Engineering, Ethics and ‘Doughnut’ Economics



Nick Hales introduces “Doughnut Economics”, a relatively new economic model that is intended to address the gulf between the preoccupations of mainstream economic theory, which relies on growth economics to address developmental issues, and the growing real-world crises such as global inequality and climate change with disrupters like Artificial Intelligence (AI) making the landscape ever more complex. Nick goes on to suggest a modification to recognise that greater cooperation is required amongst the underdeveloped, developing and developed nations.

The Mission Statement of the Systems Approach to Safety of the Environment Working Group (SASEWG) is, “To produce clear guidance on how engineered systems should be developed and managed throughout their entire lifecycle (including through system or environment changes) so as to preserve, protect and enhance the environment.” [1].

The Rules of Conduct of the IET [2], include the following two rules (14 and 15 respectively):

- Members shall at all times take all reasonable care to limit any danger of death, injury or ill-health to any person that may result from their work and the products of their work
- Members shall take all reasonable steps to avoid waste of natural resources, damage to the environment, and damage or destruction of man-made products

These ethical viewpoints have to be balanced by affordability, but there is a disconnect. It is much like the disconnect children have between the new born lamb they wish to hold close at a 'petting' farm and the lamb they have for Sunday lunch. In a world of limited resources, it is suggested that we cannot continue to look away from the problems of impact of projects simply because it is not what we like to do. In engineering, there is always the pressure to accept "the bottom line", money. The cost/benefit analysis, (CBA), is of course an essential for all projects, but there are hidden costs that are eating away at the health of the planet so, both now and in the future, we must examine the larger picture and work to protect the well-being of humanity and biodiversity, the fates of which are intertwined.

This article looks at the problem, in the modern world, of continuing to use economic models developed in the past when the issue of development was assumed to be solved by growth economics alone. A relatively new economic model, Professor Kate Raworth's "Doughnut Economics" [3], is introduced. The intent of the model is to encourage the closing of the "visible gulf between the preoccupations of mainstream economic theory and the growing real-world crises such as global inequality and climate change", and a modification to that model, developed by the author, is illustrated and the logic and reasoning behind it given.

Somehow, we must create:

- Acceptable resource usage cycles which work with rather than exploit nature and people
- Processes to utilise the resources that do no permanent or long-term damage
- Products developed by the processes applied to the resources, which must truly hail themselves as eco-friendly products in use and in disposability

A good reason to explore 'Doughnut' economics is that it can be growth agnostic. It avoids the dogma that pits ecological issues against growth obsessions.

Note: An analysis of how an engineering firm would use the model proposed by this article will be given in a later issue of this newsletter.

A Brief Overview of the Effect of Extant Economic Models

There is a tendency to conflate economics with greed. An example of this conflation, used ubiquitously, is Adam Smith's words "It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest." [4]. The problem is when self-interest becomes massively disproportionate to need. Aristotle distinguished between 'chrematistics', the art of acquiring wealth, and 'economics' , derived from the Greek for household management and could be used as the basis for caring for the natural world in the management of projects, looking after our 'home' planet.

To ameliorate the worst aspects of the potential future economic problems, some economists are now suggesting that there are alternative ways of looking at economies. Even the greatest economists have had their doubts about whether their subject is a science. One thing both Friedrich Hayek and John Maynard Keynes agreed on, best summed up by Hayek, was that "an authority, which in economics no man ought to possess" [5] is conferred by the Nobel Prize. We should therefore be open to new thinking, open-mindedness being a quality of good engineers.

Raworth's analyses show there are 2 conundrums:

Firstly:

- No country has ever ended human deprivation without a growing economy
- No country has ever ended ecological degradation with a growing economy

Secondly:

- We have an economy that needs to grow whether or not it makes us thrive
- We need an economy that makes us thrive, whether or not it grows

Solutions to these conundrums are urgently needed. Raworth proposes alternatives to seven given here in Table 1. There are of course many more.

Table 1: Economic Models and their Doughnut Economic Equivalents

Current Economic Model	Doughnut Economic Model
GDP success measure	DOUGHNUT safe space for humanity
Self-contained economy	Embedded economy
Rational economic man	Social adaptable humans
Mechanical equilibrium	Dynamic complexity
Growth will level up wealth	Distributive by design
Growth will clean it up	Regenerative by design
Growth addicted	Growth Agnostic

The Subtlety of Harm Due to the 'Bottom Line'

It is hard to avoid causing harm in one way or another when a project gets underway and this section illustrates typical problems, depending on the project, extracted from an article in Green World [6]. Table 2 gives types of problems and some examples.

Table 2: Human Activity and its Environmental Impact

Activity	Examples of Problems
Agriculture	As with palm oil plantations in Malaysia and Indonesia, destroying orangutan habitats.
Introduction of invasive species	Such as goats in the Galapagos, eating the plants the tortoises depend on.
Logging	Including the loss of tropical forests, (and many species with them), for furniture.
Construction	As with turtles on Turkish beaches with nowhere to nest now or distracted by lighting.
Climate Change	Warmer conditions can drive endemic rare species farther up their mountain homes for cooler air until food runs out at the tree line. These conditions are also bleaching corals where many fish breed.
Pollution	As when chemical fertilisers create huge harmful algal blooms in marine environments.
Human intrusion and disturbance	For example international travel has spread the fungi that are killing off amphibian species worldwide.
Fishing	Commercial boats trawl the ocean floors and catch whole fish shoals, including the young, leaving none to breed in adulthood. Climate change bleaching corals where fish breed. Now planning to destroy the ocean floor with trawls where life and death has been undisturbed for millions of years.
Water Management	Diverting rivers for agriculture can wipe out habitats and damming rivers can prevent species migrating up river to mix gene pools or breed.
Transportation	Building roads can enable poachers to find valuable species.
Capitalism	The system can perversely raise the price of rare species as each one shot reduces the numbers and increases the rarity, putting the price up further.

One example of how complex the prevention of extinction of a species can be concerns the sociable lapwing, which thrived on steppe grassland. That seems simple but the conversion of Ukraine and western Russia to wheat growing took most of these lands and the sociable lapwing prefers short grass for its nest and colonies of fellow lapwings. In addition, the rest of the steppe was home to grazing animals including the Saiga antelope but these were hunted to the edge of extinction so the grasses now grow long. The only remaining homes for this lapwing are close to villages where domestic herbivores keep the grass low. Unfortunately, that brings their nests and young into conflict with pet cats. Hence extinction becomes a possibility without due care.

The Doughnut Economic Model

Two schools of economics theory have dominated for decades. The first is that an economy is built the way Adam Smith imagined, by enterprise with selfish intent that spills over to others as it grows. The second is that sharing and a more co-operative existence will be the only way the earth and all its people can advance, as various manifestations of Marxist thought describe. Unfortunately, both thus far have led to the creation of new elites. The market economies are dominated by multi-millionaires and billionaires with their unwillingness to part with any of their earnings in the form of tax. The Marxist economies are dominated by brutal dictatorships, exclusive elitists and ideologically dogmatic committees.

In terms of technology, Artificial Intelligence, (AI), is certain to be influential where economics is concerned. Both these theories will seek to maximise the use of AI. Once the atomic bomb was created, efforts began to prevent the misuse of the devices. Equally, so must it be with AI. We are beginning to see a rapid growth in the use of the technology in many sectors and it is already recognised that this rapid expansion could lead to massive unemployment. Distribution of the wealth increasingly thus generated will become a big problem. Coping with a future without employment, poses a problem for governments and businesses. One solution a number of local governments are experimenting with is the concept of a Citizen's Income (CI) [7] which would be a sum of money to which all would be entitled, even if they were not part of the production cycle.

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Into this battle of ideologies appears the relatively new Doughnut Economics model, (Figure 1), described for the lay person in [1]. The social foundation in the use of the doughnut model employed in this article, is the United Nations' 12 Sustainable Development Goals to achieve by 2030 [7]. It should be noted that this illustrated doughnut is not the only use of the model and an internet search will provide a library of custom variations on the theme.

It is important to understand that the doughnut economic model as presented here, is as a planning tool for engineering companies. It is designed to help answer the questions, "What is it we can do, in designing, constructing and maintaining this project that will help lift some above or toward the social foundation?" and "What can this project do to reduce the pressure on the planet due to ecological ceiling overshoot?" Some of the conclusions arrived at may be cost free or even reduce costs.

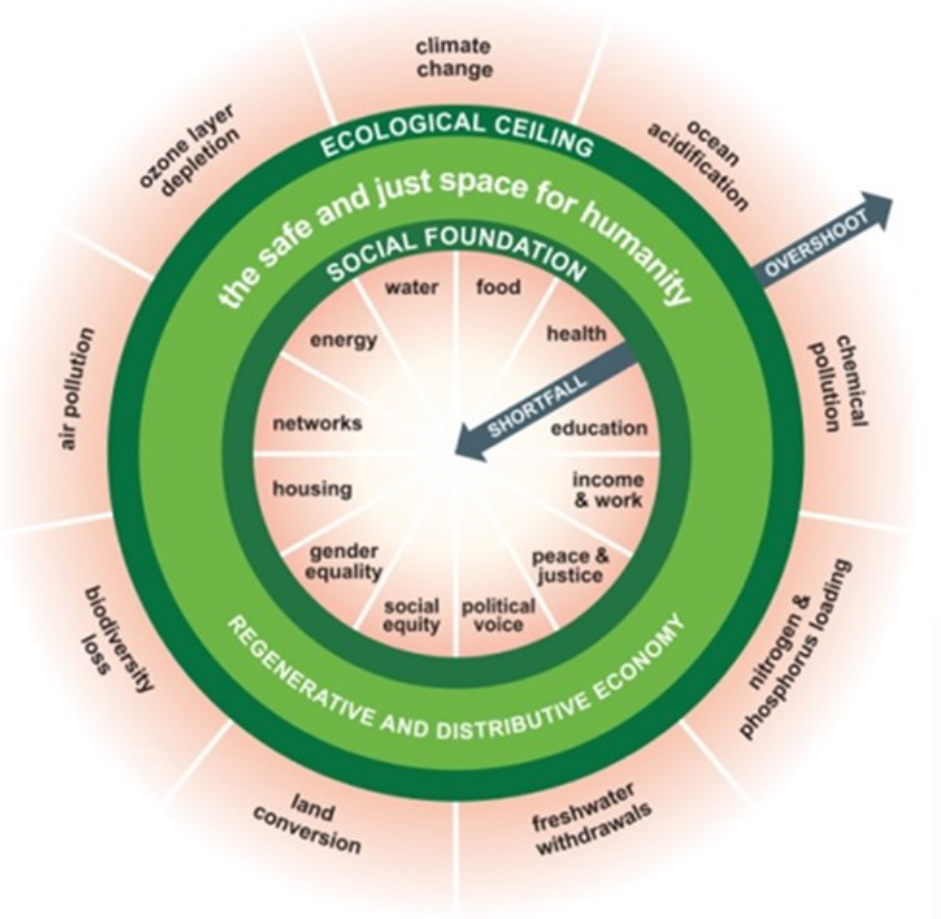


Figure 1: A Standard Doughnut Economic Model

In this doughnut, the 'safe' place for humanity into the future is represented by what would be the dough in a ring doughnut. As can be seen in the diagram, there are two of what one might call 'unsafe' places for humanity.

The first is outside the doughnut, crossing the ecological ceiling, where environmental damage occurs due to the various causes shown in the diagram. A projects intention should be to minimise those aspects of the project that are causal factors contributing to those identified effects, drawing the projects influence ever closer to the Ecological Ceiling until they pass through, where possible, that barrier into "the safe and just space for humanity". Being outside the doughnut is referred to as overshoot. To avoid overshoot, where possible, projects should introduce mitigations of their own and restorative activities to reverse the destructive aspects of previous projects. As an example, one could restore beavers to a habitat in order to create a flood plain, which beavers do naturally, to mitigate climate change effects on a new downstream eco-friendly factory construction project.

The second forbidden zone is inside the ring of the doughnut where the result of a project may lead to deprivation of one sort or another. One of the effects illustrated is a lack of water. If the water requirements of the project are such that it will deny sufficient water for the environment or people of any location it affects, then it has removed the possibility of a safe and just space for humanity. This is referred to as a shortfall. The project will have moved the local population across "the social foundation" barrier and away from the "safe and just space for humanity".

Should we be concerned if the world rejects the Doughnut model? The view of the author is that if someone is not concerned about the unnecessary deaths of millions of people every year, they are unlikely to be concerned about the extinction of any or most animal species. That would leave us, or more so our descendants, with the prospect of walking an earth with little of its beauty left and endless elitists arguments as to whether or not one should be concerned about inhuman politics?

Economic Solution Woes

There are consequences of mainstream political attempts to solve economic woes. A few examples are given here. All expressions quoted in the bullet points below are from Kate Raworth's book [1].

- Deregulate or re-regulate finance leading to "speculative bubbles, house price hikes and debt crises", bringing poverty and destructive desperation
- Promises to cut red tape that in doing so dismantle "legislation that was put in place to protect workers' rights, community resources and the living world"
- Turning public services such as hospitals, railways and water supply into "private revenue streams". These inevitably look to avoid any loss-making work in the former public stream such as long-term care on the social front, complex operations in medical care and unprofitable routes in the transport domain
- The approach espoused by Bjorn Lomborg, who famously has advocated in 'The Skeptical Environmentalist' [8], that the environment can be priced as "ecosystem services and natural capital, assigning it a value that looks dangerously like a price"

The result of the latter is that whoever wants to see tigers or a Javan rhinoceros in the wild, must come up with the money themselves, enabling those not bothered to dodge responsibility for wanton destruction of the planet known as 'Ecocide' [9]. A interactive map of the species that have gone extinct in the USA shows the astonishing lack of management of resources of the past two centuries [10]. This terrible attitude ignores what future generations may want. Extinction is forever and people alive today have no right to decide which flora and fauna are worthless. On such principles, even primary education could become available only to an elite. Slogans can always be devised by environmental crisis deniers. For Lomborg supporters, it has always been that people-focussed growth is more important than biodiversity or other ecological considerations. For Australians in the recent vote on aboriginal rights it was "if you don't know, vote no", even though the previous campaign claimed the rights were too prescriptive.

The "Three Rings" Solution

The author has developed the concept of three doughnuts as a development of that in Figure 1. The fundamental of the Three Rings solution and the necessity for such a methodology is that people in the developed nations would not support any suggestion of a leap to an egalitarian world, that led to massive debts, simply to satisfy critical voices considering only the underdeveloped countries situation. Exploitation has occurred in what is now the developed world. It was for the benefit of rich elites not the poor of those countries. Wealth for the people has emerged from those in power taking responsibility for democracy and human rights. What is needed is a good will between underdeveloped, developing and developed nations and it is proposed that the Three Ring Doughnut solution will enable this.

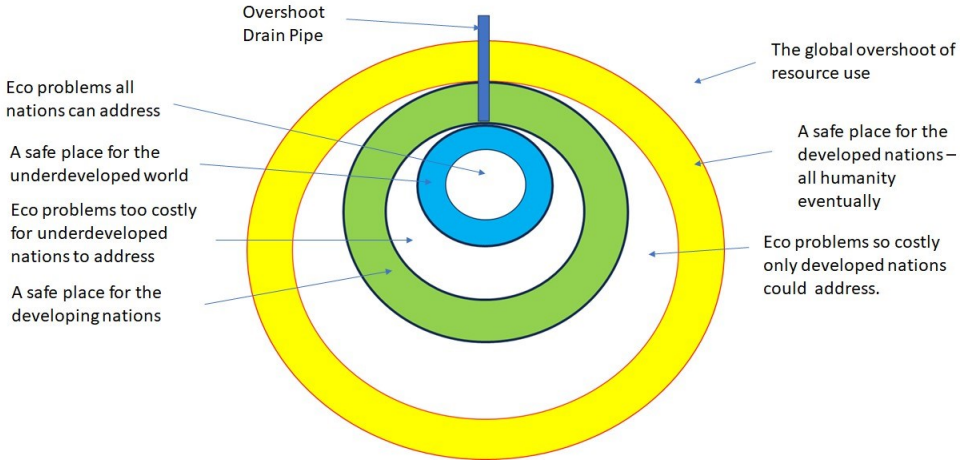


Figure 2. The Three Ring Doughnut

In the model, the developing and underdeveloped nation doughnuts only impinge at a tangent to the economically more powerful ring, or rings, within which they sit. This represents the responsibility to help nations with less powerful economies and political institutions develop; it is not reciprocal and poor economies should be able to depend on richer nations to help with environmental and social problems. The drain pipe in the diagram (Figure 2) illustrates that an underdeveloped country should consider some forms of pollution it creates as overshoot for all countries. The more highly developed the end-user, the more responsibility must be taken.

Ring Parameters for Different Applications

Each ring will have parameters in the planning of a project that differ from the parameters of other projects. Aspects of life of those affected by the project but not necessarily direct stakeholders can be improved by the project if enough thought is put into planning. It is important to orient benefits of the project for the best advantage of communities, especially if the project is in one of those countries identified as underdeveloped. The project should check to see what the people involved and the local economy are missing of the United Nations goals [7]. Next, put in measures and costs to ensure that at the very least nothing decreases the welfare of the people or is damaging to the environment. Such ethics may be highly beneficial to sales as people become more aware of the need for conservation.

A rough guide for a start might be to choose the inner third ring as representing those countries where the average wage is $100 or less per month. Developing countries could be exemplified with wages from $100 to $1000 per month, Malaysia being at the top end of that scale. Developed economies could then be defined as anywhere that monthly salaries are over $1,000 per month. None of these are definitive, each project will be different.

The Impact of AI on Economic Models

AI could be an unprecedented disrupter for human economics so it's important to consider how much impact AI could have on these models and how robust they are to the challenges and novelties posed by AI. I provide my views by considering some specific questions on AI:

Is AI just a tool to drive efficiencies helping the rich get richer or is it a significant boon to the environment by making human activities less wasteful of resources?

Our political choices will decide how much of the benefit is distributed. What Raworth noted about the market economy we can apply to AI, "Like fire, it is extremely efficient at what it does but dangerous if it gets out of control" [3]. Many disciplines have looked at complexity, including our own in safety critical engineering wherein we have to focus on anticipating emergent properties more than most. Raworth encourages embracing the complex in economics too, (see Table 1). Our grounding in complexity alerts us to incautious decisions that would be detrimental to the safe space for humanity. AI must obey and stay within the boundaries we set. The greatest benefit may then indeed come in the reduction of waste of money and time and thereby resources.

It is possible that AI will make seismic changes in employment profiles. How will that affect the economic models including the doughnut models?

There are now surgeon-controlled robots performing operations. The Royal United Hospital in Bath, declares their Da Vinci XI surgical robot will support more than four hundred complex surgical operations annually, saving time, resources and lives [12]. How AI affects current employment paradigms depends largely on whether or not the doughnut economy triumphs or the destructive aspects of the well-established historical economic models. Raworth [3] discusses two juxtapositions, self-enhancement counter-balanced by self-transcendence and openness to change counter-balanced by self-restriction.

A reasonably equitable future is possible with AI but where ever possible it must be applied to benefit people and planet, not to only provide wealth for those who already have more than enough. The key in Bath is that the hospital remains committed to providing for all citizens. Although currently under control by a surgeon, an AI computer control system would be able to make all the critical decisions leaving more of a hands-off, eyes-on approach to be taken by the surgeon, akin to airline pilots in modern digital cockpits. The RUH notes that the robot is removing health inequalities, a UN goal.

A future run by robots enslaving humans to protect the world may be science fiction, but can we envisage a world where there is an extreme reliance on AI in the future and where will that will place us economically?

Be cautious in development is the answer. The troubling questions of autonomy as yet unanswered are discussed in [13]. Where the economy is concerned there is undoubtedly the potential to impoverish billions with AI but also to enhance living for most people.

Conclusion – Don't be a Monkey

The Three Ring 'Doughnut Economics Model' is a non-egalitarian viewpoint at implementation. However, the three rings, with good will, should reduce to the two rings of developing and developed economies in a couple of decades. That is in stark contrast to the indifference that has been creating an ever-growing gap between rich and poor.

"Doughnut" economics is growth agnostic making it comprehensible to all. Using it as a tool will help identify procedures projects can engage in to help those affected by the project but not within the original specification. A researcher has discovered a group of macaques that have learnt how to use tools to open oyster shells [11]. The macaques choose the largest oysters because the rewards are greater. The oysters are now however endangered because of this selectivity. The future requires that to preserve our planet, we can continue to use tools but must resist being like the macaques. Are we intelligent enough to conserve and share our food and other resources?

More information about Professor Raworth's work and current action may be found at the Doughnut Economics Action Lab [14].

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top image: AI art from Microsoft Image Creator
fig 1: https://commons.wikimedia.org/wiki/File:Doughnut_(economic_model).jpg
fig 2: Nicholas Hales (author)

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