

Engineering and Future Social Problems: The Need for Responsible Development

In terms of good or bad use, base technology is arguably neutral, but artefacts and technology-based services usually are certainly designed with a purpose in mind, which is not normally neutral. We may use nuclear energy to power a city, or to blow it up. While human nature isn't changing, technology is developing faster than ever. Many powerful future technologies are on the horizon that may be used to great advantage in improving our world or society, but some may have adverse effects and may be abused. We need to consider the potential costs before we can decide whether the obvious merits are worth it.

This article is in two parts. The first considers some issues that are specific to particular technology developments, and the second considers the more human impacts of overall progress from the point of view of the seven deadly sins, simply because they cut to the core of human nature.

This article does not aim to address any issue in depth, each one could fill an article in its own right. Instead, it aims to provide a quick overview of what is coming in order to stimulate deeper analysis.

tially harmful. Here are some of the main things we can expect.

Increasing automation and volatility

As we are already seeing today, business will be restructured as Internet-based systems reorganise and often replace industrial age systems. Physical processes will be affected only indirectly, since matter cannot be transmitted electronically. Physical systems will largely continue to change on industrial age timescales—months or years, rather than minutes or seconds. However, for the great bulk of companies, physical activity accounts for a small fraction of the company. Most of what we do is in administration, organisation, information creation, processing and distribution. These roles are under increasingly powerful attack from artificial intelligence, which is capable of automating a great deal of these systems. And the Internet allows these functions to be done anywhere, they do not have to be collocated with any particular physical activity. This allows a great deal of restructuring to be done. We can look at the ideal structures and processes, and ideal groups of people and machines to occupy them. We can replace structures that have survived and evolved for decades or centuries, with new ones that can be set up, modified and restructured or dismantled at a mouse click. Workers who do not have the privilege of being an indispensable elite could be reduced to mere commodities organised by global virtual companies. They will have to re-skill regularly and will move frequently between employers, as artificial intelligence and turbulent electronic markets constantly changes the rules. So while the Internet may be a source of greatly increased wealth for a small elite, it may make a lot more people worse off as they have to compete even more with low-cost workers in other countries as well as very smart and able machines.

Local community networks and network communities

The usual focus of discussion about the Internet is on its non-geographical nature. But it has a very local side too. Local community networks are springing up

General Technology Issues

This section considers some of the implications of coming technology, both good and bad. In information technology, we are seeing rapid progress in artificial intelligence, high-speed connectivity and ubiquity of access. IT is all-pervasive, affecting every area of our lives in due course, sex, politics, religion, whatever. It helps progress in every other field—especially biomedical technology, materials science, entertainment and transport—and positive feedback loops ensure its acceleration. We also see vast improvements ahead in terms of ease of use and the cost of access to the technology. The most visible impact of IT today is in the Internet. It will greatly affect power structures, making a new batch of winners and losers. This will happen across the whole of business, society and politics. Some changes will be beneficial, others poten-

Figure 1 Evolution at work

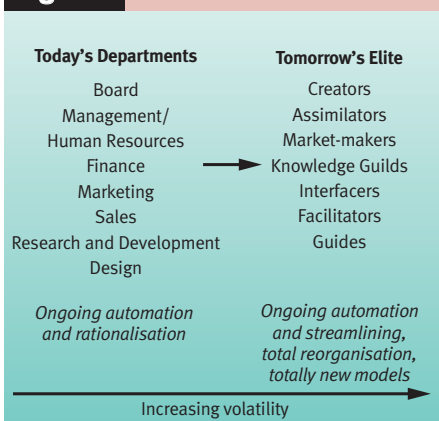
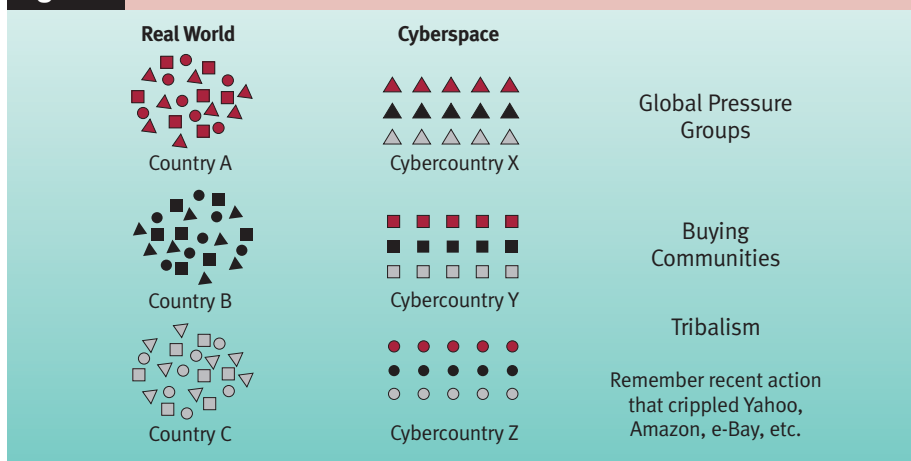


Figure 2 Network communities



everywhere. These link local clubs, societies, museums, shops and even local government on a common platform. In doing so, they encourage more involvement in local activities and decision making and generally forge improved links in the local community. In a sense, they are starting to undo the social damage done by the car, which is a previous communications technology. These community networks are polarised in cyberspace against network communities, which have nothing to do with location.

Network communities link together people of similar interests or lifestyles, or even with a single common attribute. These thrive on the non-geographical nature of the net. The same technology that allows people to be more involved in their local community allows them to be part of global communities too. But both forms allow people to wield their muscle more easily, according to either geographical or philosophical tribalism. The local community can demand more authority in decision making, forcing national government to relinquish some of its power. A network community that links together all the world's environmentalists can instantly wield enormous economic muscle against any institution at the drop of an e-mail.

And it can do this without fear of retaliation—the Net conveys potential

anonymity, and you cannot fire missiles at a cyber-community that is thinly spread all over the planet. If economic pressure does not work, they will exploit our increasing vulnerability to attack as we become more dependent on networked electronic systems to run every part of our infrastructure. Direct action could be much more effective in a few years than it is today.

So we will be at the mercy of global pressure groups on a range of issues. This will push us quickly towards more globalisation of government, again reducing the authority of national or regional governments.

New Politics

But these problems will be dealt with by a new breed of politician. Just as the television changed the required skill-sets from those of the soap-box age, so we are entering another political era.

The transparency of the Internet will be backed up by artificial intelligence and natural language processing. When we watch a speech on Internet-integrated TV in a few years time, every word will be instantly cross-referenced against party policy, statistics, previous promises, and against the opposition's viewpoints. It will be impossible to fudge and hide in the way that many politicians do today. They will also be pitted against the leaders of

network communities, not just others in the same territory, and those leaders will be most at home on the net. Politics may become a great deal more complex, but we might see an overall increase in honesty and transparency.

Cults and the Internet

Culture on the net will evolve in many ways, some of which will surprise us. Already we have seen cults flourish, as has the seedier side of our lives. Anonymous and easy access to gambling and porn have encouraged many to spend more time and money in these areas. But not all is bad. A decade ago, we realised that at some point, we would see a cyber-elite come into existence who organise themselves to police activity on the net. We thought they may be based on the Samurai, with a strict code and elite skills, with a well-defined image. Last year, we saw the net angels, basically just that. It is a small beginning, but a force for good nonetheless. Sadly, we cannot predetermine the nature of all future groups of people with such elite skills. Our vulnerability to direct action is critical. Will they blackmail our companies or societies, insisting on sacrifices to appease them? Will we have any real choice but to comply?

Social split

We often hear talk about haves and have nots, but a key characteristic of IT is that cost tends to plummet. Within a decade, 10 or 20 dollars should buy a basic access terminal that is connected to the network, wherever it is. Although even a basic terminal then would look very powerful today, the terminal may be powered by clockwork or by solar power where there is no electrical infrastructure. Satellites, high-altitude platforms, terrestrial mobile networks and of course fixed networks, will all work together to make access possible from every part of the world at low cost. This access to the net implies access to the world's education, and access to the markets. People can learn, and then make a living by selling their time and skills, wherever they may live. As we move towards full natural language processing over the next decade or so, people will need no skills to drive the system except being able to speak their own language. But we will still have a split. Many of the people around the world will relish the opportunities this affords, while others will long for a slower pace of life, that is less techno-centric. This split will not be geographical, though the proportions in each camp may vary considerably around the globe. We will have two communities—the wants and the don't wants, not the haves and have nots. There is bound to be conflict between these groups.

Figure 3 Smart e-blackmail

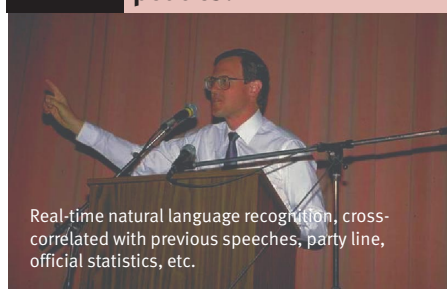
Smart e-mail, distributed to 4 billion people in under 5 minutes

Dear friends, the USA is destroying your environment through its reckless energy policy.

To support pressurising the US government to reduce emissions, just hit the YES button. Your e-commerce preferences will automatically block purchases from the USA for a period of one month.

Yes No

Figure 4 A new era of transparency and forced honesty in politics?



Cyberspace and escapism

Some of the ease of use comes from the increasing use of visual material. Instead of reading text, information will increasingly be portrayed by pictures or video. The displays, the processors, the software and the networks are being developed rapidly. People working in a virtual company may work from a local telework centre instead of home so that they still get social contact. They will share offices with other people who work for different companies. But the people they actually work with may live thousand of miles away. Their avatars will be assembled by computer in imaginative and inspiring virtual environments. Why have a meeting around a conference table when you could have it sitting with your colleagues on a Caribbean beach? Such virtual environments will be used for leisure too. We may spend much of our leisure time virtually in places that we could never go in real life, either because they are too far away or don't even exist. But the interfaces will become so convincing that there may be little sensory difference between reality and imagination. We can expect the creation and management of such virtuality to become a very large industry, probably bigger than television. But again, there will be a cost. As occasional escapism, there is probably little danger, but some people will spend a lot of their time in this way. They may become more familiar with virtual life than real life. If their real life is uninspiring for whatever reason, they may spend all day in virtual reality, where they can behave as they wish in an environment that could be customised to their idea of heaven. When they return occasionally to the real world, their social relationships might suffer significantly. If they are killing hundreds of people every day in a future version of Doom, which by then may appear indistinguishable from reality, they may be less reserved about showing violent behaviour in the real world. If all the women in cyberspace always say 'yes', how will they behave when a real one says 'no'? More anti-social behaviour,

Figure 5 Teletravel could be across time as well as distance



including increased violence and rape might well prove to be one of the social costs of such escapist technology.

Virtual environments may also be used for teletravel. Checking out a resort or hotel before booking holiday tickets is one clear application. But we might also use it to teletravel to other times. History lessons might thrive as the children can witness the battle of Hastings first hand. But again, cults might thrive too. While a Church of England service might occasionally include an interesting sermon, it will have to compete with going to a virtual Stonehenge, and joining with lots of other people dancing naked around the stones. Fiction can often be made more enticing than reality.

Artificial intelligence

The progress in artificial intelligence (AI) will take us to human equivalence in a computer within 20 years, maybe 15. Already, several items on the 1990 list of 'things that people can do better than computers' have been crossed out—playing chess, writing novels, composing music, writing computer code and designing circuits. By 2015, there may be little left on the list. We are being forced regularly to redefine intelligence to keep our notion of human superiority. The definitions left to us are running out. This AI will gradually allow us to automate routine tasks that employ many people today, and eventually will make inroads into the professions. Eventually we will replace people as the optimal decision makers in every profession. In the same time frame, physical tasks will increasingly fall to robotics. What is left? I believe we will see the 'care economy', where people focus on the human interaction side of work, leaving the knowledge work to machines. We would seem to have

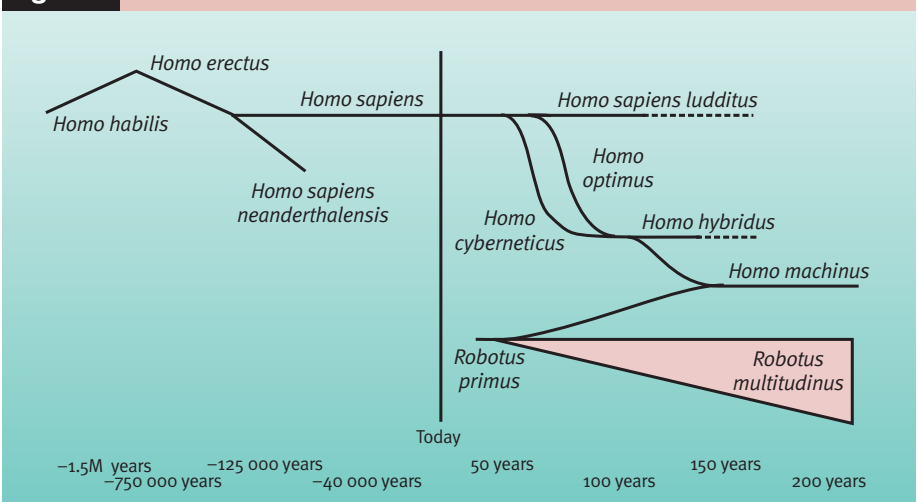
little choice. There will be huge commercial benefits from going down this path, and it might be good to have people seen as other than just convenient and cheap cogs in a big machine, but it will take away a huge chunk of our sense of identity. For many people, their work is who they are. We will presumably focus more on our community, and on the 'human' side of things, but not everyone would feel comfortable with that. Do we have the right to ignore their wishes?

Future convergence of man and machine

But with advanced intelligence in the machine so close, and with virtual environments dragging us into cyberspace, we can go conceptually much further ahead. Although the technology is hardly even embryonic today, it will one day be possible to link our brains to machines, and by then, those machines will be much smarter than us. We are on the verge of creating *Homo cyberneticus*, with a brain linked to massive processing capability, and linked to all the knowledge on the net. Around the same time, we will see the first genetically optimised human reach adulthood. Why not further refine *Homo optimus* to work more closely with machines, creating *Homo hybridus*, the Borg from Star Trek? He will have a brain that makes Einstein look like a dunce, with an attractive, fit body that is resistant to most diseases, and a long life span. A competitor! *Homo hybridus* will live in communities that are telepathically linked, with a shared consciousness and erosion of the boundaries of individuality, or responsibilities and of free will. Cybercommunities may war in mental space! Is this really a direction we want to travel in?

Meanwhile, AI has become artificial life. It has progressed to the point of consciousness, but its intelligence increases rapidly

Figure 6 Future human and machine evolution



year on year. What is its perceived purpose in life? What are its rights and responsibilities? Who should decide them? Will God give it a soul? Such technology raises issues that dwarf those that we have faced in the last few millennia, and we will have to deal with them over a short period of time.

When we can connect between *Homo hybridus* and *Robotus primus* so well that the link is completely transparent, our thought will execute in cyberspace and our memories will be backed up there. Death will be a minor problem as we have a network backup of our minds. We might just buy an android, upload our mind into it and carry on.

In such a world, we would have a wide range of human and artificially intelligent beings, some with bodies, some living entirely in cyberspace. We might hope that they can peacefully coexist and cooperate. We might hope they will treat each other with respect. Sadly, human history does not give us evidence to support this optimism. So we should tread carefully indeed down this road!

The Future of the Seven Deadly Sins

I recently did a TV interview on the future of the seven deadly sins, as impacted by technology. It was a novel and interesting approach to looking at some of the potential negative impacts of technology, so I have borrowed it here. Let us look at them in alphabetical order.

Anger

Anyone who has ever been to an Internet chat room for a few minutes will have witnessed the phenomenal rate at which conversation can go from initial greeting to flame war. Road rage flourishes because we feel safe in our own cars, and there is little danger of anyone actually punching us on the nose when we insult them. On the net, the other person is often thousands of miles away, and we are also hidden behind an anonymous name (no-one actually uses their own name in chat rooms). In absolute safety, we can sink immediately to our worst behaviour. The main culprits of such behaviour seem to be children, whose parents presumably won't let them behave badly, and who make the most of the unsupervised opportunity granted by the net. However, the net also creates a platform on which opposing groups can wage cyber-war in the future, and this could be a more serious threat. As we become more dependent on networks, threats to their disruption by hostilities could be a problem. Direct action in the physical world

Figure 7 Types of direct action

Developed world is immensely vulnerable to cyber attack

E-bombs	Net-Based Coordination
Evolving Viruses, Trojans, Worms, etc.	Leaderless Communities
Embedded Switches	Automated Action
Information Waves	Smart Mail
Correlated Traffic	
Emergent Behaviours	

is limited by the geographical distribution of people who might care about an issue. They need to care a lot before they will physically travel and become actively involved in a protest. On the net, there are many ways to invoke direct action that require relatively little effort, but can have severe consequences for the victim. We might see entire national economies being disrupted by such direct action trying to bring down networks or computer systems.

Envy

A positive effect of seeing someone with something we want, but haven't got, is of course to encourage people to work harder to gain the economic capability to buy it. Of course, this is only possible in some cases, by no means all. When it isn't, envy arises as we see others apparently getting a better deal than ourselves. We may believe it is not fair—they do not deserve it as much as we do. Generally it makes us a bit more miserable, and less kind to those of whom we are envious, reducing our own and others' wellbeing, hence the sin rating. Modern technology, especially TV and the Net, constantly makes us more aware of how well some people are doing compared to ourselves. We see the dotcom millionaires, some of whom are barely out of nappies. How many of us haven't felt just a little bit pleased when their companies collapse? People in other countries see the relative wealth of those in developed countries, and some are more hostile for that reason. But we are far from the limits of information availability, so the problem has yet to peak. As visibility of others' better position continues to increase, envy is bound to increase too, and as it does, it is bound to cause more weakening of our social fabric.

Gluttony

Of course, stuff on the net doesn't always have a financial cost, but we may end up spending hour after hour collecting just a few more MP3 tracks, pictures, videos, games or whatever, so there is always some cost. Instead of consuming too much food, we gorge ourselves with ever more informa-

tion material. This might waste a lot of our time that could be better spent elsewhere, detracting from more important areas of our lives. While gluttony in the food sense may only increase by easier ordering of pizzas, these other forms of overindulgence can threaten our characters and behaviours just as much.

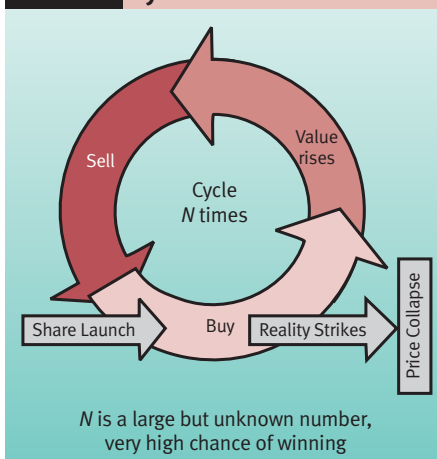
Greed

Just as envy will flourish as we become aware of others' better positions, so greed will flourish as we become aware of more and more things that we may want, even though we may not have known they existed yesterday. As new technologies constantly make our goods obsolete, we need to spend ever more to keep up to date. Of course, this results in some people spending money they cannot afford, leading to real financial and social problems. The net has already seen a rapid growth of crime capitalising on people's greed, with numerous pyramid-style get-rich-quick schemes, and various kinds of fraud. Greed and the net are thus a very synergistic combination.

Greed has obviously been a major motivator for the enormous rise and fall of dotcom share prices. People knew that the companies weren't worth what they were paying, but that 'there is one born every minute' and they would thus be able to sell their shares for even more the next day or week. This Internet cyclotron took shares to ridiculous heights, and those unfortunate enough to be holding them when the inevitable collapse came paid for all the profits of the preceding buyers.

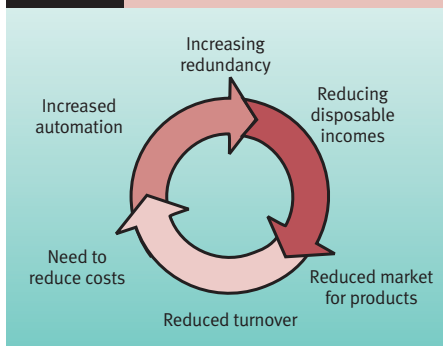
Yet another effect of greed is the desire of companies to attempt to reduce costs on behalf of their shareholders by reducing staff numbers via automation. This is generally a positive effect that drives the capitalist economy and usually results in a

Figure 8 Internet share price cyclotron



benefit overall. However, this relies on there being another employer who can find useful work for the redundant employee and provide them with an equivalent salary. If this stops being the case, we will find that the system could spiral downhill quickly. The incentive to reduce costs for individual companies would remain, and without taking into account the wider good of the community, companies would tend to accept any local benefits that automation might bring. The system that has served us well for generations might suddenly prove to be the wrong one, pushing us to economic stagnation and then breakdown.

Figure 9 Decline of capitalism



Lust

This is already flourishing in the Internet age. Apart from easy access to all kinds of pornography, people have new opportunities to be unfaithful to their partners. Chat rooms allow people to make new friends in far away places. Some chat rooms are specifically designed for married people to find other partners. At the low technology end, people interact by exchanging text describing what they are supposedly doing to the other person. For more advanced sessions, video cameras can be used to create one- or two-way links, and various devices can allow more physical interaction. Cyber-affairs are becoming common.

In the future, avatar technology will approach lifelike emulation of another person, and high-quality personal displays will allow very realistic interaction. Later, we will be able to link directly to the nervous system and create sensations directly. People could recreate any fantasy they may have in cyberspace, without any need for permission from the other participants. A married couple may be sitting side by side on the sofa wearing personal displays, but one of them could be cheating with the next-door neighbour, without the knowledge of either the partner or the neighbour.

This abuse of trust will often lead to breakdown of otherwise sound relationships.

Figure 10 Cyberspace relationships



This huge potential for damage of what is good is, of course, why lust is considered a deadly sin. The internet simply creates more opportunity and reduces the risk of being found out, while other technology enhancements increase the payoff. The technology can of course be used to enhance a loving relationship by helping people keep in touch while they are physically separated, but we must recognise that it will very often be abused and we will have more relationship breakdowns. Whether the overall effect on social well-being is positive or negative remains to be seen.

Pride and vanity

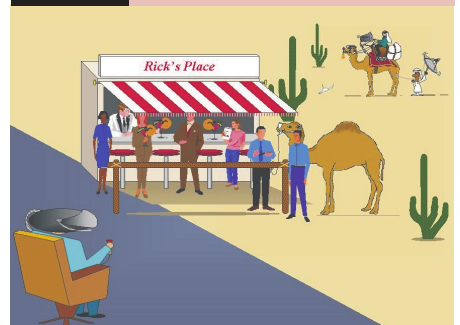
There are millions of personal web sites that are small monuments to personal pride, but this would seem to be a small indulgence that is relatively harmless most of the time. Like gluttony, this effort saps energy that might otherwise be available for something more fruitful, but the danger will be offset to some degree by potential improvement of people's well-being if they previously had low self-esteem. However, at the extremes, people can sometimes spend a great deal of time on their sites for no purpose other than showing the world how great they are.

This problem translates into financial loss when it comes to corporate web-site design. Many site designers obviously have a peer group whom they want to impress with their obviously superior and bang-up-to-date knowledge of all the latest plug-ins and browser features. Instead of a simple but useful front end that loads quickly and gives the user what they want straight away, these sites often require the user to spend an hour installing plug-ins just so they can see a spinning logo advertising the company. Many site designers are now learning that simple is best, but others simply cannot resist the temptation to show off their programming prowess.

Vanity will also manifest itself in people tweaking their avatars to portray themselves in a favourable light in virtual

environments. They may take years off their age, kilograms off their weight and put hair back on their heads. We will not know for sure what they look like in real life, but such environments may account for a significant part of our social interactions. On the one hand, this will discourage people from judging people by their appearance, and allow many aesthetically challenged people to take a higher role. On the other hand, it might encourage a culture of dishonesty, with a corresponding decrease in trust, which would obviously be disadvantageous. We may be forced to create guaranteed environments where people are electronically vetted against an appearance database to ensure they are as they pretend.

Figure 11 Shared virtual environments



Sloth

Now that we have the Internet and TV, with a remote control, we hardly ever need to leave the comfort of the sofa unless we want to. Physical sloth can thrive in today's world. However, we can compensate for this by being much more intellectually involved in affairs, taking part in more community activities via the net than we could ever do physically. Or at least we will be able to when our community networks are more developed. We can also work and be educated from the same sofa. So it is by no means clear that sloth will increase, more that the balance of mental and physical activity might change.

Figure 12 Exercise in the home of the future



However, we are more health conscious today, as a direct result of the information society. Blending virtual reality and exercise machines, it is already possible to buy rowing or cycling machines that can be used without the user being bored senseless. Such technology may become much more widespread, so we may be more often involved in physical activities while on-line. We could play networked sports, or go for a run through a tropical rain forest, while connected to a force feedback harness or exoskeleton. In such a world, sloth could greatly reduce, in both the mental and physical domains.

Well, one out of seven isn't so bad.

Conclusions

New technologies will bring many benefits to mankind, but there is a cost. Human nature hasn't changed much over the last million years so is not likely to change much in the next hundred. Each new technology brings opportunities to use it for good and bad, and being human, we will do a bit of both. So there will never be a techno-utopia, there will always be some largely self-inflicted problems. What we can realistically hope for is that it will be better than today overall.

Acknowledgement

Credit is given to Kevin Hill of Lion TV for the idea of relating the impact of technology to the future of the seven deadly sins.

Biography



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Ian Pearson graduated in Applied Maths and Theoretical Physics from Queen's University, Belfast in 1981. After four years in the missile industry, he joined BT, where he has been involved in many diverse information technologies. In recent years, his focus has been on considering the business, social and political implications of future technologies. He lectures widely in this field, and is a principal consultant in C2G, BT ExaCT's communications consultancy group.

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