Scientists for Global Responsibility

SGR
Promoting ethical science and technology

Your career and sustainable development

By Dr Philip Webber

A Scientists for Global Responsibility briefing

This briefing provides insight into a new way of thinking and an innovative approach that can help you and your colleagues to work in a way that makes a positive, rather than a negative, impact on sustainability. Readers will gain greater awareness of choices and decisions regarding their work and career that will enable them to make a valuable contribution to sustainable development.

Your career and sustainable development is of particular relevance to students and graduates of technology, engineering, design and those in all fields of work involving the use of applied science.

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This briefing is part of a series entitled ***Thinking About an Ethical Career in Science and Technology***.

Thinking about an ethical career in science and technology

Thinking About an Ethical Career in Science and Technology is intended to give young scientists and engineers an understanding of the wider ethical dimensions of various careers in science and technology. Each briefing focuses on an area in which science and technology can play a major role, either good or bad, and examines the social and environmental controversies in that area. It then gives guidance on how to make an informed, 'ethical' career choice.

The special role of scientists and engineers

As a scientist or engineer you are far more likely to be involved as a key player at the vital, design stage of a project or activity or to be involved in assessing its success or failure. Your role is crucial in helping bring about a more sustainable way of life.

Archimedes is attributed as saying "give me a lever long enough and a place to stand and I will move the world". The lever was the pinnacle of technology in Archimedes' time. In today's world, science and engineering give us all, in some sense, the equivalent of huge levers to change our world. Those of us who have even relatively slender economic resources can command forces far greater than anything possible in antiquity or even a few decades ago. The average person has at his or her disposal many watts of energy, equivalent to several hundred horsepower, that can be turned on by the flick of a switch. That physical power in turn depends upon a vast chain of activities, beginning with mineral extraction and involving a global network of industry and enterprise. Our share of that global machine causes immense environmental and social impacts across the globe – of course not in immediate response to our turning the switch, but as a result of the collective and continual processes put to work to meet our whims, whether they involve driving a bit faster on the motorway, or choosing a different shade of paint for our living room walls.

So science and technology, combined with finite limits on the possible exploitation of natural resources and the environment, have put us all individually and collectively in the position of Archimedes in his vision. Together we are indeed moving and reshaping the world, both ecologically and socially.

The special role of scientists and engineers, who provide us with this immense power, is to take responsibility for helping us to decide and plan how to use it.

This briefing introduces a new and developing methodology for assessing the environmental, social and economic impacts of any activity, called sustainability appraisal. It recommends how you can use it to optimise the positive impact of your work (and ultimately your career) on the sustainability of our planet.

Better design for sustainability

As argued in the SGR briefing *Cleaner technologies: a positive choice*, there is hope that economic development based upon cleaner technologies and renewable energy sources can deliver the services people want and need with dramatically reduced negative impacts upon the local and global environment.

The route to that aim must surmount the significant problem that so much of what happens every day is so far from sustainability that iterative redesign or gradual modification may not be enough. What is needed is a revolution in design and in the application of technology. The reality of our environmental crisis is that engineers and technologists have to start moving towards designs that reduce energy use by 90% and resource use by 80%. This makes it essential for us to have reliable, high quality public transport, lightweight recyclable designs, and an entirely renewable energy-based society. In the social field it means more social equity, more wealth sharing, more public involvement and investment. In the economic sector – particularly banking and business – it means seeing the weakness and short-termism of conventional, cost-benefit approaches to analysis and properly assessing the social and environmental costs and benefits against a longer term perspective.

That is the big picture, which will require a massive amount of investment by business and government to be realised. At the individual level however, engineers and scientists in their everyday careers can have an important influence upon how projects are designed, resourced and delivered and in so doing can dramatically reduce adverse environmental and social impact. By putting the new tool of sustainability appraisal to use, you will be better equipped to design processes, products and designs, as part of the application of your engineering or science degree, which have a reduced impact upon the environment and a more beneficial impact upon society.

The problem

Products in widespread use – for example dyes, fabrics, chemicals and concrete – have been developed without any thought for their potential impact upon the environment. A product such as a photocopier is put together from hundreds of artificially produced chemicals (for example toner, synthetic polymers, rare elements). The chemicals are often very stable and thus when released into the environment as waste do not break down but instead can create long-standing poisons or contaminants. Cheap energy, in the form of coal or oil, is another important issue. As long as it is cheap compared with the costs of people's time there is little economic incentive to make more efficient engines.

For example, the car engine is an extremely inefficient means of propulsion. Only a relatively small fraction of the energy of each petrol-air mixture actually propels the vehicle. The rest goes as wasted heat and into the cooling and transmission systems. Legislation and fuel consumption targets have resulted in some efficiency and pollution level improvements; catalytic converters have been designed to absorb some of the poisonous gaseous waste products, for example (but not carbon dioxide). However, the efficiency savings that have been made over the years have been offset by larger engine capacities and add-on services such as air conditioning. Greater efficiency is often used to enable quicker acceleration rather than reduced energy consumption.

Possible solutions

In your career as a scientist or engineer you can have an impact on the priorities behind development processes such as these and upon how such products are developed in the future.

To take a more positive example, conventional floor covering manufacture uses large amounts of energy and resources to create artificial fibres which are then treated using hundreds of dyes and preservatives. The final product is durable and does the job intended, but manufacture results in chemical by-products that poison waterways and the sea. Artificial fibres are often completely non bio-degradable creating a long-term problem.

One company has completely redesigned the process. The Interface Company, responsible for providing over 60% of all floor coverings world-wide, is in the process of completely re-engineering its products' life-cycles. The company has made a conscious decision to dramatically reduce the number of chemicals used in its processes – from hundreds to about 16, much simpler chemicals, based around organic equivalents in nature – and has thereby reduced the long term levels of poisoning of water supplies. The floor coverings have been redesigned to be completely bio-degradable by the elimination of almost all fossil fuel fibres and the company can even take back old floor coverings, after some years of use, for the fibres to be recycled and reused in new products. This further reduces the need for resource consumption and reduces waste.

Other examples of positive change can, for example, include realising that a waste product is in fact a useful resource. A chemical company (Hollidays Dyes and Chemicals, Huddersfield) realised that a horrible black sludge they produced could be used as a feedstock for a dyeing business, saving tens of thousands of pounds in waste disposal costs every year. Other companies have reduced car miles, reduced wood usage and started to take a responsibility and an interest in their local communities (for example, Layezee beds, Batley, West Yorkshire – data from public environment statement).

In other cases, involving people in the design stages of project design has reduced vandalism and increased social benefit, such as where local people and children have been involved in the choice and design of parkland areas and play equipment.

Of course in all these examples (and others, given below), it is easy to say – and true – that such changes may be largely cosmetic and insufficient to result in a truly sustainable world. However, I believe that giving people the tools to expose the impacts of their daily lives or occupations is a vital step towards the goal of realising a more sustainable world, as it gives us the means to gradually (but fundamentally) redesign how we live and work.

Impacts at work: assessing your product or service

So how can you hope to have an impact upon your workplace? You can start by gaining a better understanding of the impacts of the products or services offered by the company you work for.

The new methodology for assessing environmental, social and economic impact introduced here – sometimes called sustainability impact assessment or auditing – should help. This still-developing branch of impact analysis is now a requirement of all Regional Development Frameworks, local development plans and transport plans. Best practice and guidelines for use are still under development and applying the approach to a regional development plan presents a challenging task.

However, the assessment methodology can, with relative ease, be applied to product design or to specific well-defined projects – for example building a dam or a new brand of wallpaper. The key thing about sustainability analysis is that it will expose the impacts of the various elements of a project or job and, more importantly, can offer pointers for ways of reducing adverse effects and for increasing benefits at the design stage. Often, the results of a good sustainability analysis undertaken at the project design stage result in a cheaper project or product with positive social and economic benefits. Sometimes the approach raises more questions than it answers, but at least the relationship between the benefits, which we often take for granted (or of which we are ignorant) and their environmental, social and economic impacts can start to be seen.

The approach

To get a grip on these impacts, the sustainability appraisal framework set out in the box "Sustainability assessment: the checklist," prompts various key questions to initiate the thinking process. The assessment goes beyond accepted environmental, cost benefit (economic) and social audit analyses and postulates a framework in which all three are considered together – rather than as issues to be traded off against each other. This is important. We are accustomed to trading economic growth for environmental damage but in this type of analysis, all three elements must be satisfied at the same time, to produce a "win-win-win" solution.

The checklist provides a set of criteria against which you can start thinking about the impacts – positive and negative – of the issues or activities in question. The first step is to use the list to guide a scoping exercise, which establishes the main impacts of the activity. Then, having established the chief impacts, it can be used to "home in" on each of the impacts, and to try to establish the physical, social or economic scale of the most important ones and the timescale of their effects.

Having done this, you can identify which impacts present opportunities for reduction or for creating some or more benefit, now or in the future. With good data you can also try to establish whether key impacts are above or below critical levels (above which the activity is deemed unsustainable).

Finally the activity or product can be redesigned to minimise the impacts – or abandoned, if the outcomes are too bad. For an example of this process, see the text box: "The hanging baskets project" (p7).

Of course, it has to be acknowledged that almost in every case, no single person has the power to make much difference. But although it's easy to feel that your minor effort is worthless in the face of huge economic forces which routinely ignore social and environmental costs and focus on reducing economic costs (often by "externalising" the social and environmental costs) remember that in the long term, someone else (i.e. all of us) pays for the resultant social or environmental ills, whether through job losses, dangerous working practice or a polluted environment.

In some cases, it may be possible to use this approach roughly to assess the impact of a career or an occupation. Usually, a career path has many diverse impacts which are more to do with how things are done (i.e. designed and managed) and which are not an inevitable or unavoidable part of the job.

Sustainability assessment: the checklist

Workplaces in the UK, and across Europe and North America, have developed checklists like the following, which are used as prompts for checking sustainability. Three major headings are usually used: the environment, society/community and economy. Sometimes a fourth, fundamental issue is identified with a heading – that of preserving natural resources – but usually this can be included with the environmental issues.

1. Environment and natural resources

Are global and local environments and natural resources conserved and protected? For example:

- Does the activity or product help keep emissions of greenhouse gases to within environmental capacity (by means of energy conservation, renewable generation etc)? The UK is aiming for a 60% reduction in greenhouse gas emissions by 2050.
- Does the activity use natural resources prudently and preserve sufficient stocks for the future (by means of waste minimisation, recycling etc)? Consider whether the activity could carry on for over 100 years using existing technology. Ultimately over 95% of any product should be recyclable. UK and European targets are approaching the 50% level.
- Is an attractive and biodiverse environment supported? In the UK is open space protected and is wildlife considered? Are wildlife areas or biotopes conserved (seas, forests?). Are fish stocks and carbon sinks created or protected?
- Are there any processes that result in harmful, bio-accumulative materials passing into the environment or food chain? This should be covered by the Environment Agency but new chemicals and products continually present new challenges.

2. Social / Community aspects

How does the local or global society / community benefit? For example:

- Does the work/project benefit the community or society in any way?
- Does the activity rely exclusively upon car or air travel? This should be avoided.
- Does the activity help keep levels of crime low enough for communities to function effectively?
- Is air pollution controlled to safe levels? This is monitored by the Environment Agency in the UK. However, a multiplicity of agencies would need to be involved in any air pollution control area.
- If in health care, does the programme devote more than 5% of the resources designated to "cure" the disease to its prevention?
- Will the project empower people to take part in a functioning local community?
- Will it provide learning resources to enable people to take an active part in society?
- Can it ensure lack of discrimination on grounds of ability, sexuality, gender, race?

3. Economy:

Does the work / project benefit the local economy and create wealth? For example:

- Will it provide worthwhile jobs? (i.e. jobs that are likely to be longer term and which pay above the minimum wage or perhaps are part of community enterprises).
- Is there recognition – and ideally payment – for all occupations supporting the community (for example child-care)?
- Does the activity tend to concentrate wealth or is it part of sharing it? Wealth sharing can be as important as wealth "creation" if society at large is to benefit.

Flaws and benefits

Of course, any list like this will be flawed. Apart from the fact that it will be incomplete, the definitions themselves beg several difficult questions. For example, what level of greenhouse gas emissions is within environmental capacity? Even if we imagine a near-perfect country, which had a form of development that met all these ideals and was approaching sustainability – would it actively support similar forms of development in other parts of the world? Would it give some of its resources to help this happen? Would it trade fairly with partner countries? In any case, none of this, clearly, can be expected to occur in regions suffering violent conflict or where wealth is not reasonably shared.

The list is, of course, highly idealistic. But the idea is not perfection of concept, rather a beginning of a means to judge sustainability. And it has been endorsed (although not in this precise form) by the UK Government in *A Better Quality of Life – a strategy for sustainable development for the UK* (DETR 1999).

Closing thoughts

The typical, modern, developed country lifestyle is based on – and runs on – high levels of consumption of raw materials and energy. It may sound like a truism but all such activities must happen within two "possibility" envelopes: the levels of available resources and (often ignored), the capacity of the ecosystem to absorb and process waste outputs.

To use an economic analogy, the ecosystem supplies us with capital – resources such as fertile soil, building materials, and fossil fuel – and a certain level of services (recycling of water and other waste materials). The ecosystem also supplies us with a continuous revenue stream (a regular income) in the form of solar energy, which is utilised by farming and horticulture. However, for the most part, humanity has ignored this regular income and has concentrated on picking up and spending the wealth (capital) that has been lying around for millions of years in the form of fossil fuels.

In most parts of the world, and particularly in the industrialised countries, the whole economy and people's lifestyles rely upon high levels of exploitation of this natural capital (wood, fossil fuels, minerals). The high consumption levels are accompanied by high waste outputs. Currently, total world consumption is at a sufficiently high level that some key waste outputs are getting beyond, or may have already exceeded, the capacity of natural systems to process and recycle them. The most obvious examples, covered in more detail in the briefing "Career choice and climate change," are climate-modifying gases such as CO_2 and methane. Other examples are declining areas of available fertile soil and sharply dropping levels of sub-surface water across huge areas, for example in China, India and Africa.

Human activities are resulting in impact and consumption levels that are greater than can be sustained either by the available global economic resource or by the overall capacity of the global ecosystem. This is a recent world-view that has taken just 50 years to develop and is uniquely associated with the late 20th Century and Third Millennium. We are therefore faced with a unique, and critical, challenge.

Further reading

The whole issue of sustainable development is a new and fast-developing field. As such it is not possible to list definitive reference works. UK government departments responsible for this area have been restructured three times in the last few years and house enormous numbers of documents that need to take account of sustainable development principles – for example development plans (or 'frameworks'), transport plans and all other strategies, such as farming policies. While a web search will yield useful results it is worth bearing in mind that many documents are modified and revised on an ongoing basis and governmental structures can change rapidly.

The Government-hosted site http://www.sustainable-development.gov.uk/index.htm provides many useful links to UK policy. This includes references to "Greening Government" and the Environmental Audit Committee. See also Government departments such as DEFRA (Department for Environment, Food and Rural Affairs: http://www.defra.gov.uk/) and the ODPM (Office of the Deputy Prime Minister: http://www.odpm.gov.uk/) and the Cabinet Office (http://www.cabinet-office.gov.uk/ in particular *Resource productivity: making more with less* – a report published in November 2001).

The hanging baskets project

A group of people decide to brighten up their community by putting up some hanging baskets for summer. They decide to buy all the necessary components. They purchase a PVC bowl with a metal bracket fabricated in India by children. The bowl contains peat and is decorated with sphagnum moss. The basket chain is made from aluminium from Germany. The plants are flown in from Holland and tap water; artificial fertilisers complete the picture. Two days after they are put up, local kids pull some down and one gets thrown through a shop window.

This hanging basket is a symbol of un-sustainability at its worst, posing as an environmental improvement. Prettiness hides child exploitation, environmental desecration and high energy and resource use and the local community feels no sense of ownership.

Let's instead assume that our basketeers do some better advance planning. Rather than taking their garden cuttings to the local tip and throwing away their waste food they compost waste for a year and build up a stock of good quality compost. They then involve local schools who have been encouraging pupils to plant seeds and grow them on to seedlings as part of the National Curriculum. A local craftsperson is commissioned to make a wooden bracket and to use UK-produced galvanised steel chain. The bowl is made from a bio-degradable plastic produced from recycled plastics. The formerly sphagnum moss lining is achieved by use of a waste wool material. Local people and children from the schools are involved in placing and hanging the baskets and each has one to look after.

The net result is the same product but with dramatically reduced environmental impacts, no child exploitation, some local job creation (or support) and a sense of community pride. This same approach has, in reality, led to the creation of a sustainable hanging basket service and several jobs (in West Yorkshire, UK).

This is still simplistic. Why would local kids want hanging baskets anyway? Now that the Indian children cannot sell the brackets how can they support their family? Will they resort to less savoury occupations? Other solutions, based on similar approaches, to these parts of the problem are required. There are major buyers such as B&Q who are developing a social conscience and developing health and safety programs for children and other employees with unacceptable working practices to reduce the risks to them and the local environment. Fair trade agreements can also result in better wages.

The beauty of this type of approach is that it can be applied to almost anything, from a major dam project to a local play area.

A Better Quality of Life – a strategy for sustainable development for the UK (DETR 1999) is an update on the first strategy published in 1994. A fully updated strategy is planned by 2005.

Local Agenda 21, a comprehensive action plan at the local level for the 21st Century, first drawn up at the 1992 Earth Summit in Rio de Janeiro, should now be integrated into Community Strategies, which all local authorities and "Local Strategic Partnerships" have to draw up. Early guidance documents were produced by the (now defunct) Local Government Board.

Various new regional bodies have drawn up Regional Sustainable Development Frameworks. The content of these is subject to continual revision but try for example http://www.yorkshirefutures.com/ or http://www.oursouthwest.com/.

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Scientists for Global Responsibility SGR *Promoting ethical science and technology*

About Scientists for Global Responsibility (SGR)
SGR promotes ethical science and technology, i.e. that which contributes to peace, social justice and environmental sustainability. Our work involves research, education, lobbying and providing a support network for ethically-concerned scientists. Founded in 1992, we are an independent UK-based membership organisation.

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