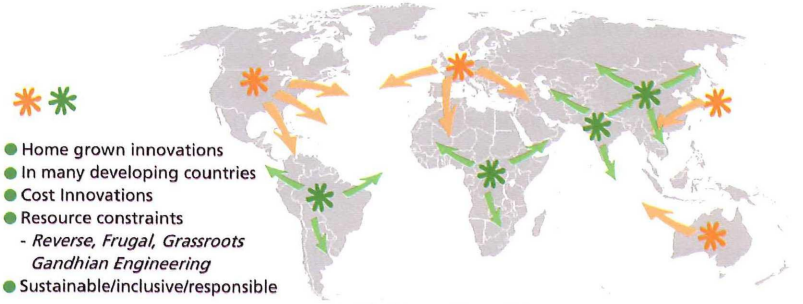
- Diffusion of Innovations
- Learning by doing, adapting
- Ideology Appr. Technology
- Sustainability (Eco-, Social)
- User driven innovations
- Base-of-the-Pyramid strategy

Prabhu Kandachar 2010

21st Century Innovations

Trickle Up?

3



- Home grown innovations
- In many developing countries
- Cost Innovations
- Resource constraints
  - *Reverse, Frugal, Grassroots Gandhian Engineering*
- Sustainable/inclusive/responsible

Prabhu Kandachar 2010

Fig 12: Innovation shift

In the 1970s and 1980s, examples of newly industrialized countries (NICs) included Hong Kong, South Korea, Singapore and Taiwan. Examples in the late 2000s included South Africa, Mexico, Brazil, China, India, Malaysia, the Philippines, Thailand and Turkey. NICs were characterized by significant growth in GDP per capita and were generally export oriented, specialising in the export of labour intensive manufactures. However, they still only accounted for a relatively small portion of world trade (less than 15%).

As of 31 December 2010, Standard and Poor's classified the following 19 countries as emerging markets (Goldman Sachs 2007): Brazil, Chile, China, Czech Republic, Egypt, Hungary, India, Indonesia, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Russia, South Africa, Taiwan, Thailand and Turkey. According to Goldman Sachs review of emerging economies, by 2050 the largest economies in the world will be as follows: China, USA, India, Brazil, and Mexico.

Emerging markets are nations with social or business activity in the process of rapid growth and industrialization. 2010 data says, there are around 28 to 40 emerging markets in the world. The economies of China and India are considered to be the largest (Jain 2006). According to The Economist many people find the term outdated, but no new term has gained much popularity yet (Economist 2008).

In the meanwhile poverty continued to be unaddressed. In search of new strategies to address the tough unsolved problem of poverty, Prahalad (Prahalad & Hart 2002) came up with so called Base-of-the Pyramid (BoP) strategy by combining two objectives in one: poverty alleviation with profit driven entrepreneurial ambitions. It is well known (Samli 2004) that a large proportion of the world's population is passed over during the current globalization process. This forgotten majority represents a big market which promises to be profitable for those who can enter this market successfully. Both Samli and Prahalad reiterate that there is an enormous market power in the lower levels of this pyramid. If modern entrepreneurship pays attention to these emerging world markets as well, much consumer value will be generated and many profitable transactions will take place. The responsible entrepreneurs of the world, thus, could make money as well as narrow the gap between the rich and the poor.

The international system-as constructed following the Second World War-is rapidly changing owing to the rise of emerging powers, a globalizing economy, an historic transfer of relative wealth and economic power from West to

East, and the growing influence of non-state actors. Several examples of firms operating independently of national boundaries, political objectives and domestic economic constraints can be seen (Bairoch & Kozul-Wright 1996). The third wave globalization looks like encompassing bi-directional and increasingly balanced trade flows between developed and emerging economies.

Parallel to this shift in economy, a shift in and strengthening of innovative capacity of these and other emerging economies can also be observed, and is schematically shown in fig 12. (Kandachar 2011). Would in the future innovations come from east?

4.3. Innovation Dynamics

This shift is already bearing fruits. Several specialists, including Indian and Chinese scientists are rapidly developing the ability to innovate and create their own intellectual property as a result of globalisation, including the movement of research and development (R&D) to these countries. Indian and Chinese companies are making strides in the most lucrative segments of global value chains. The challengers from rapidly developing economies - like China, India, and Brazil-will likely be the global leaders of tomorrow, if they can manage the innovation process.

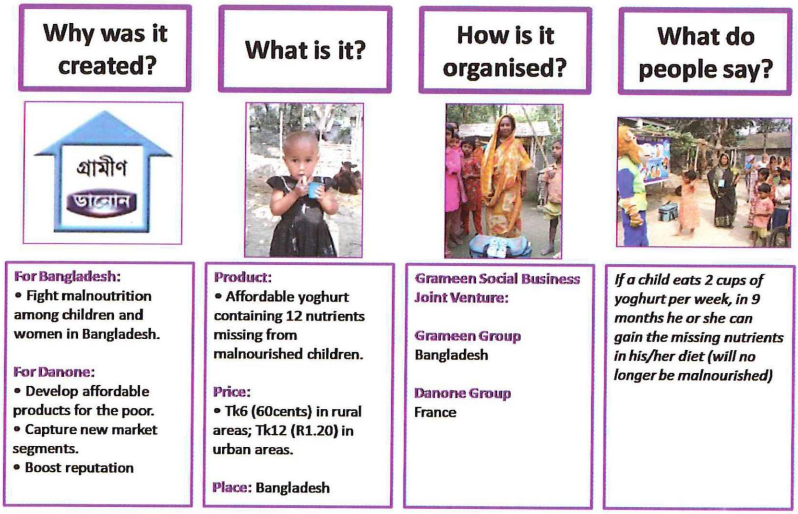


Fig.13: Grameen Danone aims to reduce malnutrition in women and children in Bangladesh by selling fortified yoghurts [Source: Bash 2010]

Some examples of what is happening:

With food, India-using a small-scale dairy production model that relies almost entirely on crop residues as a feed source- India has more than quadrupled its milk production since 1970, overtaking the United States as the world's leading milk producer. The value of India's dairy production now exceeds that of its rice harvest.

By the end of 2007, some 40 million ***Chinese homes*** got their hot water from rooftop solar water heaters.

Some of the most innovative leadership has come from cities. Curitiba, ***Brazil***, a city of 1 million people, began restructuring its *transport* system in 1974. Since then its population has tripled, but its car traffic has declined by 30%.

In ***Bangladesh***, one of the poorest nations on the planet, France's Groupe Danone started a joint venture there with microfinance pioneer Grameen Bank. As part of the business plan, it agreed to build local **micro-plants** that produced one one-hundredth of the ***yogurt of a standard Danone facility***, in part due to the lack of refrigerated storage (resource constraint). The micro-plants produced yogurt almost as cheaply as the larger ones. Danone has also managed to put enough vitamin A, iron, zinc and iodine into a 60 g or 80 g cup of yogurt to meet 30% of a child's daily needs (Fig. 13).

A similar example comes from ***Indian banks,*** where ***transaction costs*** are about one-tenth of the typical U.S. bank's. India's ICICI operates profitably in such a climate, thanks to its highly efficient systems. Suddenly cash-starved U.S. financial firms are looking to ICICI -- and the substantial number of lower-income consumers in their own backyard -- and asking, "How is it that companies in emerging markets can serve these customers and we can't?".

Other examples: ***Brazil's Natura,*** a cosmetics firm that is beating Western companies on its home land and has expanded throughout Latin America and now Europe, and ***China's Goodbaby***, which has 28% of the U.S. stroller market.

Frugal innovation is already beginning to make itself felt in the West, particularly in health care. ***GE's cheap ultrasound device,*** originally developed for the Chinese market, has become the basis of a global business, with eager customers in the developed as well as the developing world. In 2010 some 6

million Americans travelled to developing countries such as India in search of affordable health care, up from 750,000 in 2007. Medical tourism from Europe, the Middle East, Japan, and Canada is also increasing. Dr Devi Shetty, the founder of a hospital for heart surgery at ***Bangalore (India)***, is relentlessly pursuing a mission and succeeding in his objectives: an impossible-sounding success rate of 95 percent charging a fraction of what other heart hospitals do. At the same time he is building a 2,000-bed hospital in the Cayman Islands, a short flight from Miami (USA), where he will offer surgery at half the price charged by American hospitals.

The trend is apparent in consumer goods too. ***Haier (China)*** has become the market leader in the West for cheap fridges. ***Mahindra & Mahindra's (India)*** nifty little tractors are popular with hobby farmers and gardeners in America.

McKinsey (Laxman Narasimhan, 2011) predicts that ***India*** could become the world's first truly ***mobile digital society***. But grasping the opportunity requires unprecedented co-operation between the private and public sectors.

4.4. Design in Developing Countries

The involvement of the design profession in the development of nations and regions has been slow and relatively insignificant. In the 1970's United Nations Industrial Development Organization (UNIDO) and the International Council of Societies of Industrial Design (ICSID) signed the Ahmedabad Declaration on Industrial Design and Development [the event was hosted by National Institute of Design, Ahmedabad, India] to promote industrial design in developing countries. At this time the rethinking about development was in its early stages and it is therefore likely that this situation led to the UNIDO and ICSID partnership having a focus on industrial development rather than on poverty issues. Around the same time some thought leaders (Papanek, 1971; Schumacher, 1973) had a large influence on thinking about design for development. Although Papanek's thoughts appealed to specific sections of the design community, specifically those who question the lack of a sense of social responsibility in the design profession as a whole, the mainstream of the design profession has not yet been widely influenced.

The developing countries themselves are slowly realizing the importance of design as a strategic tool for economic growth, and providing the field of design a status equal to other fields such as science, technology, and economics.

Fig. 14. Examples of developing countries who have recognized the importance of design.

Examples of those who have taken action are mainly in emerging markets (Fig. 14) such as Malaysia (Malaysia Design Council, 1993), Indonesia (Indonesian Design Center, 1995 with assistance from Japan International Co-operation Agency and the Japan Design Foundation), Philippines (Product Development and Design Centre of the Philippines), Thailand (Office of Product Development & Design for Ex-port), India (National Institute of Design, since 1969 educating designers and serving industry), Colombia (Artesanías de Colombia), Cuba (Oficina Nacional de Diseño Industrial - National Office of Industrial Design), Mexico (Mexico Design Promotion Centre), Brazil (Brazilian Design Centre). South Africa (SABS Design Institute) (Amir 2004). Although these initiatives are laudable, such strategic design approaches appear to be directed to addressing the competitiveness of the international market, rather than addressing the needs of their own domestic markets in terms of alleviating poverty as well as fulfilling the basic needs of the local people. A national design policy, therefore, directed to meet the social and economic challenges of the developing countries and the betterment of their own society seems to be more than relevant and needed.

The Danish Design Centre has developed the Design Ladder in 2003 as a tool to measure the level of design activity in Danish businesses. It has four stages: (1) no use of design; (2) design as styling; (3) design as process, and (4) design as strategy. See Fig 15. Although it is used as a framework to assess the economic benefits of design in Denmark, it could be worthwhile to examine how developing countries are placing themselves in such a ladder. Further, this ladder shows great similarities with the Design Maturity notion (Fig. 10)

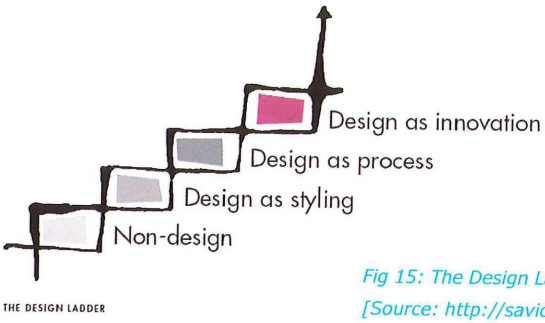


Fig 15: The Design Ladder of the Danish Design Centre [Source: http://savic.cc/2010/03/05/design-ladder/]

4.5 Innovation under constraints

Developing countries are a fertile ground for innovations due to enormous constraints. The contexts in which economic developmental processes take place at such spaces are embedded in scarcities not widely present in industrialized societies (Srinivasa and Sutz 2008). The richer part of the world can be considered as a context of "Abundance" and the poorer (Developing countries or BoP) part as a space with "Scarcity", Figure 16. Scarcity conditions include deficiencies at the level of infrastructure that is missing or is not up to date, of access to materials and equipment of the required quality or accuracy, of institutional support for the building of endogenous capacities, of enough people with appropriate skills to run projects or discuss ideas, and of money to rely on well-known solutions. Constraints need not always be objectionable as they can sometimes result in surprising innovations. {*In der Beschränkung zeigt sich erst der Meister*, von Goethe 1802]

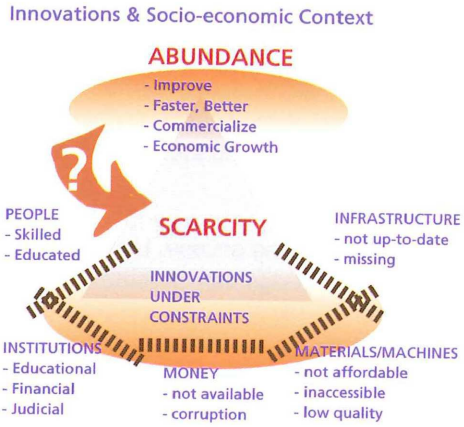


Fig 16: The socio economic contexts of the world influencing innovations (after Srinivasa and Sutz 2008).

Humans control the natural world by creating their own world by designing tools and artefacts, including buildings, social institutions, and symbol systems. Design is therefore central to the human nature and actions. All over the world, including those at developing countries, humans have shown to possess these skills and are successful in finding their own solutions, even though they are not professionally trained as designers. For instance, there are a number of grassroots innovations at the local level, designed by local people to solve their own persistent problems, holding the potential of wealth creation in a truly sustainable and equitable manner. Examples include Honeybee (2010) in India with a database of innumerable number of local innovations and South Africa (Grassroots Innovation, 2007).

5. STRATEGY AND DEPLOYMENT

5.1 Focus on well-being and inclusive innovations

Considering all the world challenges and how the world community – academic, governmental, non-governmental, business, etc. – is preparing to respond, albeit slowly, the strategy of what needs to be done (Fig 17) and how is also becoming clear.

Firstly, sustainability at the global level is the urgent need of the day and all activities need to be directed towards this goal. The current challenges: population growth, consumption explosion and drastic rise in ecological footprint are calling for strengthening the path towards global sustainability.

Secondly, while we continue to accelerate towards global sustainability, a radical shift in the focus is also essential. Focus on social and ecological sustainability, especially well-being of all the people on this planet should be the priority, paving way to redefine progress. All insights, tools, methodologies, etc., hitherto developed in the domain of environmental sustainability are valuable. All technologies are needed. They should be continued to be applied and developed further.

Thirdly, innovations should be inclusive, not excluding anyone. Here in lies a great opportunity for designers and innovators. Design can become a major change agent in addressing the larger scope of the UN definition on Sustainable Development.

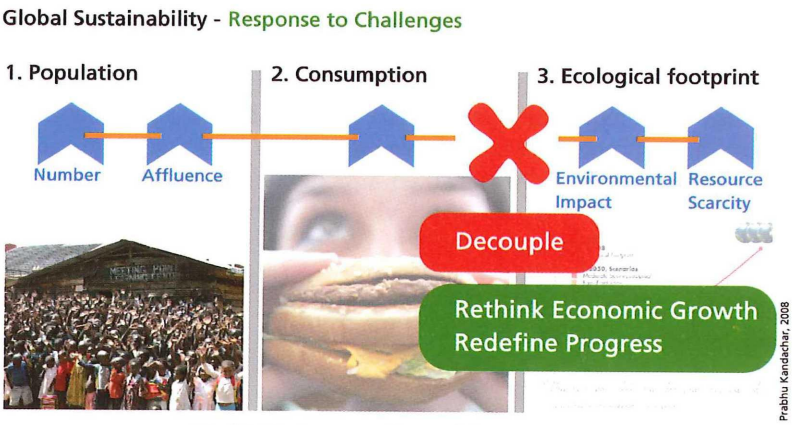


Fig 17: Strategy to address global challenges.

Fourthly, as design as a discipline is itself maturing and developing beyond the classical notion of designing artefacts, the challenge lies in addressing much larger issues such as social innovations.

Consequences are (1) the Role of design will shift from "designing artefacts" to "designing responsible interventions" (2) ***Need to develop a theory of social design***, including how to deal with social sustainability; human centred design in place of conventional artefact-centred design theories (3) ***Translating these ambitions to develop concrete guidelines*** by means of research and practise to develop design processes, methodologies and tools, accounting for various factors such as cultural influences and intercultural collaboration, evaluations and feedbacks to learn lessons.

5.2 Differentiation – Countries with high & low footprint

While the objective at the global level can be set as 1 planet Earth (Fig.7) for the whole world, a differentiation between countries is needed as some regions are currently consuming more than 1 earth and some or not.

From a fairness and justice point of view, consumers engaging in overconsumption need to retreat from the global environmental space and make space for consumers with no or low consumption. Following Kantian principle (the freedom of a nation is constrained by the equal freedom of all other nations), the consumption of finite resources ought to be at such a level that the right of other nations to flourish is not constrained. Translating these

thoughts, Wuppertal Institute for Climate, Environment, and Energy (Sachs and Santarius, 2007) argues that no nation has the right to a disproportionate share of the environment. Each country should achieve the common goal of material and energy consumption compatible with the demands of other countries. At the same time all countries should converge towards a maximum consumption of one earth. These thoughts have led a model of global of contraction and convergence (Fig 18). This model differentiates between countries with high footprint per capita and those with low footprint per capita. This model puts the responsibilities on all countries. "Rich" countries need to drastically reduce consumption, while "poor" countries can increase consumption slightly, yet staying under the limits of 1 Earth.

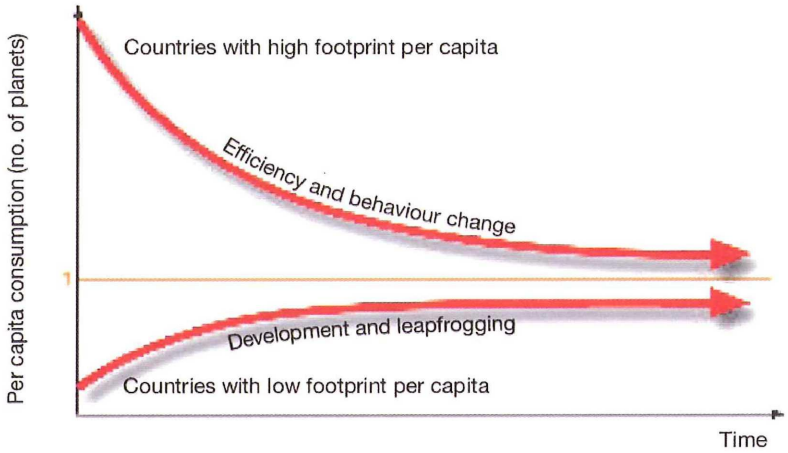


Fig 18: Opportunities from a global perspective (Sachs and Santarius, 2007).

5.3 Designers' New Roles

Preliminary steps have been taken in the direction to define a sustainability manifesto for designers.. To develop a set of principles to guide designers in their thoughts and actions in 'designing for sustainability', the DEEDS (DEsign EDucation & Sustainability) project, was set up. DEEDS is funded by the European Union Leonardo da Vinci Programme and comprises of five partners from the European design and sustainable development communities, embracing Higher Education, research and practice. The motivation was to face the current world challenges and to "redesigning the future". Urged by the need for more sustainable products, processes and consumption patterns by business and consumers, DEEDS is set up to (Blincoe et.al. 2009):

- promote a complex model of sustainability, comprising not only environmental and economic but also social and institutional objectives.
- suggest implementing these objectives throughout the product life ('cradle to cradle'), formulates guiding principles and provides tools and examples of doing so.
- address all of a fragmented profession (we and communication design, architecture, product and service design, textile and 3D design, etc.).

In concrete terms, DEEDS' aim is to demonstrate the actual and potential added-value of a sustainable design approach to design educators, design students, design professionals, as well as the wider design industry and policy-makers.

The principles developed in 2006 and 2007 after several iterations were presented in the "*Changing the Change*" conference in Turin, Italy as new DEEDS Design Research Agenda for Sustainability (Draft 1-12 July 2008). This recommends:

- Sustainability must be the meta-objective of every possible design research activity.
- Sustainability here is intended as a systemic change to be promoted at the local and global scale. It will be obtained through a wide social learning process, reorienting the present unsustainable transformations towards a sustainable knowledge society.
- Design research has to feed the social learning process towards sustainability with the needed design knowledge. That is, with visions, proposals, tools and reflections to enable different actors to collaborate and to move concrete steps towards a sustainable knowledge society.

This conference also indicated what the new roles of designers are: 'connectors and facilitators, as quality producers, as visualizers and visionaries, as future builders (or co-producers), as promoters of new business models and as catalysers of change'. Premsela, the Netherlands Institute for Design and Fashion, has similar thoughts. Leaning on the principles of Open Design which offers unprecedented possibilities for design to improve the world, Roel Klaassen and Maria Neicu of Premsela . urge designers to help find solutions to global problems. The new role for deign profession is to shift its emphasis from designing and producing things to creating templates others can use to make and alter them. Designers must become meta-designers – creators of models and systems that allow others to solve problems, designing for configurability (Klaassen and Neicu 2011).

Fig 19. The Zimbabwe Bush Pump {Source: Morgan, P. 2009]

An interesting example of this is *The Zimbabwe Bush Pump*, Fig 19, which has existed for more than half a century as a water pump, but not remaining the same and altering over time and is under constant review. An anthropologist and a professor of political philosophy in the Netherlands have attempted to find out what makes it an 'appropriate technology'. This turns out to be what the authors call the 'fluidity' of the pump (of its boundaries, or of its working order, and of its maker). They find that in travelling to intractable places, an object that isn't too rigorously bounded, that doesn't impose itself but tries to serve, that is adaptable, flexible and responsive – in short, a fluid object – may well prove to be stronger than one which is firm (de Laet and Mol 2000). All Bush Pumps are entirely Zimbabwean in origin and design, locally manufactured by 12 companies in Zimbabwe, and are regarded in Zimbabwe as National Treasures. No other hand pump on the African continent has provided such a prolonged service to its own people (Morgan 2009).

5.4 Design for Sustainability at Industrial Design Engineering, TUDelft.

Principles of sustainability have always attracted the attention of the Dutch community, especially the Faculty of Industrial Design Engineering at Delft University of Technology. In the beginning the focus was on environmental aspects, but later the social aspects were also added as part of educational and research projects.

Papanek's book *Design for the Real World* which appeared In 1972 inspired the Faculty of Industrial Design Engineering (Delft University of Technology) to initiate investigations in a modest manner on environmental aspects of products. It was not until the late eighties that the ideas on environmental and product design were further developed. The Brundtland report "Our Common Future" (1988) probably gave just that extra stimulus needed. In 1989, the first policy note on ecodesign program appeared. This was commissioned by the Dutch Ministry of Economic Affairs collaborating with a contribution from the Ministry of Environment and the European Community.

Since the first half of the nineties, there has been an exponential rise in the field of environmentally conscious product design. Several actors such as European Design Centre, TNO Product Centre, companies such as Ahrend and Leolux, associations such as O2 Netherlands have contributed since then. Since 1992, Delft University of Technology has also a professor (Prof. Han Brezet) in this field. The knowledge and expertise developed in this field has also been made available abroad to countries such as Sweden (TNO / Kathalys), Costa Rica (TU) and Basque Country (BECO). Being continued as *Design for Sustainability* program, it is one of the most successful activities of the the Faculty of Industrial Design Engineering at Delft University of Technology. Several researchers are working currently on variuos aspects of sustainability.

5.5 Social Innovations

The Faculty of Industrial Design Engineering (IDE) at Delft University of Technology is also making contributions towards social sustainability by means of social innovations at Base-of-the-Pyramid (BoP). Exploring BoP results in opportunities to provide innovative products and services for consumers that have not even been perceived as such by the business world - and it is 4 billion plus humans who have unmet needs. Reaching this target group cannot be achieved just by marketing existing products, but needs the development of new goods and services. By adopting a systems approach, designing and developing products and services for BoP markets is being explored at IDE. Taking an approach of Integrated Product Development (IPD), IDE addresses several stages of product development: discovering, defining, designing and delivering, in an integrated and iterative manner. It considers all aspects of product design from the beginning (fuzzy front end) until the product is delivered, used and disposed or recycled. When working together with entrepreneurs, Integrated Product Development (IPD) also lays the foundation for the next stages of a structured process leading to the development and introduction of new products

and services into the market. A systemic approach is very relevant to BoP, and an integrated approach appears to have a maximum potential in the developing world (Jagtap and Kandachar2010).

Trials to apply this approach to Base-of-the-Pyramid at Delft started long back and have been systematically pursued from 2003. Since then more than 200 projects in association with multiple stakeholders like business enterprises, NGOs, etc. have been carried out by the students at Delft. (Kandachar et. al,, 2011). Issues covered have included water, healthcare, energy, housing, etc., in countries all over the world. Fig. 20.

Fig.20. Overview of projects on social innovation carried out at the Faculty of Industrial Design Engineering at Delft University of Technology (Kandachar et. al,, 2011). A detailed description of a selected number of projects can be downloaded from: http://io.tudelft.nl/beyonddesign

Recent examples include a Silk Reeling Machine (Fig. 21a). In 2006 Miss Annemarie Mink of Industrial Design Engineering at Delft graduated on the re-design of a Tasar silk reeling machine for rural women in eastern India. After graduation she continued working on the development of this machine, on behalf of the Dutch NGO ICCO in collaboration with the Indian NGO PRADAN. In 2010 the reeling machine was patented on her name and it was also named after her (Anna Charkha). As on April 2011 there are 67 new reeling machines are running in 3 villages with solar power. Moreover, another 1.000 more machines have been ordered. Another example (Fig. 21b) is: from Jaipur Foot India. Mr Antonio Recamier Elvira, of Industrial Design Engineering at Delft graduated

in February 2011 by developing the concepts of a dynamic alignment system for exo-skeletal prosthesis, which is a device that helps the technicians at the Limb Fitting Canter of the Jaipur Foot Organization in India to make delicate adjustments to the foot's orientation during the delivery stage of the fabrication process. The aim was to find ways to improve the production of prostheses and improve their quality during use. Mr Antonio Recamier Elvira, being of Mexican origin, is currently exploring if the prosthetic products offered by the Jaipur Foot Organization in India are suitable for Mexicans who have suffered loss of an arm or leg, as well as the steps for possible manufacturing and distribution in Mexico. Are Innovations trickling from South to South?

Fig 21 (a) Silk Reeling Machine [Mink}and (b) Jaipur Foot From India to Mexico?[Recamier]

In addition, several PhD research projects are running at Delft including, *Medical Products Development for Rural China* (Jiehui Jiang), Technology and Human Development; A Capability Approach (Ms. Annemarie Mink, collaborating with Ms. Ilse Oosterlaken, Faculty of TPM, TU Delft and Mr.Pramod Khadilkar Indian Institute of Science, Bangalore, India, *Sustainable Product Innovation in Vietnam, Cambodia & Laos* (Ms.Shauna Jin), *Diffusing Innovations in Rural India: A Framework to Upscale Grassroots Innovations* (Ms. Ann de Keersmaecker), *Medical devices in disaster response* (Ms. Ana Laura Rodrigues Santos), *Nature-Inspired Design Methods* (Ms. Ingrid de Pauw), *Materials Scarcity & Design* (Mr David Peck), etc.

More information at:
http://www.io.tudelft.nl/en/research/research-programmes/technology-transformation/design-for-sustainability-emerging-markets/

5.6 Lessons Learnt (till now)

The domain of social innovations being very large, learning lessons from exploration is a continuous process. When designing products and services for the underserved parts of the world (BoP), one or more of the following design requirements have always played an essential role: affordability, accessibility, availability, adaptability and reliability. Further the following are also relevant (Kandachar 2010): (1) ***User centric approach*** by "Putting People First" and Co-creation: Putting the user at the centre of the process, within the larger context of the system surrounding them, necessitates the commitment and participation of the user for optimal results. 'Co-creation' has the benefit of involving the user and producer as allies through direct engagement with professionals to create solutions that are truly responsive to their needs. This approach provides businesses opportunities to create value as well. (2) ***Understanding the context***: Of all the various aspects, understanding context is particularly crucial, and that includes an in depth understanding of the culture of the BoP community being addressed. (3) ***Involving multiple stakeholders:*** As complex problems cannot be addressed from a single point of view, designing for BoP is a multi-stakeholder team effort involving several actors: users, business enterprises - small & large, NGOs, governments, specialists, designers, etc. to consider and balance concerns, values and perceptions of all involved. (4) ***Systemic thinking***: The teams would benefit from including members with a systemic thinking familiarity to help in framing the question in a holistic manner and also considering implementation, with designers involved and contributing from the beginning to the end.

6. CONCLUSIONS

The current and projected state of the world with complex sets of challenges: population growth, consumption explosion and drastic rise in ecological footprint is a great opportunity for everyone, including designers. These exceptional challenges of today lead to significant opportunities for tomorrow. Social and ecological sustainability, especially well-being of all, should be the focus in place of dominant focus on economic growth. New insights and methodologies in the field of design and innovations offer excellent opportunities for designers to collaborate with others to refocus. These challenges offer also great opportunities for the worldwide design community to generate visions to harness its potential for social ends.

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...and many many more.

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