Engineering a Sustainable Framework.

In the past, engineers have been very good at core engineering areas such as Mechanical, Electrical, Electronic and Chemical Engineering, however we appear not to have been so adept at aligning this excellence with social economic and global sustainable needs. The last decade however has seen a steady shift in emphasis and for example the issue of sustainability is now well established in the field of engineering, although I suspect not fully understood by all. One of my own areas of expertise was plastics and this has seen the general public turn against this material particularly in the context of packaging, ocean plastic waste and the Grenfell Tower fire. All these are totally legitimate causes for concern and for me it has resulted in a lot of soul searching about how engineers in general should rationalise their own professional activities.

In the 1990s I was privileged to meet and work with a Dr John Westhead who was a Fellow of the Institute of Electrical Engineers and at the time the Chief Executive of an electronics company known as Bowthorpe Holdings. John had a brilliant mind and when I quizzed him about how he selected new innovative companies for his organisations I recall him saying. "It is quite simple, I ask three basic questions. Is it legal? Is it ethical? And is it profitable?" At that time he was only thinking in the context of buying a new company, however I now see that if this criteria is broadened, a framework for sustainable engineering and other activities can be constructed.

Is it legal?

There is no doubt that society needs enforceable laws however there are a number of problems with the apparently straightforward statement that an engineering or other activity needs to be legal. Unfortunately in some essentially non democratic countries rulers can create their own rules for their own advantage which makes legality a very grey area right from the start. In democratic countries there are also difficulties that can, for example, be seen from the Grenfell Tower Fire where it would appear either through complacency or ineffective legislation, the fire regulations for certain building materials was completely inadequate. A further problem with the area of legality also occurs with the ever increasing speed of technological innovation. The dramatic emergence, for example, of the internet in the last twenty years resulted in a "wild west" environment where internet providers had essentially a free hand without having to comply with any rules. It is only now, some twenty years later that some of the main players are being brought to account.

Is it ethical?

The term ethics is not often debated by engineers, but in my opinion it is at the heart of right and wrong engineering practice. Something may be legal at a particular time but unethical and it is ethical practice that should guide engineers towards developing ethical sustainable technologies. In the case of Grenfell Tower, in my view, it would be both unethical to manufacture and apply a potential fire risk building cladding with a material such as polyethylene that has a melting point of 130^0C and at 300^0 C has the properties of candle wax. In another plastics related instance, the problems with Ocean microplastics and plastic waste is not new, but the scale and extent of the problem is now known. Legislation has not yet fully kept up with the control of plastics but engineers and technologist should now have an ethical responsibility to take on board the consequences of their work in plastics technology.

Is it Profitable ?

Unless there is a benevolent backer to an organisation or the activity is a charity all organisations in the long run need to be financially profitable, but the term profitable can be broadened to cover other areas as well as financial profitability. The term can be thought of much more generally and used to think about the general "profitability to society" of the exercise. Profit should not be just about money; it may well be a necessary condition for an organisation but it certainly is not a sufficient term. Multinational companies are now aware that they need to satisfy sustainable and environmental criteria and the cost, for example, of the BP Gulf of Mexico oil pollution and the VW diesel emissions scandal have hit companies where it generally hurts them most; their wallets and share price. Surely all future engineering operations should be justified in a general profitable sense and not just by monetary profit, in the long term this should benefit everyone.

My hope is that current leading engineering institutions, Universities and companies take on board the importance of good sustainable engineering practice and ensure that all future engineering and other related endeavour are **legal, ethical and profitable** where these terms are taken in their general, rather than specific sense.

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