

Chapter 21

The Future

So far we have examined the history of engineering, its values, and some of the work currently being done by practicing engineers. If we compare the present state of technology with what has existed through the greater part of human history, what strikes us is that we are at a time of very rapid change. Technology is not standing still, it is going somewhere. Where?

To make any predictions about the future of engineering, we must first predict the future of society. Before attempting this, it is salutary to look at earlier attempts to foresee the future, and see how successful they've been. We'll do this in three parts: first, we'll look at the *historicists*: philosophers and historians who believe that there are laws governing the historical development of society. Next, we'll look at the amateur prophets: visions of the future from artists and writers in the first half of the twentieth century. Lastly, we'll examine the professional dreamers – the practitioners of the supposed science of futurology – and see how well they do. From this, we may be able to tell how much confidence we can put in our own predictions.

21.1 The Historicists

The idea that human history follows a fixed, knowable pattern dates from antiquity; ancient Greek myth speaks of successive ages of mankind, descending from a lost golden age to the present. In Hinduism also we find the idea of a succession of ages or ‘*yugas*’, the worst of which, the *Kali Yuga*, or age of iron, is the one we’re in now.

Rather similar to these ideas is the universal history of Giambattista Vico, who in his “Universal Law” of 1720 described how every society cyclically progresses through a fixed sequence of stages. Initially, we find ourselves in a savage and lawless state. The rise of strong patriarchal leaders leads to an orderly but autocratic society, which Vico calls the Divine Age. This is followed by the Heroic Age, in which alliances are formed between individual patriarchies, then by the Human Age, in which democracies arise. According to Vico, these democracies will inevitably become corrupt and, unless they are first overthrown by other cultures, will degenerate back into savagery, at which point we start the cycle over again.

Two later ‘universal historians’ were Arnold Toynbee and Oswald Spengler. Spengler, in “*Untergang des Abendlands*” [“Decline of the West”], published in 1926, suggested that all societies pass through set stages, ending in ‘culture’ – characterised by artistic creation – ‘civilization’ – characterised by a concern for comfort – and ‘decline’, which was the stage he believed the western democracies were just entering.

A more influential philosopher and historian was Hegel, who saw history as the working out of an escalating series of contradictory ideas, which he called the ‘dialectic’. Each stage of society is characterised by the struggle between two great ideas, a ‘thesis’ and its ‘antithesis’. The struggle ends in the emergence of a synthesis of the two, which then becomes the thesis for the next stage in history. Through this process, said Hegel, we proceed from the earliest stage of despotism (which he rather arbitrarily identified with ancient China) to democracy, and finally to monarchy, which Hegel believed to be the highest state (and which also happened to be the form of government in Prussia, where Hegel lived.)

It strikes us as peculiar to place monarchy ahead of democracy. Hegel accommodated this by distinguishing the *general will* of the people from the *will of all*. The latter is merely a numerical majority, as might be expressed in a popular vote, whereas the *general will* of the people can only be sensed and implemented by the monarch. The people's freedom, in Hegel's sense, consisted in their right to obey the laws laid down by the monarch.

For Hegel, the dialectical working out of history was a process of competing ideas. For Karl Marx, historical change sprung from changes in the material basis of society, specifically, from changes in the way in which production was organised. He saw all societies as necessarily passing through the successive stages of savagery, barbarism, feudalism, capitalism, and, he predicted, socialism and communism. Each stage is characterised by a struggle between classes. During the capitalist stage, Marx argued, competition between individual capitalists would force the wages of workers down to the lowest level compatible with life – since any company paying its workers more than that would eventually be undersold, and hence driven out of business, by harder-headed rivals. This process he called 'the immiseration of the proletariat'. Socialism comes about when the immiseration of the working class under capitalism leads to a working class revolution. After a certain period of socialism, classes will disappear entirely and the State and its institutions will wither away, ushering in the final political form, communism.

Although Marx does not have a very good reputation today, the socialist movements in Russia and China showing no signs of developing into classless societies, his record over the hundred years following the publication of the Communist Manifesto in 1848 is impressive: he wrote in a world that was entirely capitalist, yet in the succeeding century, half of humanity went through the socialist revolution he'd predicted.

Karl Popper, commenting on Marx, noted that it's possible to separate historical description from prescription: a historian might agree that society was bound to go through the stages Marx outlined, yet still harbour a personal preference for capitalism over socialism. (Just as a physicist might accept that the universe is ultimately destined to finish up at a uniform four degrees Kelvin, yet still prefer to keep the thermostat in her home at twenty degrees Celsius.) In practice, though, all Marxist historians seem to feel a personal obligation to move history along in the direction they suppose it to be going.

21.1.1 Popper's Refutation of Historicism

According to Popper's "The Poverty of Historicism", all attempts to formulate laws of historical development must fail. The reason is straightforward: the level of scientific knowledge in a society is one of the important determinants of that society's nature. Consider, for example, how futile it would be for a prophet with no knowledge of electricity to attempt to predict our current way of life. The ideas current in science affect society in two ways: directly, by their effect on the intellectual life of the citizens; and indirectly, by their application to technology. Yet, Popper argues, it is intrinsically impossible to predict tomorrow's science; if we could predict it, it would already be today's science. And to this I would add that it is impossible to predict tomorrow's technology, even when it's based on today's science. Consider, for example, that the scientific basis for the computer had been established for decades at the time when Watson, the CEO of IBM, made his notorious prediction that the future US should not need more than ten computers.

While arguing for laws of historical development, the historicists simultaneously deny any possibility of there being timeless laws of human behaviour. For them, the laws of human behaviour change with the form of society, and the form of society evolves along the lines set out in their particular philosophy. Thus, for example, Marxists are among the loudest critics of such theories as sociobiology. But, says Popper, there are many timeless laws of human behaviour. He gives a number of examples, including Lord Acton's law:

You cannot give a man power over other men without tempting him to misuse it – a temptation which roughly increases with the amount of power wielded, and which very few are capable of resisting.

Popper’s criticism of historicism extends to the idea of progress. If progress were inevitable, this would be an example of a successful historicist law. However, Popper concludes that progress is not inevitable (recall the thousand-year intervals of stagnation we skipped over in Chapter Two.)

21.2 The Amateur Prophets

The bibliography at the end of this chapter recommends several films made in the early years of the twentieth century – Fritz Lang’s “Metropolis” and Menzies’s film version of the H.G. Wells novel, “Things to Come” – which offered visions of the future. But the future of the early twentieth century is our past, so we can now look back and judge their success. We will notice that the predictions an age makes of its future tell us more about that age than about the future. This is illustrated by art forgeries; the best forgeries of a particular age are evident to later experts as forgeries, and moreover as forgeries of that particular age – their creators unconsciously incorporate the style of their own age in all that they do. In the following few pages, then, we will examine the past’s vision of its future:

In the future, everyone will dress alike.

We see this in “Metropolis” and Gene Roddenberry’s Star Trek. More recently, the same observation has been made by the social commentator Jerry Seinfeld. A superficial explanation for this phenomenon might be that it’s a ploy to reduce the cost of costume design in movie sets, but this would not account for the prevalence of a uniformed future in novels such as Zamiatin’s “We” or Huxley’s “Brave New World”.

A better explanation might be that this reflects an assumption about the future commonly held in the first part of the twentieth century: that the future would be a time of increased social cooperation, individuals giving up some of their individuality to better serve the shared goals of humanity. In support of this interpretation, we note that the two major new political movements of the first half of that century, communism and fascism, both advocated the subsumption of private goals to the goals of the State. This is implicit even in the names of the movements: communism aims at the communal ownership of the means of production, fascism takes its name from the *fasces*, the bundled sticks and axe symbolising the strength of the collective as compared with the weakness of the individual. We recall from Chapter Five that Howard Scott's techocrats and the technocrats of the film "Things to Come" also liked to wear uniform, no doubt for similar reasons.

Humanity will evolve into two sub-species: an effete class of owners, and a degraded class of workers

This is a vision found in "Metropolis", "Brave New World", by Aldous Huxley, and "The Time Machine", by H.G. Wells. It can probably be traced back to Marx, writing in the mid-nineteenth century, when he predicted that unchecked competition between capitalists would lead to the immiseration of the proletariat. So far, it has proven false: the standard of living of the working classes in most of the world rose for most of the last century.

The latest new technology will lead to a change in the moral character of mankind.

In the early part of the twentieth century, the new technology was the aeroplane. Two British aviators, Graham-White and Harry Harper, writing in 1914, speculated that

Airplanes, by linking the Earth, will bring about lasting peace between these close-knit nations.

H.G. Wells's novel and the associated film, "Things to Come", also see aviators as bringing in a new social order, and this theme is repeated in Rudyard Kipling's short story, "As Easy as ABC".

These ideas have an echo today. For example, here's Graham-White and Harper's prediction with one word changed:

The Web, by linking the Earth, will bring about lasting peace between these close-knit nations.

Haven't we heard this recently?

Closely allied to this view is the expectation that the latest technology will bring about a qualitative change in education, opening up new possibilities for society: here's Thomas Edison, writing in 1922.

Motion pictures will revolutionise our educational system, and in a few years will supplant largely, if not entirely, the use of textbooks.

We note several things about this quotation. Firstly and most importantly, it's quite false. Nothing of the sort occurred. Secondly, we note that the quote comes from someone whose business included the sale of motion picture apparatus. Thirdly, we can again turn it into a familiar contemporary quotation by changing 'Motion pictures' to 'Computers' or 'The Web'.

Future technology consists of more of what we've got.

In 'Things to Come' and in 'Metropolis', the technology of the future consists of steam engines and electricity. A particular example is streamlining; this was a breakthrough in plane design in the 1940's and 1950's; it was then adopted by Detroit, largely for aesthetic reasons, leading to the 'tailfin era'. We still tend to think of 'futuristic' and 'streamlined' as synonymous. Similarly, our current visions of the future are of better computers and electronic gadgets.

We conclude that when artists and visionaries offer us a window to the world of tomorrow, they are more likely to be showing us a mirror reflecting the prejudices and preconceptions of our own time.

21.3 The Professional Prophets

Starting in about the 1950's, a new science (or pseudo-science) emerged: 'futurology'. Its first proponents were academics, offering advice to government planners, but books like Alvin Toffler's, "Future Shock" and John Naisbitt's "Megatrends" made it into a popular entertainment. In the 1960's and 1970's, the sub-genre of ecological forecasting emerged with the Ehrlich's "The Population Bomb" and the Club of Rome's "Limits to Growth".

21.3.1 Kahn and the Hudson Institute

Among the first people to try to make a living from predicting the future was Hermann Kahn, who entered public awareness in the 1950's with "Thinking about the Unthinkable", a book on how to fight and win thermonuclear wars. From here he went on to found the Hudson Institute, a right-wing group of professional prophets and pundits.

In 1972, Kahn and the Institute published "Things to Come: Thinking about the Seventies and Eighties". Despite the fact that he was looking only two decades ahead, and despite being a specialist in military matters, Kahn included in this book such predictions as

There will be nuclear-powered aircraft, weighing thousands or tens of thousands of tons.

And,

Between 1975 and 1985, the next nations to develop nuclear weapons may be Japan, followed in about five years by West Germany, soon to be followed by Italy. Other possibilities are India, Australia, Sweden and Switzerland.

This prophecy scores one out of a possible seven, though we should also take points off for the now-nuclear nations that he fails to mention.

One of the most interesting chapters in the book is Chapter 8, “The 1985 Technological Crisis”. Kahn quotes from John von Neumann:

The great globe itself is in a rapidly maturing crisis – attributable to the fact that the environment in which technological progress must occur has become both undersized and under organised... in the years between now and 1980, the crisis will probably develop far beyond all earlier patterns.

(John von Neumann, *Fortune*, 1955.)

With hindsight, we can see that the crisis did not occur. Was the problem solved, or was the crisis just deferred? In his subsequent books, Kahn and the Institute rapidly migrate to the view that there never was a crisis. For example, in “The Next 200 Years”, written in 1976, Kahn suggests that by 2000, a quarter of mankind will live in ‘post-industrial’ society, in which the task of procuring the necessities of life has become trivially easy. Virtually everyone in these societies will be rich and devote their leisure to cultured pursuits, and more than two-thirds of humanity will earn more than \$1,000 a year.

It’s evident by now that these forecasts are excessively optimistic. But as time went on, Kahn and his colleagues became even more cheerful. For example, ‘The Resourceful Earth’, published in 1984 by Kahn and his disciple Julian Simon, assured the reader that

Fish catches are resuming their long upward trend

There is no sign of climate change

There is no evidence of species loss

The truth is, just two decades years later, that virtually all scientists agree that climate change is taking place (though there is still some disagreement on the cause), and that we are losing species at the rate of about one every ten minutes, a rate of extinction without precedent in the last sixty-five million years.

21.3.2 Limits to Growth

More pessimistic predictions came from the Club of Rome, a group which used computer models to extrapolate existing trends. In “Limits to Growth”, published in 1972, they foresaw global catastrophe within the next few decades, due to population growth, pollution and resource depletion. These prophecies are familiar to us from Chapter Four, where we noted that similar predictions made by Paul Ehrlich in “The Population Bomb” (1968) had failed to materialize. Contemporary critics noted several problems with these predictions – for example, the Science Policy Research Unit at the University of Sussex showed that running the ‘Limits to Growth’ computer model backwards implied that the human population in 1880 must have been many billions.

Part of this debate is familiar to us from our earlier discussion of the environment. We are no closer to resolving that debate, though we can note rather gross inaccuracies in the predictions of both sides.

21.3.3 Popular Prophets: Toffler and Naisbitt

Finally, we note the emergence of prophets seeking to appeal to the general public. A typical case is Alvin Toffler (“Future Shock”, 1970), who writes:

As we hurtle towards super-industrialism, a new ethos emerges in which other goals ... supplant those of economic welfare.

One of the healthiest phenomena has been the sudden proliferation of organisations dedicated to the study of the future

To improve education... there should be a 'council of the future;' in every school and community

There should be whole new curricula, designed by futurists.

The first thing that strikes us is Toffler's unnecessarily breathless style. Compared with the first half of the twentieth century, the second half was a period of relative tranquility. No-one today would think of the early seventies as a time when we were 'hurtling' towards anything.

Secondly, we note that there is no sign of the new ethos he refers to; if anything, the purely economic view of the world has gained popularity.

The third and most striking aspect of these prophecies is their consistently self-serving nature. Toffler styles himself a futurist, and the chief thing he has to say about the future is that lots of futurists should be hired and put in charge of things.

Although his title, “Megatrends”, suggests the same breathless style as Tofler’s, Naisbitt actually begins the book by acknowledging that detailed prediction of the future is impossible, and that the best we can hope for is a clear analysis of the present – which, for “Megatrends”, is 1982. Even given this admirable caution, his record in distinguishing trends from fads is less than perfect. Trend Two, for example, predicts that the Human Potential movement will grow in pace with the increased use of computers; in retrospect, I think those who can remember the Human Potential movement would associate it with the ‘Me Decade’ of the later Seventies. Far from companies following his Trend Four and going from short-term to long-term planning, exactly the opposite has occurred: the past two decades have seen managers increasingly pre-occupied with planning for the next three months – since in the longer term, they expect to move to another company or retire on their accumulated bonuses. Lastly, Naisbitt’s Trend Six sees curative medicine being increasingly replaced by a new public commitment to healthier lifestyles and regular exercise, a prediction noticeably at odds with North America’s current swelling to unprecedented levels of obesity.

21.4 Failure of Futurology

The general basis of futurology is to draw a straight line through some points, then extend the line. More sophisticated modellers draw their straight line on log-log paper. This doesn’t work, because not all processes are linear. In fact, some processes are chaotic, and hence inherently unpredictable. And the sum of a predictable process and an unpredictable process is an unpredictable process.

A second weakness in futurology is the ‘closed world’ problem: any model of the world will include some features and omit others. How can we tell if the omitted factors will change the result? One example of this comes from “Megatrends”: although Naisbitt’s third megatrend is the replacement of national markets by a global market, the only country outside the US that he mentions is Japan. This allows him to be blindsided by the impact of events elsewhere, such as the collapse of the Soviet bloc and the rise of militant Islam. For a more extreme example, note that the “Limits to Growth” model doesn’t include the motion of comets in the Oort cloud, beyond Pluto. Yet such a motion might have consequences that would render all the model’s conclusions invalid, such as a new comet appearing on a path intersecting the Earth’s orbit.

A more down-to-earth example of this problem is given by David Suzuki. Models used for economic forecasting will include the environment as a sector in the economy, covering agriculture, fisheries, and mining. So losses in the ‘environment’ sector could be compensated for by growth in, for example, the high-tech sector. But the reality is that all of human culture, including the economy, is included within the environment.

A third feature of futurology is the self-serving nature of its predictions. This is most evident in Alvin Toffler’s ‘Future Shock’, where a constant theme is the need for futurologists to be employed in increasing numbers throughout society. But when looking at the predictions of the Hudson Institute, too, it is useful to ask, “Who’s paying for this?” The Institute is funded chiefly by large corporations which have a vested interest in establishing the conclusion that growth can proceed forever and that pollution is nothing to worry about.

Similarly, some of the trends Naisbitt describes in “Megatrends”, such as the replacement of the welfare state by private, and hence profit-making, companies, were items in the political agendas of Reagan and the Bush dynasty in the US and Margaret Thatcher in the UK. However, Naisbitt does not present them as political choices, which would lead to the question, “Do we want to go this way?”, but as naturally occurring processes, leading to the question, “How can we profit from this process?”. In Naisbitt’s more recent writings, such as “Megatrends 2000”, he joins with Kahn, Simon and Lomborg to assure us that any concern for the effects of industrial development on the environment is misplaced.

21.5 Conclusion

In the course of this book, we have encountered several theories of engineering that imply particular visions of the future:

The trickle-down theory would hold that science leads technology: the direction of scientific advance makes new things possible, and these are the things that technology creates. To predict tomorrow’s technologies, then, we should look at the most recent advances in science, and even, if possible, anticipate what turn science will next take. But Popper’s arguments tell us that this is intrinsically impossible.

The view that engineers apply science for the betterment of humanity, on the other hand, suggests that the needs of humanity lead technology: engineers work on products and problems for which demand exists, a demand which can be expressed either through the market, or through the elected representatives of the people. On this model, the future is one of steady progress towards utopia. However, looking back over the last century and its unique achievements in the technologies of torture and mass destruction, it is difficult to have much faith that that’s where we’re headed.

Could we say, then, that it is military goals that lead technology, and that new technology in turn leads to new military goals? This is consistent with the observation we made in Chapter Two while examining the Bronze age: the technologically backward nation is at the mercy of the technologically advanced nation. If we live in a world of potential enemies, we must develop weapons at least as sophisticated as theirs – or, to be safe, a bit more sophisticated. This yields a vision of the future as a series of arms races, in which civilian technologies emerge as spin-offs from military goals.

Our analysis of the role of engineers as managers, in Chapter Five, could suggest that it is the decisions of managers that lead technology: managers of private or state-run enterprises choose which technologies to develop, and manipulate public demand to create a market for them. Their decisions, based on corporate goals, shape technology, and indirectly shape science. An illustrative example, reported on the website (1), would be the conviction of General Motors, Standard Oil and the Firestone Tire Company in March 1949, for having criminally conspired to destroy the electric trolley system in Los Angeles and replace it with gasoline or diesel-powered buses. (An offense for which the three companies were fined a total of \$5,000.)

If we have learned anything from the discussion of this chapter, it may be that none of these models should give us any confidence in our predictions. To the extent that we can predict the future at all, our best guide is to understand the past. Unfortunately, we're becoming less good at this. For example, over the past ten years I have seen my students' sources of references in their essays go from 90% text-based to 90% Web-based. The Web is a wonderful resource, but how much of the information on the Web predates, say, 1975? And what fraction of humanity's collective wisdom is likely to have been expressed in the years since 1975?

One of the arguments of this text has been that familiarity with the writings of the distant past can show us that people thought differently in the past, and will therefore think differently in the future. We have some perception of this, but our perception tends to be that "People in the past were stupid". They weren't; the brains of Neolithic humanity, thirty-five thousand years ago, were as powerful as ours. Our society differs from the Stone Age because we have used our brains to do different things.

So although an understanding of the past will not allow us to know the future, it does permit us to set wider bounds on the range of possible futures. The variety of human civilizations that have preceded ours should save us from the temptation of thinking that the future will be identical to the present.

Knowing the future is not just a matter of prediction, but choice. We have a responsibility as citizens to participate in the processes through which our society chooses its future. And we have an additional responsibility as professionals: the biggest effect we have on the future may lie in the technologies we choose to spend our lives developing. We are neither guaranteed a utopia, nor doomed to imminent extinction, but every day we spend at work moves us towards one or other of these ends. The cumulative achievements of engineering have given humanity powers unprecedented in our history; we have a responsibility to use those powers wisely.

21.6 References

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21.7.2 Films

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