Edward Thompson

Finalist in the 19 to 24 age category

Are engineering and technology essential for future development?

I used to get a weekly sense of British contentment from cackling at Clarkson's scathes about every vehicle that did not bear the Aston Martin badge. One day, my smile was wiped off by an advert which read "What have engineers ever done for us?"

That advert made me rethink what I believed engineering to be about, as at the time my personal statement was naive, uplifted by an unwritten sentiment that going into an engineering career would fulfil a wide enough range of clichés to make Band Aid's 'Feed the World' look like an anarchist rant. My reasons for being in an engineering career evolved into "advancing human development" or "developing engineering solutions to help society's progress". These abstractions are widely accepted, but I never considered (until now) exactly why engineering and technology are conducive to progress. I dug around, looking for evidence.

Economics
Engineers and technologists tend to be uninterested in dreary descriptions of economic concepts. However, uninteresting does not imply unimportant. Briefly explained, modernisation theory describes how the modernisation of a society through investment, development and implementation of technologies into a society brings about direct social, economic and cultural benefits to that society's people.
Often omitted in this theory is the vulnerability that reliance on technology quietly enforces. Failure of the technological systems that run our lives would result in an instant return to agrarian culture. If you don't know how to farm already, sorry – there's no 'app' for that. No such disaster has occurred, but climate change may yet surprise us. Engineering and technology will protect us, and yet leave us more vulnerable than we would like to consider.

Politics
Evidence exists, but does not prove the modernisation theory. I mentioned 'Feed the World' earlier - it was relevant. The magazine Current Concerns believes that "if the Democratic Republic of Congo exploited their full agricultural potential, they could feed all Africa and countries in the EU". Given that, why can the DRC not even feed itself? Well, corruption has entirely suppressed investment in basic technological essential in all areas of society leading to widespread poverty, crime, political unrest and the vicious circle which has gripped many African countries. Here, corruption is an obvious suppressor of human development.

Philosophy
Last year, I drove 5000 miles across Russia and throughout the trip I could not understand how such a powerful G8 nation could be so underdeveloped in anywhere other than the major cities. The lack of good roads (or roads at all) and shouts of "Нйт Бензин!" ("No petrol!") at so many petrol stations prompted me to research what has impeded her progress so much.

For a long time, Russia's philosophy was communism. The country created a society in which the fundamental concept of property rights (both intellectual and physical) barely existed. Hesitation to establish any proper legislation regarding these rights meant that both public and private investment in engineering, technology and general scientific advance was entirely insufficient and damaging to their economy. "Russia's post cold war technology sector was composed largely of a handful of elite state-funded scientists and engineers" (Financial Times, May 2009) and the halls of the Kremlin echoed with proud leaders' intentions of creating a 'nationalised group effort' in science, omitting (perhaps deliberately) the fact that technological development of these scientists and engineers was only being used to feed the political agenda of the era. Who knows whether this was done out of greed, or out of their persistent belief that the communist regime would, in the long term, provide economic growth and social expansion. Either way, this example shows us that even with political stability and (some) appropriate investment, without a shot at personal gain through invention or innovation, national development will suffer.

Politicians love to throw around abstract nouns. For example, "Development survives off investment in engineering and technology" as if development were some kind of Palaeolithic creature thriving off financial grovelling, but we must realise there are more sensitive issues at stake. My point is that yes, engineering and technology are essential to human development, but society requires responsible decision making and a supportive political agenda to attend to widespread social needs. Future development through engineering and technology demands three clauses, on individual, group and holistic levels: Individuals must have proper incentives, corporations must have sufficient operational freedom and most importantly society as a whole must be culturally, economically and structurally open to technological advance.

Luckily, here in the UK, we have all three.

Thomas Dean

1st Place in the 19 to 24 age category

Are engineering and technology essential for future development?

The classical Greek philosopher Plato said “necessity is the mother of invention”. This quote still rings true today, at the dawn of the twenty first century. As we enter an age of uncertainty with the threat of climate change, exhaustion of natural resources and economic insecurity, engineering ingenuity and practise is perhaps more vital than at any other point in history.

Between 1798 and 1826 the British scholar Thomas Malthus published six papers entitled ‘Principles of Population’ containing his theories concerning population dynamics. He observed that ‘checks’ such as famine, disease and war would ensure the population would remain at a sustainable level. However in 1965 Danish economist Ester Boserup proposed the idea that agricultural methods depend on population size. As the population grows, new techniques are found to cater to the increased need, embracing the premise that “necessity is the mother of invention”.

Now in 2010 with a global population of around 6.9 billion people, according to the United Nations Survey in 2009, advanced farming techniques are capable of a far greater yield per acre than has previously been thought possible. Progressions in genetics have increased the resilience of crops to harsh climatic conditions and disease, enabling them to be grown in previously desolate environments; suggesting that Boserup was correct in her assumptions.

However evidence that supports the Malthusian school of thought still exists. Although enough food is produced every year to feed the entire planet, people are still dying from famine. Grain mountains build up in European silos in order to keep the open market price high, whilst 792 million suffer from a chronic food deficit (Food & Agriculture Organisation, 2000).
Although genetically modified crops have been engineered to grow in arid and adverse conditions, benefitting areas of drought and malnourishment, they have also been altered so that they do not produce any seeds. Although originally researched for more convenient consumption of certain fruits, this trait also means that farmers are dependent on purchasing more seeds from the supplier after each crop. Basic medical care taken for granted in more economically developed countries is an unavailable luxury for 270 million children in the developing world.

So it could be argued that new technology is not necessarily what is required for future development. Methods for sustainable energy production, clean water and plentiful food supplies are no longer visions of the future, but readily available right now. It is more the improved distribution and implementation of these existing technologies which is the key issue.

It would be shorted sighted and naive to suggest that technological advance should plateau at its current state. The more progress that is made to improve current methods for energy production and resource management, the greater the benefit will be to humanity. However efforts should be made to focus innovative efforts away from commercial novelties and focus placed on solving the life changing challenges that face humankind.

Any engineer would tell you that a system where the majority of the power is consumed by the minority of components is grossly inefficient, and needs improving. Yet this is exactly the situation our world is in. According to the ‘World Development Indicators 2008’, published by the World Bank, the richest 10% of the global population consume 59% of the world’s energy, where as conversely the poorest 10% only consume 0.5% of the world’s energy.

Advances have been made to try and restructure this imbalance to ensure the spread of basic amenities, such as reliable electricity, water and sanitation, across developing countries by many nongovernment organisations. But it is very apparent that there are numerous economic factors intricately entwined with the development and implementation of beneficial new technology.

Therefore I propose that the question should not be “if engineering and technology is essential for future development?” but instead “how will we use engineering and technology for future development?”

The technology required to sustain the population, and the planet, in the future already exists today. It is the challenge of engineers to ensure that it is accessible to all and applied efficiently, providing the greatest effect and benefit to civilisation.

In the future we will need to look at engineering for a different economy in order for the human race to advance and flourish. Not an economy based on financial wealth and personal gain, but an economy of grace and compassion. An economy based on the priceless value of life itself.

Rosemary Jackson

Finalist in the 19 to 24 age category

Are engineering and technology essential for future development?

It is widely considered that the Romans were the first to discover glass in the first century AD and thus the first to realise that glass which is thicker at the centre and thinner at the outside magnifies any object being observed through it. During the 13th century scientists began to realise the benefits of being able to magnify subjects and began using the lenses to study tiny insects and the lenses became known as “flea glasses”. By the 16th century the first simple microscopes were being commercially produced, followed shortly afterwards by telescopes. Since then magnifying glasses, microscopes and telescopes have been developed and refined to such an extent that we can now explore subjects on an atomic scale.

This ability to build upon the power of our natural eyesight has allowed us to make advancements that would never have otherwise been possible. Had the Romans not discovered glass, would ‘science’ have come to an effective standstill after a few centuries? It is certainly a possibility. When we have exhausted ourselves trying to manipulate matter on one scale we look to getting closer and closer and more in control of what we are doing, eliminating the luck one might say, and looking for technologies to grant us access to this lower level.

We increasingly require devices that use these more sophisticated technologies to compensate for our ‘out of date’ eyesight. The fashion in science it would seem is to be able to see things on a smaller scale than ever before. And how does one go about incorporating a new technology in to a useable device? Through careful engineering of course. Even when we get there though, when we can see and manipulate individual molecules, it is engineering again that takes us forward.

Nanoscience is a prime example of how advancement in technology, enabled by careful engineering, is opening up new doors for science and offering fresh opportunities for development. The Royal Society definition of nanoscience is the “study of phenomena and manipulation of materials at atomic, molecular and macromolecular scales, where properties differ significantly from those at a larger scale”; take simple aluminium foil, when it is cut up into tiny pieces that are on the nanometre scale of x10 9 the small pieces become unstable and explode.

Simple materials around us, of which we believe we have realised all the uses, can be transformed completely by studying them on the nanometre scale. Despite engineering bringing us this far however, it still has work to do, as it is what we then do with these materials on this scale that can transform the direction of science and have a massive impact on our lives.

Looking again to the Royal Society, their definition of nanotechnologies is “the design, characterisation, production and application of structures, devices and systems by controlling shape and size at the nanometre scale”. Not only has engineering enabled us to study materials at this tiny scale but it also allows us to exploit the contrasting properties that materials may have at this scale to develop these structures, devices and systems. Consequently nanotechnologies are making an impact on all areas of our lives. There is practically an example to fit every situation. The application of nanotechnologies is resulting in developments in healthcare, security, cosmetics, computing, electronics, construction, sun protection, the environment, food and drink, packaging, paints and coatings, sports and leisure, textiles and clothing, transport and energy.

Nanotechnologies are inescapably touching and shaping our lives. Businesses all over the globe are exploiting nanotechnologies to produce smaller, faster and more sophisticated electronic devices; more broadly nanotechnologies are providing a much needed source of opportunity for businesses to tap in to with the American Natural Science Foundation estimating that there will be a $1 trillion global market in nanotechnologies by 2015.

It is by no coincidence that in recently published reports by both the Conservatives (“Making the UK the leading high tech exporter in Europe”) and the Royal Society (“The Scientific Century: securing our future prosperity”) science, technology and engineering lay at the heart of recommendations for securing long-term economic growth and economic sustainability for the UK.

I see the future as a place where I will be healthy until I am nearing one hundred. I see it as a place where terrorism isn’t a concern for our society because security systems are more sophisticated than we could ever imagine. For me the future looks fresh and clean and, carbon neutrally, engineering is going to get me there.

Joseph Wee

Finalist in the 19 to 24 age category

Are engineering and technology essential for future development?

Technology can be introduced as loud as a space shuttle lifting off into space, or as subtle as a new silicon chip that makes our lives slightly more convenient. Either way, it is happening daily. Is engineering and technology essential for future development? Essential might only be an under-statement. In so many ways that technology has an influence on the things that we do, hear, taste and feel. It has changed our lives, often without us realising it.

When it comes to leading the "cutting-edge" technology, if it's not from military then it must be from the medical field, and soon others will follow. CT imaging that was used to probe into the lives of immortal pharaohs and kings is first designed to save the living. The integration of engineering with other disciplines such as biology and chemistry has resulted in numerous breakthroughs in manufacturing more efficient drugs with better targeted delivery. The future without cancer is possible. A bigger involvement of electronic engineering has vastly improved the quality of medical care, introducing prosthesis such as ears and arms to replace what people had lost, or were born without it. The movie "A.I." was once a fantasy story that gave us a glimpse of what's possible in the future. Yes, every future begins with a dream.

Speaking of dreams, aviation was once only a dream, first brought to life by the Wright brothers in 1903. Since then people have travelled faster and further, reaching beyond what was thought impossible. Technology is not only about the big things that leave people in awe, but also things as small as a step on the brake in your car that also signifies a step in fighting energy losses and climate change. Regenerative braking system and Shinkansen bullet trains are only part of the numerous technological advancement that we have seen in the transportation sector. The future without distance is possible. Frank McCourt once said that the sky is the limit. Apparently he's wrong. There are already footprints on the moon.

Heavy Carbon footprint is in fact one of the by-product of our deeds in engineering our world. The energy sector alone accounts for one third of global greenhouse emissions. However, energy is and will be the main driving force of human development. Since food was accidentally rolled into the fire 1.8 million years ago and possibly transforms us into the dominant species, energy usage has been an inseparable part of our lives. It brings light into darkness, to keep us warm when it's cold, to achieve tremendous things with the flip of a switch. Engineering and technology has brought us here, and it will continue to lead us into a future where everything is less powered by fire and combustion. We will look at the energy sector like never before, and technology has enabled us to do so. The development in renewable energy such as wind, wave and solar has given us a peek into the future that we can tap into a whole new area of infinite resources. The future without carbon emissions is possible.

Technology is like a young cub; it must couple with economic sense to thrive, carefully regulated and comprehensively enforced to keep it under control. Technology such as Carbon Capture and Storage (CCS) will never make sense without government incentives and high carbon emission prices. The balanced technological development alongside regulation and economics is extremely important, or technology will only turn into yet another problem for our future generations.

In view of all the global challenges, taking a step backward into cave living will not solve the problem. Acknowledging our past mistake is a step forward, and the second step is knowing that science will take us there. A tremendous challenge lies ahead of us as we try to usher in a greener and more peaceful future, and at times it seems daunting. But there is still hope. Engineering and technology is in fact the amazing grace for mankind. Because of it, human kind will advance forward into spaces where no one has ever been. Because if it, the deaf hear, the blind see, was lost but now am found.

Lisa Mears

Finalist in the 19 to 24 age category

Are engineering and technology essential for future development?

Bio: Logical answers for future development.
Biotechnology and biochemical engineering

The Industrial revolution transformed the way we pursue our everyday lives, creating the economically driven, socially unequal, resource draining world we now live in. A new bio-revolution is essential, not only to stop this self destruction, but to reverse the damage, and create balance, as nature intends. Cells are advanced, natural, machines, for an endless array of processes. Enzymes are biological catalysts, triggering fast and specific reactions. If we can realise the potential of these natural wonders and learn how to utilise them responsibly, we can progress to a future in harmony with our surroundings. Sustainable development is now a responsibility of engineers, to allow future progression, which is not just focused on the current environmental crisis, but also encompasses social issues and economic benefits.
Consider the sustainable world of our future...

Imagine buildings as alive as the inhabitants, as dynamic and sensitive as the natural world. These fully self sufficient dwellings, source water from the surrounding environment, and create power with rooftop photovoltaic cells, harnessing the natural energy abundant from our sun, operating pollution free, where there are no wastes, only outputs which become inputs to subsequent processes. For instance waste water streams cleaned by thriving bacteria and sunlight, generating heat whilst creating a clean recycled water supply. Photo-luminescent bacteria create natural light as they live in engineered vessels, and responsive photocells adjust their output to the surrounding brightness. Buildings will be engineered to be sensitive to the weather, rather than generic regardless of climate or culture, creating and retaining heat efficiently when cold, and retaining water when dry, as well as maintaining air quality by passive ventilation technology. Intelligent materials of construction could aid the environmental benefits: "We aim to program protocells to make carbonates from carbon dioxide, thus acting as a 'carbon sink'. This is the first step towards developing a 'smart' surface coating that could extract carbon dioxide and other pollutants from the environment.'' Dr Rachel Armstrong, UCL Bartlett School of Architecture. The technology is in development and engineers are needed to implement these revolutionary ideas.

Fermentation technology, instead of oil refineries, will dominate the fuel industry. Instead of diesel, we have green algae processing: Reproducible, efficient, and sustainable, all words an engineer likes to hear. Large photo-bioreactors, utilise the sun's abundant energy, growing algae which produces clean oil. The company PetroAlgae is developing the technology successfully. 'Micro-crop fuels are carbon-neutral, consuming nearly double their own weight in CO2. The PetroAlgae system recycles 98 percent of the water used' It can be used on land unsuitable for agriculture, and produces no toxic waste. After processing to extract fuel, a high concentrate of protein remains which can then be sold as a human or animal nutritional additive. Other fermentation processes use highly efficient, engineered enzymes, to convert common agricultural waste, in particular cellulose, into glucose. Bacteria then metabolise the sugars into bioethanol fuel. This single stage process, known as Simultaneous Saccharification and Fermentation provides a supply of continuous biofuel production, without impacting on food supply. Process optimisation to reduce costs is the role of engineers to push this industry into reality.

Health-care has become health-regeneration. Instead of treating symptoms of disease, regenerative medicine technology allows us to reverse damage, and restore function of the body. For diabetic patients, currently needing to inject insulin every day, we can instead restore function of the pancreatic tissue, and end treatment, which also reduces the risks of the long term complications of diabetes, and reduces the ongoing cost of treatment. With the current demographic of developed countries shifting towards an older population, the ability to treat degenerative diseases associated with ageing will be of great importance. There are endless possibilities for regenerative medicine technology; Neurone repair therapy for Huntington's and Parkinson's disease, replacement corneas to restore vision, the growth of whole organs for transplantation, or even the production of teeth from stem cells to replace those which are lost or damaged. Public perception is a major obstacle to overcome, however with successful scale up to mass production, this can become a vital form of future healthcare, or rather health renewal.

Biotechnology provides the answer to society's needs, and allows future development to be sustainable. The concept of Industrial Ecology must move from theory into practice; the idea that industry is a man-made ecosystem, which must interact with the environment in a dynamic equilibrium. The communication barriers between engineers, scientists, architects and politicians need to be bridged to ensure this multidisciplinary field can prosper.

Andrew Wilson

Finalist in the 19 to 24 age category

Are engineering and technology essential for future development?

"We are stuck with 'technology' when what we really want is just stuff that works."

This quote from Douglas Adams epitomises our modern relationship with technology, but couldn't be farther from the truth! Engineering and Technology now form such a cornerstone of our society that it is easy to forget that they are even there, except, of course, when they go wrong! The fact that we take Engineering and Technology for granted so much is testament to the impact it has already had on society, and hints at how things will change in the future. The only way we are going to build this future is through the work being done now in Engineering and Technology research.

Developments in basic engineering and technology have led to some of the most important breakthroughs of the 20th century. Hospitals across the country now rely on Magnetic Resonance Imaging (or MRI) to diagnose patients quickly and safely. But going back just 30 or 40 years, the idea that you could 'see inside' a patient without physically cutting them open, and even see real time images of the brain, would be laughable. The breakthroughs which led to us being able to produce these amazing machines, which provide these amazingly detailed images of the internal structure of the human body, have all come from Engineering and Physical Science research. Since its invention MRI has helped improve the life expectancy, and quality of life, for millions of people through early diagnosis of anything from Cancer to Arthritis. Current research into engineering and technology will be just as essential for what will become the big breakthroughs of the 21st century.

Research being done now in the areas of engineering and technology will allow us to solve our big societal challenges. Whether the problem lies in the global economic downturn, international terrorist threats, or climate change, it is engineering and technology which hold the key to success. New materials, such as graphene, are allowing us to engineer smaller, lighter yet more powerful computers – helping boost Britain's digital economy. 'Smart homes' are helping monitor dementia sufferers, allowing them to remain independently in their own homes. Low energy LEDs in traffic lights are saving local authorities thousands in lighting costs and preventing the emission of thousands of tonnes of Carbon dioxide gas – thought to lead to climate change. All around us, these practical applications of Engineering are shaping and developing our world for the better.

Engineering and Technology are especially important during these troubled financial times. Evidence shows that, during the major recessions of the 80s and 90s, companies who cut back on their research and development found it much harder to recover. When a recession ends it is vital for companies to still have innovative products to re-stimulate the market, and it is through engineering and technology that companies can evolve to meet future customer requirements. Those companies which maintained their research and development programmes for engineering and technology during the hard times gained dramatically in the years following. Recent reports from both the Council for Science and Technology and the Royal Society have highlighted the concentration on science and engineering in many countries' financial stimulus packages. This serves to emphasize the importance current decisions about engineering and technology will have on our economy in the future.

It is difficult to predict where engineering and technology will take us in the future. From 300 mph trains, helping us get to work on time, to medical 'nano-bots' to cure us of all disease, from innovative electromagnetic-'shields', to protect soldiers from missiles, to super-efficient light bulbs, to cut our dependence on energy and fossil fuels. We simply can't predict what tomorrow will bring, but what is certain, is that essential to all these possibilities will be technology and the well trained young engineers this will require. All of the things we take for granted today, were once the innovative new brain-child of an engineer or scientist. Although we don't know what tomorrow's world will look like, we can be certain that engineering and technology will be essential to building and developing this future.

Douglas Adams once said "We are stuck with 'technology' when what we really want is just stuff that works". We are currently technologically advanced enough to notice when things don't work. The next step from this will be the fully integrated 'Digital Economy', where technology is blended seamlessly with our everyday lives, so we never notice it's there. Engineering and Technology will be essential for this future development.

Peter Cripps

Finalist in the 19 to 24 age category

Are engineering and technology essential for future development?

From the early development of tools in the Stone Age, it is clear that the relationship between humankind and technology has always been present. Laërtius, biographer to ancient Greek philosophers, said "Change is the only constant", and technological change has been a constant in our development.

However, in 2000, academics Chaharbaghi and Willis wrote that technology is "often equated to being modern and holds out a panacea in which the future is invariably better than the past". This is because the significance of technology in human life has been ever-increasing through the twentieth-century, to the point where technology now pervades every aspect of modern society.

Driving the rate of technological change was the rise of modern corporations who invested heavily in research and development (R&D). This trend originates from Germany where industrial chemical laboratories were used to direct resources towards specific commercial objectives, and is something which remains central to some of the most successful companies in the world: Bosch describes innovation as "a key element" to their strategy" and in 2008 spent €3.9 billion on R&D alone. The rise in corporate R&D also changed the direction of technological change, shifting away from mechanics towards high-tech industries.

Engineering and technology has a wider influence than just economic development though: Nandan Nilekani, co-chairman and co-founder of the global Infosys Technologies, describes technology as playing "a great enabling role" in the social development of India. He points to affordable mobile phone technology that has connected the poor, and to the electronic voting machines that were used across a widely-illiterate India in the 2004 general elections. The case for scalable and cost-effective technology to be used for social development, he says, is strengthened by a large population and low average incomes.

So why does technological change have any opposition? Groups of textile workers now termed 'Luddites' opposed the mechanisation of their industry in the early nineteenth-century, thinking that technology was replacing workers. Now, 'New Luddites' oppose modern technology, often believing it alienates people and destroys cultures, societies and families. Even the US government in 2001 repressed technological change when George W. Bush enacted a ban on the expenditure of public funds on embryonic stem cell research. In these cases, technology was clearly not considered essential to our development but perhaps detrimental. Chaharbaghi and Willis use the term 'stable instability' to explain such examples; It refers to our natural disposition to want to fulfil our growing expectations and improve the quality of life, whilst also being naturally inclined to resist change. Plato, though, was more critical of technology itself, saying it presents us with a paradox: our survival depends on technology but our problems derive from it.

My intention, however, is not to weigh-up the benefits of and consequences to specific technologies. The given examples highlight a broader, critical point: technological change is not autonomous, but is a factor in a much larger environment. As such, technology interacts with political, economic and socio-cultural factors, and technological change may not always be the most significant of these in driving our development. For example, social developments in the early-nineteenth century empowered women and gave them suffrage, whilst also encouraging Individualism within our society that later allowed for huge economic growth and consumerism. More recently, the search for sustainable technology is surely driven by political, economic and social factors.

It may be misleading to say then, that engineering and technology is essential for future development; to do this seems to devalue the other factors which influence our development, and a technology can only be successful if it fits within the environment created by all four factors, as embryonic stem cell research in the US shows. However, the continuing presence of technology in our history is because it is a tool we have at our disposal. Chaharbaghi and Willis describe technology as "nature's gift to humankind for survival…[allowing humankind] to overcome its own natural limitations". Just like it now provides companies and countries with competitive advantage, technology has given humankind a competitive advantage over other species on the planet.

But, with engineering and technology ever more present in our society, and with it increasingly being the solution to our problems, engineering and technology's influence on the political, economic and socio-cultural factors is surely larger than ever before. This infers that as engineering and technology is increasingly adopted, it becomes increasingly important as a tool for enabling development. Whether you are opposed to it or not, engineering and technology is an addiction humans have always had: the more we have of it, the more we will need for it.