



Futures Review: Looking at previous global futures

February 2008

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1 Introduction

1.1 Purpose of this paper

This paper aims to provide a context for the early phases of the Beyond Current Horizons programme which is tasked with producing:

a long-term and challenging vision for education in the context of socio-technological change to 2025 and beyond.

The paper is intended to stimulate debate about the principles, methods and focus areas that should structure the programme going forward. Essentially, this paper is intended to help us ask: 'what are the really big questions for education in the context of social and technological change?'

It in no way presents a 'settled' view of educational and technological futures that we 'predict', but is, instead, intended to encourage a mapping of the broad fields with which the programme may choose to engage.

It is intended for use primarily by the Beyond Current Horizons programme team and partners in developing the programme, by the Expert Advisory Group in choosing the five challenges and by the Technology, Education and Social Responsibility Group in advising the programme in its earliest stages.

1.2 Content of this paper

How do we ask questions of the future?

In contrast to many popular conceptions, 'the future' is not determined solely by developments in science and technology, but by the ways in which these developments interact with social and cultural contexts and trends. The invention of a jetpack, as many commentators from the 60s will attest, is no guarantee of widespread adoption or changes in social practice.

Similarly, education will not be changed simply as a result of a given invention or discovery, but by the ways in which these developments are incorporated into social life (changing our values and goals for education) or into educational practice (changing the methods and tools we have available to education).

As such, this paper does not start with an account of technological developments, but with a wider range of trends and issues as identified by respected futures research. It is only by developing a complex picture of the potential relationships between technological, scientific and socio-cultural development, we argue, that we will develop a picture of possible educational futures that is robust and which avoids the realms of science fiction. Only having first explored these diverse social and cultural trends do we then go on to talk more specifically about the potential role of technological and scientific developments in these contexts, and their consequent potential implications for education.

The review therefore covers four areas.

First, we discuss some of the different methods to studying the future currently in use as a rapid introduction to readers to the range of approaches in the field.

Second, we present summaries of some 'previous futures' and draw out areas of shared concern and attention. These future scenarios are drawn from a range of different sectors: from government, industry, not-for-profit and international organisations.

Third, we explore the place of technology in these and other futures, we discuss the complexity of the relationship between social and technological change, and we identify three categories within which we feel technological innovation may offer challenges or insights for education in the coming years.

Finally, we identify a set of potential organising questions which might provide raise provoke rich discussion about the potential future choices offered to education in its response to, influence over and exploitation of socio-technological change.

2 Examining the future: some challenges and methods

While it is true to say that, on a simple psychological level, humans beings have been basing their actions on an idea of future events ever since the notion of cause and effect occurred to our species, and equally true to say that humans have created many techniques for divining future events from the observation of natural phenomena (the flight of birds, the entrails of sacrificial beasts, the patterns made by yarrow stalks thrown on the ground or tea leaves in the bottom of a cup), or that the ancient empires of Persia or Greece would have been nothing without military and social planning, the robust and systematic examination of possible future events as a distinct field of enquiry has a relatively short history. Its origins are widely dated from the publication of HG Wells' 'Anticipations of the Reaction of Mechanical and Scientific Progress upon Human Life and Thought', which appeared in 1901, although Victorian authors of the fantastic, such as Jules Verne or Edgar Rice Burroughs, might also be claimed as prefiguring the study of the future, and normative scenarios depicting an ideal future could be said to date back to More's Utopia.

Wells called for the formation of a science of 'Foresight' (Wells, 1932), a discipline that would examine the "future consequences of new inventions and new ideas" with resources equal to those devoted to "records of the past". This discipline, more commonly now referred to as 'futures studies', was clearly established by the 1960s, although Bell identifies the work of pioneering social scientists Harold D Lasswell and Nathan Israeli as making major contributions to the field's scope and methodology as early as the 1930s (Bell 2005, ch1).

Today, the work of forecasters is often broadly characterised as the examination of possible, probable, and preferable futures¹. There are many different approaches and methods used to achieve this (a cynic might say that there are as many methods as there are futures consultancies), too many to permit an exhaustive summary: there are additionally a number of ways of characterising these approaches. For example, Masini (1999) distinguishes between descriptive, normative, objective, subjective and systemic methods, while Slaughter (1999) suggests considering four types of futures methods: input methods, analytic methods, paradigmatic methods, and iterative and exploratory methods. More simply, Gordon (1992) suggests a division between exploratory and normative methods. However, rather than debate the merits of each categorisation, here we give an overview of the main methods commonly used.

Bell (in Slaughter 1996) points out that many standard social science research methods – statistical analysis, surveys, participant-observation, focus groups and so on – are applicable to futures work. These can provide accounts of the past and present (from which to understand the context for future developments) and can provide insights into the beliefs and attitudes that people have about the future (from which to understand what different individuals and societies may be working to bring into existence). In fact, the majority of the methods commonly employed in futures work have been borrowed from other disciplines: as an emerging discipline that synthesises work from many fields, futures studies is able to draw on whichever methodologies are appropriate in addressing a given task. Issues of reliability, validity and techniques of triangulation common from social sciences research can also be employed in the futures field in relation to developing accounts of past and current conditions, and beliefs and aspirations.

The base unit of futures work, however, is the **scenario**, which draws not from social sciences but from drama. Essentially, a scenario is a story about a future which articulates

¹ Amara (1981). Some more recent authors discuss 'plausible' or 'potential' futures in addition to these three core 'p-words': however, the value of these additions is questionable.

a consistent future vision that can act as a model to test assumptions and current paths of actions in the present. There are as many different uses for scenarios as there are ways of generating them: scenarios can be used to summarise research, support further futures work, communicate visions of future circumstances to a wider audience, inform strategic thinking and to inspire change.

Some scenarios might be generated through highly codified and systematised methods (for example, morphological analysis²) while others might be the product of a more speculative and subjective process, making use of personal experience and insight. In general, while there are many different approaches to building and using scenarios, there is an understanding that working with between two and five scenarios gives the ideal balance between multiplicity and comprehension (too many options can make it hard to see the differences between them), and that part of the value of using scenarios lies in the goals and values reflected implicitly or explicitly within them.

Scenarios are deliberately framed narratives that have been constructed within the context of a particular group's areas of interest and designed to encourage that group to assess their activities in a new light. Consequently, they are likely to become less useful as ways of considering future possibilities the further one steps from that particular context. Additionally, much of the value of scenario thinking is found in their development and construction: it is during the process of creating different scenarios that members of a group find their assumptions about future events and opportunities challenged, as much as it is in their presentation to a wider audience (Schwartz 2005). Scenarios, then, often reflect the current concerns and direction of the group with whom they have been constructed: this is certainly something we see in those presented below.

One of the difficulties in beginning futures work is deciding which factors are important and will influence the future, and gathering together a selection of factors that might be usefully considered as trends or drivers of future changes.

Monitoring is a process of examining current events in a wide variety of fields and forming ideas about the trends their behaviour might indicate, or the possible future impacts they might have: as with all the techniques discussed here, there are a number of ways of going about this, but all monitoring techniques are essentially iterative, comparing the projected behaviour of a particular indicator against its actual performance and adjusting the projection accordingly. Successful monitoring balances the frequency of these iterations against the scope of projection (bold projections might need to be assessed more rigorously than conservative ones) and draws on a wide range of sources, from outside as well as within the expected domains. 'Horizon scanning', emergent trend analysis, the search for 'weak signals' (the first indicators of new trends, too subtle to be perceived by any except those intentionally searching them out) are all examples of monitoring activity.

Monitoring provides indicative areas of interest, and perhaps the beginning of an understanding of which trends might be of interest. Projecting these behaviours into the future more reliably, and extrapolating the behaviour of variables from that of others, requires a more systematic approach, borrowing standard techniques from economics and statistics: time-series analysis (to infer patterns of activity from quantitative data) cross-impact analysis matrices (tabulating the suggested effect a change in one variable may have on others) and probabilistic forecasting techniques are useful here. Building relationships between variables, and forming ideas about the ways in which these relationships interrelate leads to the construction of a model of some sort: **modelling, simulation** and **'gaming'** are all ways in which complex relationships can be played out and different scenarios examined. Using computers, parameters within a model can be set, relationships between variables specified and the scenario allowed to unfold. This

² Morphological analysis is used to address complex, multivariate problems, through careful structuring of the relationships between the variables involved. For more on the strengths and background to MA, see www.swemorph.com/ma.html: the technique is not used by any of groups discussed below and so is mentioned only in passing.

mechanistic approach towards using scenarios is perhaps closer to RAND's original sense of the technique than to modern uses of scenarios as catalysts for examination and discussion, but they are capable of providing rich data sets and uncovering hidden relationships that may have far-reaching consequences. Simulations and computer models are invaluable in many areas of scientific forecasting, for example making sense of likely changes to the global climate.

These trend modelling techniques approach the future as a set of factors that can be analysed and to a greater or lesser degree forecasted. However, an important component of futures work lies in providing a normative view of the future, in embedding values and goals in the final presentation, and this cannot be garnered from the analysis of trends alone: for values to be embedded in a particular future, people's beliefs and attitudes towards the future need to be addressed. There are many techniques, drawn from established **qualitative social science methods**, that enable people's beliefs and ideas about the future to be articulated. Many of the results of these techniques are familiar: for example, market researchers routinely ask about consumers' purchasing intentions, and psephologists draw on the responses made to questions about voters' intentions in real or imagined elections. Some researchers, however, have made an explicit study of peoples' images of the future, in particular their hopes and fears towards possible futures (Cantril 1963), and an understanding of how people perceive the future can help when presenting them with possible alternatives as an incentive to action in a particular direction.

Discourse and **linguistic analysis** both have techniques to offer in this field.

These techniques treat respondents as everymen and women, not making a special distinction between them on the grounds of expertise or knowledge. However, when attempting to understand the possible future directions an individual trend or pattern of events may take, it is useful to consult people who may have a special insight into the relevant domain. **Interviews with experts** can help to ground and contextualise the broad trends observed through monitoring, helping to inform decisions about the likelihood and direction of events. Of course, individuals within a field of expertise can, and do, hold very different notions of the future directions it might take: for this reason, it is relatively common for researchers to survey a panel of experts and attempt to establish a consensus of opinion. One widely-used approach to doing so is the **Delphi** method.

The Delphi method is notable for being one of the first techniques created specifically to aid forecasting (rather than being adapted from another discipline), and has become established as one of the most common approaches taken towards forecasting. In the years since its creation in 1953 by researchers at the RAND Corporation, there have evolved many different variations and implementations of the approach, but it might be simply described as the iterative administration of a questionnaire designed to elicit the beliefs and judgments of a panel of experts, with the results from each round shared with the respondents, who might modify their responses in subsequent rounds accordingly. Rowe and Wright (1999) characterise the technique as allowing researchers to access the positive aspects of group interaction (the benefits of contributions from a variety of sources, the dynamic evolution of ideas or concepts, etc) while minimising the negative attributes of such interactions (for example, those due to political or social conflict or manipulation). Additionally, they suggest four features a process of this type should have in order to be identified as 'Delphi': anonymity, iteration, controlled feedback and the statistical aggregation of group response.

Many authors³ have highlighted the ways in which the Delphi technique may not necessarily possess the authority often ascribed to it and the disproportionate lack of evaluation of its outcomes. In particular, the method may lend itself to misapplication or misinterpretation, with Stewart (1987) claiming that the results of a Delphi study "may be the product of the creativity and ingenuity of a skilled practitioner or of the misconceptions and stumbling of an ill-informed novice, but there is no easy way to tell the difference". While the technique

³ See, for examples, Rowe and Wright (1999); Stewart (1987) also provides a wide selection of criticism.

itself may indeed possess, in Bell's (2005) words, "few safeguards against incompetent work and few guarantees of quality", the problems he identifies with the contemporary use of the technique – that the private and proprietary nature of many Delphi implementations fosters a lack of peer review and professional criticism, and that many Delphi researchers "use, create, test or know precious little – if any – social theory" – might be said to apply more generally to many areas of the forecasting industry. As far as we are currently concerned, it is enough to bear in mind that the use of the technique in the reports discussed below does not automatically confer authority on the resulting forecasts.

Forecasts supported by Delphi studies tend to be those directly addressing a need for policy change in some area – that is, they usually contribute to the construction of a normative future, one that explicitly demands action in the present. There are many routes to this type of future. Another approach used extensively, usually as part of scenario planning, is 'backcasting'. Rather than beginning with trends and extrapolating forwards, as in forecasting, **backcasting** (usually) starts with a desirable or preferable future and works backwards, asking: what action would be necessary to bring this state of affairs about? It is a useful tool for directly calling for action, or for assessing the practicality or likelihood of a suggested future: if the path to a desired future is seen to require unrealistic actions in order to come into being, that particular future can be discarded in favour of one that stands a better chance of coming about. Of course, for this technique to be useful it must be supported with some kind of understanding of how factors and trends combine to give rise to events, in order for the route plotted backwards to be one in which an audience can have a degree of confidence.

There exist, of course, other approaches available to futures workers, many developed by specific groups to address their particular challenges, many that are employed only by the organisations that designed them, and many that are closer to shorter-term strategic work or longer-term future visioning than we are currently concerned with. The general areas outlined above encompass the techniques described by the reports examined below.

There is also another class of futures methods that arises from the emerging academic field of futures studies itself. Many of these methods stem from an awareness that the commonly-used futures techniques are often inherited from a Western military or industrial background and so speak only to a minority of humanity: additionally, there are many ways in which common futures approaches have not benefited from the increasing sophistication of other social sciences, and frequently reflect a naive and unidimensional view of the world. '**Critical futures studies**' attempts to bring a deeper and richer perspective to the field. Methods include: ethnographic futures research (developing scenarios that encompass a much wider sociocultural field than traditional scenarios tend to), participatory futures work (engaging those whose futures will be affected by certain actions in the decision-making process) and causal layered analysis (examining the hidden worldviews behind explicit visions of the future, making a critical assessment of their value and the actions they support more valuable) are. However, few if any of the reports discussed below originate from a context in which this more academic perspective might be welcome.

3 Selecting 'previous futures'

Outside the fields of academic research and the arts and culture, many sectors have identified and responded to a need to systematically examine and anticipate the futures they may be working within. These groups range from corporations attempting to set out scenarios that might influence their business strategy, to non-governmental organisations (NGOs) looking to the challenges they will face in their efforts to ameliorate human disaster, to government foresight groups attempting to shape future policy decisions, to special interest groups examining the impact of future events on their particular area, to supra-national committees taking a global geopolitical perspective, to professional futures organisations attempting to provide an inter-disciplinary overview of the interrelations of social trends.

The corporate sector has a long tradition of developing techniques for shaping strategy and action in order to gain advantage within the marketplace. Perhaps most notably, members of Shell's planning department developed and systematised the use of scenarios in shaping thinking and challenging assumptions. Foresight activity in this sector is necessarily shaped by a commercial imperative, with reports often concentrating on a particular sector of society or region of the world (in contrast to the primarily global scope of the previous reports). However, there is much overlap between the corporate sector and other groups with a need to imagine possible future, and many corporate entities with experience in trend analysis and scenario development often work with supra-national groups⁴.

Many governments around the world increasingly see a value in anticipating the demands likely to be made on the state, with departments providing their own, internal forecasts; increasingly, inter-departmental groups explicitly addressing a futures agenda, rather than concentrating solely on strategy or planning, are also developing. Inter-departmental foresight groups are commonly located within that part of government concerned with science and industry⁵. Organisations whose membership spans countries, and whose policy decisions have an impact on an international scale, have many of the same motivations for considering the consequences of current trends as governments. Similarly, planning and foresight activity tends to take place within specific departments, or more broadly as part of a science and industry agenda. However, in contrast to much government-level foresight work, there is often a more global perspective to the work of NGOs.

Each of these groups necessarily looks at the world through their own perspective: so, for example, it is natural that a report from a major technology company has more to say about technological progress than it does about human relationships or climate change, or that an agency considering the ramifications of climate change may have more to say regarding migration and security than it does about telecommunications infrastructure or wearable computers.

With these diverse origins in mind, we have tried to make the underlying perspectives of the reports discussed below visible, by being explicit about their origins and methods. The selected texts in no way constitute the totality of futures work from each of these sectors: rather, they are those that meet a majority of the criteria for selection outlined below, and as such are strong examples from that domain.

Some notes, then, on the selection of the reports in the first section of this paper.

⁴ For example, members of Shell's scenario group were consulted for the NIC report, and worked pro bono for the UNAIDS report.

⁵ So, for example, the UK's Foresight project (www.foresight.gov.uk) is the responsibility of the Office for Science and Innovation, within the Department for Business, Enterprise and Regulatory Reform, and came about primarily in order to improve wealth creation within the UK through supporting technological R&D (Wood 2001, in www.nistep.go.jp/achiev/ftx/eng/mat077e/html/mat0774e.html).

Availability and accessibility have constrained the selection of texts in two ways: there is an inherent bias towards English-speaking texts: this does not indicate that we believe non-English speaking countries have no interest in futures or foresight activity. Additionally, all texts were freely available within the public domain. The NIC (2004) report is described as “unclassified”, a description that reveals the difficulties inherent in accessing information valuable to powerful agencies, and there may well be more detailed assessments of future possibilities available to a more privileged audience than those discussed here⁶.

Given the increasingly globalised nature of the world, and the inability of events to respect national boundaries, it might be reasonable to expect that futures with a global scope might be more relevant than those limited to a particular country or region: consequently, the texts discussed below between them address global trends in demographic change, environmental impacts, effective governance, technological innovation, and so on, even if the particular perspective of their home nation is occasionally to the fore.

Another factor influencing the choice of reports is the degree to which the work is genuinely and explicitly addressing future concerns. As Rear-Admiral Parry observes in the DCDC ‘Strategic Trends’ report discussed below, many people attempting to describe possible futures “merely tell people what is already happening” (DCDC 2006). Similarly, many groups ostensibly describing a current situation unavoidably present pictures of situations yet to come. For example, the United Nations Population Fund’s ‘State of World Population 2007: Unleashing the Potential of Urban Growth’ report (UNFPA 2007) is necessarily a forward-oriented document, considering the impact of current trends in population movement on subsequent habitation patterns, despite being presented as an examination of extant trends. Indeed, any document examining circumstances that change over time might have a contribution to make towards considering the future.

In order to help us be sure that we are reading work that both avoids rehearsing the present-day, and is explicitly oriented towards the future, then, only those documents that consider a timescale of not less than 15–18 years have been examined in depth. Within the reports that have been discussed, and within futures studies more generally, there appears to exist a general consensus that operating within too short a timespan limits the range of options available for consideration, while attempting to work over too great a period of time renders any description of the future open to charges of excessive speculation: most groups here seem comfortable dealing with a time span of between 15 and 30 years, though of course there exist futures organisations that address much larger timescales, from a hundred to a thousand years, and the Long Now Foundation⁷ concerns itself with intervals of ten thousand years. For our current purposes, the immediate future of 15-30 years ought to be appropriate.

Not only is it preferable that reports summarised here be genuinely future-oriented, but they should ideally present multiple futures. A multiplicity of futures makes it possible to test assumptions and beliefs about the present in different situations, giving us a richer understanding of our ability to cope with change. More fundamentally, imagining multiple futures reflects a belief in an open future (Bell 2005), rejecting the idea that our futures are somehow predestined or inevitable. It is difficult to support the idea that there is only one certain future, something pre-existing that may be discovered by those sufficiently perspicacious to read the signs. Without becoming entangled in a discussion on the existence of free will and the impossibility of fate, it might be enough for now to say that future events are more or less likely, that they have particular probabilities of coming to pass, and that as long as any event is less than certain of occurring we must entertain the notion that there are alternative futures to be considered. And, of course, these events are contingent on previous events, meaning that as some events come to pass, the likelihood of others occurring increases or diminishes, so that the probabilities associated with each event are in constant flux. The future must always remain uncertain.

⁶ See also <https://www.cia.gov/offices-of-cia/intelligence-analysis/organization-1/gfp.html>.

⁷ More information on the activities of the Long Now Foundation can be found at www.longnow.org.

Perhaps a stronger motivation for preferring to consider multiple possible futures than the rudimentary epistemological argument sketched above is that imagining the future as unwritten allows the possibility of action to remain with us. If the future is yet to happen, we have the choice of which future we bring about. An open future allows us to hope that we might make it a better future. This is particularly important as a consideration at the outset of a programme such as Beyond Current Horizons – to start with a set of assumptions about the inevitability of certain futures over others would be to doom the programme to a repetition of existing patterns of thought, and fail to provide the insights that we are looking for.

Of course, the future will not be better if we do nothing in the present. Futures work supports action in the present: far from being an abstract pursuit, futures studies is intimately bound with real attempts to improve current human action (Bell 2005, ch2 p90). Another factor, then, in choosing the reports below over the others is the degree to which each is motivated by a desire to support present-day action through the exploration of possible futures. To some extent, the production of alternate futures supports action in a general sense, if they are made public, as they can be drawn upon by other groups to support policy positions, but ideally the link between vision and action is tighter, making it clearer to identify desirable policy.

And finally, for any future to be credible the way in which it was arrived at must be transparent. The future is not a subject that can be examined directly: there are no empirical truths about the future, speaking strictly, and any statements about the future must necessarily be contingent, conditional, provisional and to some degree speculative. When discussing the future, then, we are not talking directly about the future but about our beliefs concerning it – what it may be, what may contribute to it, the comparative likelihood and importance of various elements of it. It follows that if the most we can hope for when discussing the future is to share what are in essence opinions, if we are to have any confidence in our conclusions, or provide any support for the actions we take consequently, the means by which we drew these conclusions must be credible. The beliefs regarding the future that we share must be justified, and any assertions we make towards what is or is not likely must be seen to be warranted. So in the reports discussed below attention is paid to the degree to which the authors share the methods they used to construct the futures they describe, and the degree to which these are robust.

To summarise the above criteria, in the first section of the report, we survey futures work that is:

- in English
- available in the public domain
- possessed of a global, not regional, perspective
- genuinely future-oriented
- addressing futures at least 15 years away
- offering multiple alternative futures
- intended to support present action
- clear about the methodology used.

This is not an absolute list, and some reports are stronger in some areas than are others: some might be focused more towards promoting action in the present than on the diversity of alternatives presented, while others might spend more time discussing the methodology employed than on considering futures over a long timespan. All the reports discussed below are, however, worth considering seriously, as the culmination of long and thorough periods of work, representing a number of different perspectives and from mainstream organisations who are listened to by a wide range of audiences: taken together, they provide us with a collection of possible and plausible futures whose implications for education in the coming years should be given our attention.

4 Selected future scenarios

4.1 A note on reading these scenarios

Below we present brief summaries of a number of future scenarios from various different groups⁸. While reading these summaries, we would encourage the reader to consider the questions: what might be the role, nature, purpose and organisation of education in the context of these diverse scenarios? What risks or opportunities emerge for education in these contexts? We would also encourage the reader to explore the questions: what alternative futures might we consider? What questions, concerns, voices and trends are being overlooked or ignored in these accounts?

These summaries of various future scenarios here are presented to begin the process of thinking about educational futures in the context of social and technological change. They are not presented as deterministic accounts of the future for which we must inevitably prepare.

4.2 Global Scenario Group 'Great Transition: The Promise and Lure of the Times Ahead' (2002)

Focus and motivation for report

The Global Scenario Group (GSG)⁹ is an "independent, interdisciplinary and international" body convened in 1995 by the Stockholm Environment Institute (SEI)¹⁰ and the Tellus Institute¹¹ to explore the prospects for global sustainable development through the development of alternative scenarios. These scenarios have been used by the UN, the IPCC, the OECD and other organisations to try to reach a deeper understanding of the elements directing global development and to inform strategy for sustainable development on a regional, national and global scale. In contrast perhaps to the other reports discussed here, the audience is primarily the development sector, rather than the futures community (whether commercial or academic).

Methodology and scope

The scenarios themselves are discussed in greatest detail in Raskin et al (2002): the methodology supporting them, however, is laid out in Kemp-Benedict et al (2002), in which the underlying indicators for the drivers used to construct the scenarios are analysed in some detail, and Gallopín et al (1997), in which the scenario planning approach used here is described. Unlike the other reports discussed here, the authors do not make particular mention of any external consultation with domain or methodology experts, although there is a mention of consulting with colleagues across the world as part of the GSG's general activities. The technical discussion of the methodological approach underpinning this and other GSG publications¹² concentrates primarily on the analysis of the many trend indicators and the use of the PoleStar¹³ software to model interactions between these.

The description of their approach to scenario planning centres on the introduction of a two-tier taxonomy of scenarios, in which "fundamentally different social visions" are represented as "classes", while "variants" within these classes reflect differing possible outcomes within each class.

⁸ Links to the full texts can be found below in the References section.

⁹ www.gsg.org.

¹⁰ More information on SEI can be found at www.sei.se.

¹¹ More information on the Tellus Institute can be found at www.tellus.org.

¹² A range of other GSG publications can be found at gsg.org/gsgpub.html.

¹³ SEI's PoleStar project looks at critical aspects of the transition to sustainable development: more information can be found at www.polestarproject.org.

While all worthwhile future work is to some extent normative, as discussed above, the work of the GSG is explicitly so, and is focused on promoting an appetite for a fundamental change in the mindset of individuals and organisations. The scenarios developed by the GSG are directed at challenging assumptions regarding global capacity for sustainable development. Consequently, two of the scenarios described have been constructed as 'backcasts': that is, in each case the authors worked to construct a vision of a desirable future state, and then identified plausible ways in which these states might be arrived at from the present day. Throughout, they argue strongly for the desirability of one particular outcome.

The scenarios are not linked to a definite timescale or posited to evolve by a particular date (again, in contrast with reports discussed below): however, the GSG's desirable outcome supports a process of human development they identify as taking place over a timescale of around 100 years or so.

Outcomes

The basis for the development of all the scenarios presented by the GSG is consideration of the following drivers:

Demographics:

Population growth, and aging populations due in part to lower fertility rates, will increasingly pressure infrastructure, environment and social cohesion in an urbanised world.

Economics:

Global economic systems are increasingly interconnected, and their emergent effects harder to predict and manage: multinational companies dominate the market, challenging the role of nation states.

Social issues:

Growing global inequality, traditional support systems and norms are being eroded by market-led development; disease and crime retard development in some areas of the world.

Culture:

On the one hand, culture is increasingly globalised (and is both a result and a cause of economic globalisation): on the other, this can provoke nationalistic and religious reaction, reinforcing local differences.

Technology:

The growth of information technologies, biotechnology and miniaturised engineering, and their transformative power in medicine, agriculture, working lives and our leisure time, will bring new ethical and environmental challenges.

Environment:

Increasing impact of human life on the planet and the associated degradation of the environment will demand a global response, requiring a change in geopolitics and global governance.

Governance:

Trends towards the democratisation and decentralisation of society will continue: on an individual level, greater attention will be given to rights; corporations will be less hierarchical and civil society will emerge as a significant voice in decision-making processes.

The authors describe these drivers as "proximate": they are responsive to comparatively short-term interventions and are described as the focus of "mainstream development policy" (and perhaps mainstream futures work as well).

The authors also identify an additional order of drivers they refer to as "ultimate drivers". These are more stable, undergoing transformation as a result of long-term social and cultural change: they define the limits of conceivable change, and it is the authors' contention that by actively intervening in their development the boundaries of the possible

would be sufficiently enlarged to imagine radical change. Within this model, then, proximate drivers such as population, economic growth, technology and governance depend ultimately upon 'ultimate drivers' of: **values, needs, knowledge and understanding, power structures and culture.**

Three classes of future scenario are described, with two alternative outcomes under each.

Class	Variants
Conventional Worlds	Market Forces Policy Reform
Barbarization	Breakdown Fortress World
Great Transitions	Eco-communalism New Sustainability Paradigm

Table 1: GSG scenarios

The **Conventional Worlds** class stands for a "business as usual approach", based on the assumption that the dominant forces and values currently influencing social and economic development (eg competitive markets, private investment) continue to evolve with no shocks or fundamental discontinuities. Environmental or social concerns are addressed through market adaptation or through policy adjustments. Growth is steady, with economic and industrial needs taking priority over those of sustainability; free trade and unregulated capital continue to globalise world labour markets; the values and practices established during industrialisation continue unchallenged. Gallopín et al (1997) describe this position as "apparently moderate, though not necessarily probable" (the majority of scenarios offered within futures work would fit comfortably within this class).

Within this class, the **Market Forces** variant represents a *laissez-faire* attitude towards regulation, with actors such as the IMF and World Bank working to overcome barriers to free trade and to initiate developing nations into the global economy (similar to the development approach characterised by the 'Washington consensus'¹⁴): sustainability priorities are secondary to economic growth. In contrast, the **Policy Reform** variant attempts to actively address sustainability issues through policy management, while still working within a traditional market economy.

The **Barbarization** class depicts a world in which the issues confronting the conventional world have failed to be adequately managed either through the invisible hand of the markets or through policy adjustments. Global inequality, rising levels of conflict, environmental degradation and other products of the industrial society work together to create "self-amplifying crises", a series of stresses that positively reinforce each other, overwhelming institutional and national capacities for coping, leading to the breakdown of civil order and a world sunk into chaos. The **Breakdown** variant represents a world in which this global catastrophe has not been avoided. The marginally less pessimistic **Fortress World** variant imagines that members of the global elite have been able to protect their own interests, establishing protective enclaves from where they impose global order on the impoverished majority in a form of "planetary apartheid".

The **Great Transitions** class represents a fundamental change in the underlying values and priorities of mankind, in which societies affirm the central place of sustainability, equality, community and solidarity. This is the favoured scenario of the authors, though they acknowledge the scale of the historical discontinuity implied by such a major change. One variant, **Eco-communalism**, imagines diverse, small-scale communities, semi-isolated

¹⁴ For a description of the 'Washington consensus', see www.cid.harvard.edu/cidtrade/issues/washington.html and multinationalmonitor.org/mm2000/00april/interview.html.

and self-sufficient – the archetypal ‘green’ vision. The authors suggest that such a scenario is most likely to occur following recovery from **Breakdown**. More optimistically, the **New Sustainability Paradigm** describes an alternative to retreating to rural isolation. A growing global concern over the social and environmental consequences of placing economic growth above all else leads to increasing disenchantment with consumerist lifestyles and a growing attachment to values of simplicity and fulfilment amongst the youth of society, enabling a global shift towards equity and sustainability.

The way in which these scenarios have been used differs in two important ways from the approaches demonstrated by the reports which follow in this paper.

First, they are discussed as representing likely futures. While there is no hard-and-fast set of rules regarding what is and is not ‘scenario planning’, scenario planners conventionally treat stories about possible futures as caricatures of possibility, stories in which a set of factors have been intentionally exaggerated in order to emphasise the differences between that scenario and others being used to challenge assumptions about future developments. Within the GSG work, however, though they recognise and support the traditional purpose of using scenarios to consider alternatives, these scenarios appear to be treated as descriptions of likely futures: that is, they are not described in terms that indicate the authors consider any aspect of them exaggerated or cartoonish.

Within the GSG scenarios we also see a continuity, a suggestion that a future of **Market Reform** might be the same as that of **Eco-communalism**. This is the second difference: the cumulative effect of the scenarios presented here gives the impression of a timeline, a choice of chronologies rather than a set of possibilities. Considering the period of time being covered by the ideas within the GSG’s work, it may well serve their purpose better to chart the progression between stages of development, rather than proposing single scenarios that span 100 years.

4.3 Siemens/TNF Infratest ‘Horizons 2020: A thought-provoking look at the future’ (2004)

Focus and motivation for report

Siemens AG is a major multinational engineering and electronics firm. In 2004 it initiated the ‘Horizon2020’ project¹⁵, examining the possible changes in the way Europeans will live their lives in 2020: this document is the final report from the project. It presents a pair of “communications scenarios”: that is, stories intended to promote dialogue with “the public” around the changes that might occur in society, and that would contribute towards the expectations held by a society towards its future. Although a substantial part of the report is concerned with pan-European political and economic developments, the body of each scenario concerns itself with how Europeans will live on a domestic and personal level, and the technologies that will support those lifestyles.

Methodology and scope

The authors examine changes in the economy, technological progress, the political arena and society as a whole over a 16-year period. The rationale for choosing such a timescale was that it provided a balance between the need for the scenarios developed to relate to life in 2004 and the benefits of looking as far forward as possible. Additionally, the authors suggest that industry and society are unlikely to change radically in 16 years, allowing “precise predictions” for the future, and avoiding any accusations of “utopian thinking”. The report further suggests that holding optimistic expectations about the future places that society in a better position to address critical challenges that may arise. Consequently the two scenarios presented do not follow what the authors describe as the traditional pattern

¹⁵ More information on the Siemens Horizon2020 report can be found at w3.siemens.de/horizons2020/index_en.htm.

of offering a desirable and undesirable future: rather, they attempt to describe two alternatives that are equally positive, albeit in different spheres.

The scenarios were developed primarily through an adaptation of the techniques developed by the Battelle Institute¹⁶ for scenario planning, underpinned and supported by technology forecasts previously generated by Siemens¹⁷ and a survey of 116 experts in the fields of economics, society, culture, politics and technology from across Europe, used to validate the scenario development process and to generate the "optimism index".

Underpinning the development of the two scenarios are five key drivers (shown in the next section). Two hundred metrics that described these drivers were established through discussion and consultation with the project's Advisory Board. These comprised 10 'megatrends'¹⁸ (factors having a strong influence over likely future developments), a set of non-critical descriptive metrics or 'descriptors' (likely, but not influential), and 108 critical descriptors (elements that could be decisive in the development of a particular driver). A Delphi-like survey of 671 experts reduced these 108 critical descriptors to 76. Two alternative courses of development were defined for each descriptor, making 2^{76} (76×10^{21}) possible alternative futures that could be generated from combining these. These were filtered into two groups presented using "consistency software"¹⁹ and correlating critical descriptor alternatives with the optimism index generated by the expert survey in order to spread positive and negative alternatives evenly throughout each scenario. Each descriptor, therefore, contributes towards both scenarios in one of its two forms. From these two pools of descriptors, and through a process of discussion and consultation, the project team developed the two scenarios presented here. Finally, the scenarios were examined for their validity should discontinuities appear in any of the driving trends.

Outcomes

The five key drivers underpinning the scenarios are identified as:

- politics
- society
- economy
- environment
- technology.

The ten 'megatrends' used to inform the scenarios are identified as:

- increasing globalisation
- increasing age
- fewer children
- higher importance of women in the economy and society
- increasing mobility ("delocalisation")
- increasing stream of immigrants from outside Europe toward Europe

¹⁶ www.battelle.org.

¹⁷ These forecasts are based on Siemens' 'Pictures of the Future' project: more information about the project is at www.siemens.com/index.jsp?sdc_p=ft4mls3u20o1168864ni1412960pFFcz3&sdc_sid=22640744941&www.siemens.com/Daten/sicom/HQ/CC/Internet/Research_Development/WORKAREA/fue_inno/temp_latedata/Deutsch/file/binary/CT_PoF_Szenarien_EN_1190686.pdf, and the report is available for download from www.siemens.com/Daten/sicom/HQ/CC/Internet/Research_Development/WORKAREA/fue_inno/temp_latedata/Deutsch/file/binary/CT_PoF_Szenarien_EN_1190686.pdf.

¹⁸ The term 'megatrends' was coined and popularised by John Naisbitt in his 1982 book 'Megatrends: Ten New Directions Transforming Our Lives': it describes dominant trends that influence inevitable events.

¹⁹ Within the report there is no description of what the "consistency software" might be: however, given that the authors claim to follow the Battelle approach, and from the account of its role in developing the Horizons2020 scenarios, it might be reasonable to assume that the software is similar in function to Battelle's Interactive Future Simulations (IFS™) software, described in general terms in Millett and Mahadevan (2005).

- increasing relevance of virtual communities
- half-life of technical knowledge
- increasingly networked communications media
- free choice of way of life.

The “trend breakers”, or discontinuities within trends that would radically alter their supposed progression, proposed by the authors are:

- natural catastrophe (extreme climate change, such as cessation of the Gulf Stream)
- war and terrorism (use of atomic weapons, attacks on vital infrastructure)
- political events (dissolution of the EU, US resignation from the UN)
- loss of trust in technology (health risk from smog, spam and viruses overwhelm the internet)
- dangers to health (new illnesses, “information fatigue”)
- radical changes in the structure of the population (abrupt decline in birthrate).

Of these possible trends breakers, only natural catastrophes, or disasters arising from war or technical disaster, are considered to have the capacity to render either scenario invalid.

Within each of the two scenarios, many different aspects of life are described, under the headings below:

- lifestyle
- home life
- work
- consumer behaviour
- travel
- leisure
- health care
- eating habits
- education
- security.

Additionally, within the first scenario the authors address media and communication, old age, and the family. Within the second relationships between people have a greater focus.

The wide range of topics explored indicates the level of detail of each scenario, and indeed there is insufficient space here to list all of the trends described in each. Instead, we offer a short summary of the main thrust of each to prompt discussion and consideration of their potential implications for education.

The first scenario presented in the report is subtitled **“Equality, freedom and modesty”**. This account is characterised by an emphasis on social responsibility and contribution to community, a greater role for government in the provision of social services, and a partial rejection of the instant material gratification promised by brands and marketers. In part, this renewed attention to non-material parts of life has come about as a result of the reduced income and increased financial burdens that sustain higher levels of government spending on medical research, education and infrastructure, and follow the playing of a greater role by the private sector in service provision. Europe’s economy continues to follow a liberal, free-market direction, although the corporate sector has embraced the “sense of values” present in society, and moved beyond image-building towards making genuine contributions to society. This sense of solidarity and responsibility within society helps people to alleviate the difficulties faced by a state healthcare system affected by the demographic shift towards an older population: people eat better, exercise more, and actively take a preventative approach to healthcare. These shared values also allow all actors – the state, the corporate sector, and individuals – to conserve energy and “protect the environment”. These efforts do not, however, prevent the steady expansion of the economy.

In this world of economic pressure and renewed interest in life outside consumerism, knowledge is growing at such a rate that learners have little capacity for the assimilation of purely factual knowledge: instead, the focus is on generating knowledge, and knowing where to find answers. Filtering information and acting on it are vital professional skills, along with experiential knowledge: those without these skills are at a disadvantage in the labour market. The primary educational objective is learning how to learn, with qualities such as independence, strong teamwork, communication skills and creativity a central part of the curriculum.

Schools are “community learning centres”, facilitating company placements and concentrating on the practicalities of fitting learners for work. At the same time, they are taking on more of a role in inculcating ethical standards, assuming some of the historical role of the family in promulgating moral norms and standards. The transition from school to working life is smoother than previously. For immigrants, “integration pre-schools” are available to help their children learn the local language and culture. At regular professional development seminars, teachers learn motivational and leadership skills, alongside “therapeutic disciplines” to alleviate “deficiencies” in parental education. These teachers are often experts from industry and the public sector, working part-time, or retired professionals working voluntarily. Mainstream schools are increasingly professional and market-oriented, although there is a growing alternative sector catering to parents actively wishing to promote communication and creativity in their offspring.

The second scenario has “**Speed, networks and risk**” as its subtitle. Where the first scenario presented a society with strong government and a sense of community at its core, this scenario centres on the withdrawal of government from much of public life. Industry’s needs are paramount, with society and individuals becoming more “flexible” and responsive to the notion of continual change: this brings with it increased risks for individuals and society, but also greater opportunities, both commercially and personally. Movement between social strata is easier here: however, this mobility exposes individuals to the risk of moving into the side of the digital divide that has no access to the communication technologies or social capital required to maintain and contribute to the networks that are vital in supporting modern personal and professional lives. For those that live in this fast-paced world of constant change, the need for social networks that are as flexible as the individual has led to the erosion of traditional ideas of family and friends. Ties between people and institutions are becoming less binding as identities constantly fluctuate, changing to accommodate the needs of business and make use of the affordances of new technologies.

The gap between public learning institutions, with their lack of funding and frequent violence, and private ones is increasing: a private education is a prerequisite for employment, with its interdisciplinary degree courses and international locations. On-the-job training and internships are commonplace, and virtual education programmes allow learners to juggle different locations to fit these into their lives. Specialist knowledge is less useful now than the ability to learn through practice: consequently, degree programmes finish faster, and there is a decline in post-graduate degrees.

Centres of learning now cater for a wide range of ages, reflecting the need for frequent reskilling and facilitating intergenerational learning. The new flexibility within work and education fostered by a market-led approach has enabled professionals from industry to teach as a “sideline”: those respected in their field are highly sought-after by educational companies hoping to enhance their reputation. Virtual simulations and remote lectures are commonplace in these well-resourced organisations.

Cross-disciplinary learning has enabled people to cope with frequent career changes, as well as enabled them to work at two or more jobs at once. Factual knowledge has been superseded by a holistic education focusing on deliberation, methodology and social skills. More vital than these, however, is knowledge management: finding credible sources and reliable data in this networked world is increasingly time-consuming.

4.4 Shell: 'Global Scenarios to 2025' (2005)

Focus and motivation for report

Royal Dutch Shell plc is one of the largest energy firms in the world. The decisions made in the energy sector operate over larger periods of time than most other sectors, giving a strong incentive for energy firms to examine the future in a systematic fashion. Shell's strategy group have been using scenarios since the 1970s, when Pierre Wack developed a method of constructing alternative futures to help company strategists anticipate change, and since that time Shell has built a reputation for shaping corporate futures practice beyond its own planning work. In particular, its 'Global Scenarios' series is an influential range of scenarios published since the 1990s, used widely outside Shell's strategy group to inform strategic thinking by a wide range of organisations.

Shell's core business – energy – and the markets within which it operates inform much of the thinking behind the current scenarios offered as part of this Global Scenarios programme. In general, the previous scenarios addressed possible responses to the 'forces' of globalisation, technology and the liberalisation of world trade. Understanding the intersection of these forces, their influence on the environment in which business will be done, and helping to shape their development through engaging with corporate and political futures work, is the motivation for the Global Scenarios programme.

Methodology and scope

The report is broadly divided into two sections: one discussing the three scenarios presented, and one describing current trends influencing the business environment that could be expected to be still relevant in 2025. For each of the three scenarios, present-day "Signposts" or indicators are described, a "Focus" is given to a particular aspect of energy policy in the context of the scenario, and "Insights" from domain experts on elements of the scenario are shared in the form of short interviews. Within the discussion of the scenarios and some of the current trends, a detailed series of business drivers are examined in a set of matrices the authors dub "trilemmas".

Before the scenarios are described, the model used to construct them is discussed in some detail.

Previous Global Scenario publications from Shell have concentrated on constructing two scenarios, each of which describe a world where one particular driving force was in the extreme ascendant: these utopias²⁰ might imagine a world entirely governed by market forces ('Business Class', 2001), or one centred on the state as prime actor ('Barricades', 1992). The report under discussion here breaks with this practice by offering three scenarios, each constructed by considering three driving forces in tension – market incentives, government-led regulation and coercion, and community – each of which could only be fully ascendant at the expense of one of the other two. By balancing these three drivers and considering the trade-offs necessary for the fuller expression of one of the them, the authors hope to articulate some of the complexity of global and social relations, while still producing scenarios that are "internally coherent, challenging, contrasted and easily communicated". The scenarios, then, are not intended to be an accurate 'prediction' of a future world. Rather, each is a caricature sufficiently bold to allow it to be differentiated from its companions, while focusing attention on the interaction of driving forces in preference to an examination of these forces in isolation.

The authors propose initially a model of all possible futures described within a triangle: the points of this triangle correspond to futures in which one of three driving forces is felt most strongly. Taking the centre of the triangle to represent "where we are now", futures

²⁰ The popular sense of 'utopia' is normative: that is, it describes a desirable world, albeit one that is unachievable. Here, Shell's scenario team appear to use it to emphasise the ultimately unrealistic nature of a particular world, rather than to indicate its desirability.

positioned closer to the “market incentives” apex represent worlds in which market forces are stronger than at present (a world they characterise as “more globalisation”), while futures positioned closer to the “community” apex represent worlds in which social ideals hold more influence than they might do currently (“a world more respectful of the planet” or “closer to our religious ideal”). The scenarios described are worlds which are equidistant from two points of the triangle, or “two wins – one loss” areas in the words of the report. The equal pressure from two of the three forces suggests an equilibrium, a state that might plausibly be considered sustainable in the long-term. While the report notes the possibility of major discontinuities (such as massive climate events or a global pandemic) that might disturb these equilibria, it claims the trilemma framework would not be a valid tool for understanding these shocks, and consequently they play little part in the report, being addressed primarily in separate Shell works²¹. The authors suggest, however, that the responses of various agencies might be positioned somewhere within the trilemma framework.

The trilemma framework is a fundamental part of Shell’s scenario work, and presented as a separate contribution to the futures community: there is a distinction between the framework and the resultant scenarios. Particular scenarios (or indeed driving forces) are not entailed by the use of the triangulation method, and more complex or weighted scenarios might equally be described in these terms. The authors have a clear idea of what kind of scenario would be most useful to the report’s audience, and have chosen to situate their alternative futures in locations that make it easier to contrast the three of them. However, the driving forces used in this instance have been inherited to some extent from previous Shell scenario work, and it is possible to imagine different forces being substituted in other contexts.

There is no mention of the way in which this trilemma framework was tested or developed, and although the contribution of a wide range of varied and authoritative external agencies is acknowledged, the form of this contribution is not specified.

Outcomes

The report sets the scene for the futures described within it by first addressing the present. Shell Global Scenarios from the 1990s onwards have been “fundamentally challenged” by what the authors call “the dual crisis of security and trust”: the confidence in the capacity of the market to address the world’s problems and operate freely has been shaken by the corporate deceptions of the early 21st century and the rise in fear and anxiety since the attacks on the World Trade Centre in 2001.

“Security” here is a broad definition including the consequences of environmental degradation on the safety of communities and individuals already living in poverty, food health scares such as BSE²², data privacy and internet safety, and terror (and, tautologically, the fear of terror). Within this report, five key issues are described: terrorism (and the risks inherent in promoting a climate of suspicion), stability in the Middle East (and the impact of the Iraq war on the wider region), nuclear proliferation (both amongst states and less public organisations), failed states (and the proximity of corruption and lawlessness to abundant natural resources) and energy supply (including the logistics of supplying rising powers with diminishing resources, and the vulnerability of supply routes to terrorism and piracy).

²¹ The company’s scenario team use air navigation as a metaphor for the three different levels of detail they address, with this report being a “Jet Stream” description of long-term trends, and regional effects of the wider “Jet Stream” trends described in “Weather System” reports: external risks and shocks fall under the scope of their “Navigation” work. Importantly, the regional emphasis of the “Weather System” reports prevents Shell from assuming that the broad scenarios described here would be equally relevant across the globe.

²² Bovine Spongiform Encephalopathy, or ‘mad cow disease’.

The other half of the crisis is referred to as “the third great wave of distrust”, following the 1930s and 1960s²³. Corporate failures of governance and the bursting of the first internet bubble have led, the authors claim, to widespread distrust towards corporations at a time when market mechanisms play a greater part in the lives of states and individuals. Additionally, this distrust is reinforced by the increasingly litigious nature of civil society, threatening the state’s role as primary arbiter and defender of rights.

The two issues, security and trust, share roots and consequences and so are discussed as two facets of a single “crisis”. This is the context for the three scenarios, and the motivation for Shell’s scenario team to add “coercion and regulation” to their previous themes of community and market forces: the three scenarios, then, can be seen as attempts to manage this crisis within the framework established by the earlier scenarios of a liberal market economy responding to the values of different communities.

Scenarios

Low Trust Globalisation

This scenario occupies the side of the triangle between efficiency, in the shape of market incentives, and security, in the shape of coercion and regulation: it describes a world where market forces are pervasive, active in all areas of life, but operating in a context of distrust that entails a complex regulatory burden, shared between the private and public sectors. Transparency is a vital asset for institutions and businesses, leading to organisations holding greater responsibility for their actions: this applies equally to the regulators, who must work to satisfy their charges and the media that the many benchmarks open to scrutiny in this data-rich world are being met. This impetus results in a “flight to quality”, with companies and organisations preferring to work within open and well-regulated environments.

There are many consequences of this scenario from an economic perspective, and these are explored in detail within the report. Of particular relevance for the current discussion are the impact of this climate of suspicion and competition on research and development activities, and the notion of public goods in a market-driven world. The authors suggest that technological R&D activities will largely become the preserve of a few communities, collaborations between the private sector, universities and government, with high barriers to entry for smaller groups not able to surmount the regulatory hurdles. Intellectual property rights will enjoy strong protection, though the form of this protection will vary between global regions. For the most part, this regulation will come from within the market itself, though a few domains are proposed that might require more direct regulation by the state: data transfer, law, individual privacy, biotechnology and vehicle emissions are all suggested as candidates.

In this scenario, located at maximum distance from the “values”, or community cohesion, corner of the trilemma, the notion of a “public good” is reduced significantly from the present. Apart from national security, the state provides no public services, preferring instead to regulate the market in order to ensure their production. The authors’ example is higher education: this would be provided by the private sector, following a curriculum dictated by the labour market. For groups addressing issues tangential to the concerns of the market – NGOs such as environmental groups, consumer advocates, community organisations and so on – this means emphasising their role as part of the regulatory network (for example, calling attention to polluting companies, or demanding higher levels of corporate transparency). These groups work to achieve their aims both through legal challenges to those corporations falling short of their standards, and by working in alliance with government, businesses and even religious groups²⁴.

²³ The authors do not expand on these previous two “waves of distrust”, nor provide any references to support the term: we presume they refer to the aftermath of the Depression and the pre-Second World War rise in geopolitical tension, and the height of the Cold War.

²⁴ The authors suggest “GRINGO”, for “government-related NGO”, “BINGO” for “business-initiated NGO” and “RINGO” for religious NGOs.

Open Doors

This scenario is located between the points of the triangle representing market efficiency and social cohesion, or the force of community: where 'Low Trust Globalisation' dealt with the "crisis" of trust and security through diktat, 'Open Doors' is a world where community plays a much stronger role in building trust between individuals and between companies. Instead of coercion and regulation, there are incentives and reputation: instead of suspicion and competition, there is tolerance and collaboration. Fundamentally, however, the scenario still addresses the same need for businesses and institutions to be transparent in order to foster trust and confidence. This, too, is a world focused on achieving global economic growth, and a world that looks very similar to some present-day political visions. There are references to a "Scandinavian model" of welfare provision, and the suggestion that, in securing social provision through market incentives, societies in this scenario owe a debt to Giddens' "third way"²⁵. The hard-nosed US legalities of the previous scenario (seen in the frequent references to Enron and the Sarbanes-Oxley legislation) have given way to a gentler, more European idealism.

Again, the implications of this scenario are discussed at length: here we shall summarise only the primary directions. There is a far greater degree of integration and interaction among companies, governments and civil society than at present, with these institutions sharing results and overlapping in roles and actions. The traditional barriers between domains and organisations have become more porous, reflecting the way in which the barriers separating different identities within the individual – churchgoer, employee, parent, gardener – are becoming less pronounced. People are acknowledged to have multiple ways of "belonging" by the organisations they are associated with, enabling them to make horizontal connections across domains as they search for self-fulfilment as well as employability, and enabling their organisations to form new kinds of connections.

Connections thus become central to success in this networked environment. These interactions between groups are what give companies their value, a principle that gives rise to a number of ideas central to the 'Open Doors' model: "voice" is crucial and all stakeholders must be acknowledged; trust and security are "co-produced", arising from the networked interactions between investors, civil society, the wider market, companies and individuals; reputation becomes vital to maintaining access to these networks from which trust and security spring, with companies voluntarily adopting high standards to meet the prevailing mood of social responsibility. In this way, the "crisis of security and trust" is managed through the fundamentally interconnected nature and mutual dependence of all elements, at all levels, of society.

This interconnectivity is facilitated in large part by "technology" (for the most part unspecified). Provenance (of goods, processes and individuals) and identity are managed by technology, employing tracking software, databases, biometrics, "smart bar codes", and presumably the connective infrastructure needed to enable these tools to communicate effectively. "Technology" also plays a large part in enabling the barriers between identities and organisations to become more diffuse: in general, moving between domains, whether in jurisdiction, in individual life or in business, is facilitated by standardisation and interoperability between networks.

As a result of this diffusion and blurring of boundaries between groups, the line separating the public and private spheres is increasingly blurred, as in the 'Low Trust Globalisation' scenario. However, in 'Open Doors' this happens in a more reciprocal fashion: rather than the public sphere being eroded by market forces and traditionally public goods being produced entirely by the private sector, here the public and private sectors work in partnership, "co-producing" essential services such as health or education. The authors envisage a world in which partnerships between governments, private companies and NGOs

²⁵ The authors cite Giddens, A (1998) 'The Third Way: the Renewal of Social Democracy' (Polity Press) and Dahrendorf, R (1999) 'The Third Way and Liberty: An Authoritarian Streak in Europe's New Centre' (Foreign Affairs, September/October 1999).

depend on the skills of NGOs, the resources of business and the legitimacy provided by government to service public objectives.

This lessening emphasis on boundaries occurs at an international level, with non-state actors (such as political movements or national institutions not associated with the state) finding it advantageous to use transnational networks to achieve their aims, and states subject to the same kind of incentive-led management from supra-national bodies (such as trade organisations or international governance bodies) that they themselves exercise on a national level. In the same way that private companies compromise their market aims in order to be able to work in partnership to achieve public goods on a national scale, so too will governments be able to trade sovereignty rights among international organisations in order to achieve mutually beneficial aims. The example given in the report is the compromise made by Turkey, offering to give up its right to punish adultery according to Sharia principles in exchange for the benefits of EU membership; other trades could be made to assuage climate change or to resolve conflicts.

This reflects the emergence of what the authors describe as “Market States”, states that deal with cross-border or trans-national issues through skilled use of a market in sovereignty rights, rather than complex legislation or negotiation between governments. Examples of domains in which such trading might be seen first could be in monetary policy (building on arrangements similar to the Euro zone), in which one country might bid for macroeconomic adjustment within another; on security issues, forces modelled on the European defence force, NATO or the UN might arise under the authority of an international command; development aid would be overseen by multilateral agencies operating outside the political constraints of particular governments.

Flags

This scenario sees the Market Forces element of the triangle receding from dominance and the equilibrium between coercion and regulation, and community. While the world of ‘Open Doors’ depends on the connections between different groups and shared values, in ‘Flags’ these connections are viewed with suspicion and there exist many different ways of seeing the world. This scenario depicts a world in which societies are divided into many disparate groups, all of which share very different values. Within groups relationships are tight-knit and loyalties strong; between groups there exists widespread distrust. Nations, causes, movements, attitudes, religions – there are many flags to rally round in this world.

The role of government here is to promote and support cohesion between the many different communities and agendas in this fragmented society. Economic growth, while still in evidence, has taken a back seat to the pressure felt by states to protect national interests and to lessen the impact of a volatile global economy. Stability and sovereignty are often chosen over economic opportunity, with states more concerned with looking inside their borders for solutions than reaching out to the global community. There is still, however, despite this general insularity, a global, transnational elite with objectives that transcend this nationalism, and whose cosmopolitan members have more in common with each other than the divided societies. For this group, who might equally be frustrated capitalists or campaigners against multinational corporations, it is difficult to achieve their objectives in a segmented world, especially one that lacks strong transnational organisations.

While the market forces that saw the production of public goods assumed by the private sector in ‘Low Trust Globalisation’ and ‘Open Doors’ are less in evidence, the “welfare state” is threatened by a tendency to implement populist “pro-poor” policies over more considered and sustainable approaches. The media, previously pictured as an impartial watchdog safeguarding standards of social responsibility, continues to have a role as the scrutineer of public life: however, its focus is more on uncovering political connections and unearthing scandal than promoting improvements in civil society.

Global Business Environment

The final section of the Shell report contextualises the scenarios by exploring a set of major trends considered by the authors to be predetermined. These are:

The US, China and changing globalisation patterns:

Describing geopolitical changes under the influence of the US and China, with particular attention given to India and Europe and the transatlantic relationship.

African futures:

Charting the particular difficulties faced by Africa and the special problem of the "resource curse", where abundant natural resources can attract destabilising elements that retard progress.

From Nation States to Market States:

Examining the move from "Nation States", maximising the welfare of the nation, to "Market States", maximising the opportunities of its citizens²⁶.

Demography and migrations setting the stage:

An overview of some of the expected demographic changes to come, particularly with respect to population growth and migration.

Patterns of economic growth:

Modelling different trajectories of growth for each scenario.

The triple discontinuity and the search for energy security:

Articulating the relationship between energy consumption and economic growth.

The energy-and-carbon industry of 2025:

Attempting to reconcile environmental concerns with continued growth in energy markets.

4.5 National Intelligence Council: 'Mapping the Global Future' (2004)

Focus and motivation for report

The US National Intelligence Council is a central part of the US intelligence community, reporting to the US Director of Intelligence, and produces both analyses of current issues relevant to foreign policy and what it refers to as "over the horizon" estimate of broader trends. The report deals explicitly with "global" trends – that is to say, it privileges a geopolitical account of the forces acting within the world – and offers a set of different scenarios in order to aid readers to better position themselves for action within a range of possible futures. Arising from the broader 2020 Project²⁷ initiated by the NIC in 2003, the primary purpose of the report is to enable US policymakers to identify developments that require action, although it is written with an awareness of a larger audience.

Methodology and scope

The 2020 Project considers global developments from 2005 to 2020: there is no particular rationale given for choosing this period, though around 15 – 20 years is a span that appears to be generally accepted within futures work as a span that can be examined with confidence. There were three broad strands to their research:

²⁶ The authors draw heavily from Bobbit (2003) to support this idea of the 'Market State'.

²⁷ For more information, see www.dni.gov/nic/NIC_2020_project.html.

- consultation with a core interdisciplinary group of 25 domain experts (including established professional futurists and members of the intelligence community)
- reviewing existing methodologies and futures studies²⁸
- holding a series of workshops and conferences on particular issues.

Areas covered by the workshops included: the changing nature of warfare, the politics of identity and gender, biotechnology, climate change, technological change and international relations; additionally, a number of events addressed specific regions of the world (Africa, Europe, Asia, Russia and Eurasia, and the Middle East). From the examination of these trends participants developed alternative scenarios, which were then refined by a Scenario Steering Group into the scenarios presented in the report.

Outcomes

The report is centred around four global scenarios, chosen for their relevance to policymakers and for their capacity to challenge assumptions readers may have regarding the future :

“Davos World”:

This focuses on the effects of globalisation on the relationship between the “West” and Asia.

“Pax Americana”:

This examines the changing geopolitical landscape and America’s role in policing the world.

“A New Caliphate”:

This suggests that the global community of Islam might become a political entity, and proposing some of the challenges to established patterns of governance that might consequently arise.

“Cycle of Fear”:

This explores the growth of feelings of insecurity through increased migration, ecological and sectarian terrorism, and “cybercrime” facilitated through improved telecommunications.

These are underpinned by a set of trends assumed to be influences acting on any possible future:

Expanding global economy:

The world economy will grow around 80% by 2020, driven largely by economic activity in the BRIC countries. Corporations will be diverse and global, remaining outside the influence of national governments. Changes in the locus of global economic power will be felt most strongly amongst the middle-classes in the developed world. There will remain large inequalities between and within nations.

Accelerating pace of scientific change and dispersion of dual-use technologies:

Increased attention given to science and technology funding in India and China will drive global innovation at an ever-faster rate: this will support more work between the developed and the developing world, on a more equal basis, while threatening some present-day aspects of economic life, such as protection of intellectual property. There is a need to balance the benefits derived from biotechnological research against the threat such technology presents in the possession of terrorists.

Lingering social inequalities:

Despite global rises in literacy and health indicators, there will still be vast differences between OECD and developing nations (and, internally, within OECD nations

²⁸ Organisations consulted and reviewed include the US National Security Agency, the UK MoD (whose study is summarised below), Shell’s scenario team, the UN Millenium Project, the RAND corporation, Toffler Associates and a number of individual thinkers within the futures movement, such as Peter Schwartz.

themselves). In particular the effects of the AIDS pandemic in Africa will have a particular impact on economic growth.

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Emerging powers:

The BRIC group and SE-Asia states will be playing a more central role in the world economy in 2020, along with developing nations who are stable enough to allow them to use new technologies to "leap-frog" traditional stages of growth. "Islam", presented here as a homogeneous entity, will be more significant as a political force.

Global aging phenomenon:

The populations of developed nations, in particular Europe, Japan and Russia will be aging over the next two decades (followed rapidly by China after 2020), in contrast to Central Asian and sub-Saharan states: migration from these states will mitigate the economic effects of an older workforce.

Halting democratisation:

"Identity politics" based on religious belief and new communication technologies will challenge the spread of democracy across the world, particularly in SE-Asia and Central Asia where democracy has only shallow roots. The concept of democracy may alter as different governments adapt various elements (for example, elections at a local level, but appointed heads of state).

Spreading radical Islamic ideology:

The growing segment of young people disaffected and alienated by their government's failure to realise economic benefits from globalisation will foster the growth of radical Islam throughout West and East Africa and the Middle East, supported by new communication technologies. This could provoke violence and schism as well as terror attacks, across the world, and perhaps even provide the ground for a new "caliphate".

Potential for catastrophic terrorism:

This is intimately linked, in the NIC's view, to the above trend: there is little mention of terrorism that does not appear to be linked to Islam by the authors. Terror attacks (and internal conflicts) have the potential to disrupt global trade, as well as inflicting huge loss of life through (in the worst instance) nuclear attack, although the greatest long-term danger is represented as the establishment of economic, trade and information systems independent of those established by developed democratic countries.

Proliferation of weapons of mass destruction:

While the authors note that the "potential" for the proliferation of these weapons may influence a global sense of insecurity (affecting markets), the actual proliferation of WMDs could be facilitated by organised crime working on behalf of terrorist groups. The authors discuss bioweapons, devices intended to disperse radioactive material and nuclear weapons as the most likely forms.

Increased pressure on international institutions:

The changes in the approaches necessary to manage the world economy, the rise of powers previously isolated from international governance, and the perception of the current order as being more relevant to a post-WWII world than the present-day will all test the ability of international institutions to respond meaningfully to world events.

Throughout the report are a series of short discussions of various other topics. Some enlarge upon themes raised within the descriptions of the scenarios (eg "Mapping the Global Future", discussing a new conception of the world beyond "East" and "West", or "Biotechnology: Panacea and Weapon", acknowledging both the potential of biotechnology to promote human wellbeing and the increased danger of terrorist organisations using bioweapons as biotechnology becomes more widespread). Others take the form of questions, indicating the uncertain nature of many of the trends discussed (eg "Eurasian countries: Going their separate ways?", suggesting that members of the CIS are unlikely to

act as a bloc in future, or “How can sub-Saharan Africa move forward?”, stressing the importance of good governance and economic reform for individual states and their ability to benefit from adapting new technologies). Although these topics might in some ways be thought to demonstrate some limitations of the scenario process when attempting to provide a comprehensive overview of such a broad field, their presence also highlights the authors’ commitment to taking the fundamental uncertainty of forecasting to heart and not succumbing to the temptation to squeeze all trends within convenient themes.

The report concludes with a brief discussion of some of the policy implications suggested by the four scenarios. In particular, the report calls for careful management of economic growth to ensure globalisation is a tool to promote international cooperation, attempting to combat terrorism overseas rather than at the borders of the US, being alert to more flexible relationship-building, acting to prevent US technological expertise being “eroded” and preparing to “battle” world opinion.

Throughout the report there is a sense that it is informed by existing attitudes that see the world as divided between “them and us”, whether reassuring readers that despite huge projected growth, Asian economies are unlikely to outperform the US on every economic indicator, or discussing the “revival” of Muslim identity and its supposed link to terrorism. Interwoven with this is a desire to stress the need to be prepared for “insecurity” and a re-imagining of traditional categories – the “nation state”, the “middle class” and “technology leaders” will, warn the authors, look very different in the next few decades. While the individual indicators that foster such a feeling of threat in the authors appear to come from robust sources, the resulting report is perhaps an example of the ways in which present-day beliefs about the world can unknowingly frame attitudes towards the future.

Finally, those events likely to disrupt the trends discussed are, in general, similar to the discontinuities and shocks described in other reports: pandemic disease, major economic slowdown, rapid escalation of climate change or attack from terrorist organisations are all possibilities that would significantly alter the landscape in which the NIC’s scenarios are imagined.

4.6 Ministry of Defence (Development, Concepts & Doctrine Centre): ‘The DCDC Global Strategic Trends Programme’ (2006)

Focus and motivation for report

The report is presented as a “live” document, a reflection of an ongoing process of strategic analysis and risk assessment leading to identification of general implications for defence and security. It forms part of the work of the UK MOD Strategic Context Process, which informs UK defence policy. As such, the focus of the report is on those trends likely to impact on UK security requirements and policy, although the authors stress the importance of a “broad and diverse” evidence base, and underline the independence of the strategic programme from MOD decision making. Defence is necessarily the lens through which these global trends are perceived, but there is a commitment to understanding that a wider perspective is essential in understanding the context in which defence decisions will be taken, rather than focusing solely on future military threats.

Methodology and scope

The scope of the report reaches over a 30-year span: the report also hopes to highlight developments likely to have an impact in the next 15 years or so. Two primary reasons are suggested for this timescale. Defence decisions on action take a long time to reach, appropriately for decisions with such long-term consequences, and the weapons with which these decisions might be implemented take up to 15 years to produce: once in service, they may continue to be used for anything between 20 to 50 years. Additionally, establishing

defence relationships and recruiting personnel are long-term processes that must be informed by an idea of the futures in which they may be operating.

The general approach to identifying the various global trends discussed, and establishing their relationships and impact on security policy, seems to have been largely consultative. The report acknowledges the contribution of a panel of around 30 experts, drawn from within the UK security community and from related areas within academia and industry²⁹. However, no other methodological approaches are explicitly described.

The report considers these trends within five "dimensions"; within each of these dimensions, the authors establish a range of outcomes³⁰, based on the ways the trends within each might be expected to interact, ranging from "probable" to "plausible", and the defence and security implications of each of these alternatives are identified. Potential outside possibilities are considered, in the form of "strategic shocks" (unexpected events on the magnitude of the Black Death in Europe in the 14th century, or the extinction of the Minoan civilisation in 1450 BC). Underpinning these outcomes are three "Ring Road Issues", deemed to be highly likely to exert a major influence on all trends under consideration. Overall, the report is structured around four global themes: within these themes, individual drivers of change are examined, before the five dimensions are analysed and a particular topic in each highlighted.

The report is careful to be precise about the difference in likelihood between various events, stressing the differences in its use of "may", "will", and "might". The risks (from "strategic shocks and other factors" attending each suggestion are clearly outlined, and the interactions represented between "issues", "trends", "drivers" and "dimensions" complex enough to convey an understanding of the rich inter-relationships between all four elements. The DCDC has also made an effort to ensure that "non-Western" voices have been included in the report, working with members of the LEAD network³¹ to assess levels of agreement with the judgements in the key themes. Broadly, LEAD network members agreed with the assessments made by the DCDC, and their insights into the importance of various trends have been taken into account.

Outcomes

The underpinning issues they identify that inform all possible future outcomes are:

- climate change
- globalisation
- global inequality.

The four key themes around which the report is structured are: "population and resources", "identity and interest", "governance and order" and "knowledge and innovation". For each theme, key implications of major trends are identified, and the primary drivers described.

Population and resources

Competition for resources will intensify, possibly forcing some nations to make "moral compromises" as they attempt to secure resources from other regimes. Increased migration and urbanisation may destabilise communities, will strain nations' infrastructure and pressure authorities to manage populations' expectations sufficiently well that messages

²⁹ Institutions and organisations represented include DSTL Porton Down, Qinetiq, Chatham House, the British Geological Survey, the Defence Academy of the United Kingdom, Surrey Satellite Technology Limited, the US Naval Academy, the Delta (S&T) Scan, the Eurasia and various academic institutions.

³⁰ The process generates "over 500" outcomes: it is not made clear how these are differentiated or discarded (presumably by filtering through the "Ring Road Issues" and "Key Themes").

³¹ LEAD International is "an international not-for-profit organisation with a... network of 1,700 leaders in more than 80 countries" (www.lead.org). 286 members from five regions took part in calibrating the DCDC study.

from extremist groups are not responded to. Failure on the part of authorities of vulnerable state to achieve this will, coupled with the effects of climate change, the uneven distribution of wealth and disease, lead to humanitarian collapse. More positively, sustained economic growth in developing countries will support a greater role for women in these societies.

The drivers with most influence in this area are identified as being **economic growth** (global growth will be steady though uneven, at around 2–3% per annum; sub-Saharan Africa in particular is likely to lag behind due to the effects of poor governance), **population growth** (by 2035 global population is likely to have grown from 6.5 billion to 8.5 billion, with most growth in areas facing economic and material risks), **resource competition** (demand for energy is likely to grow by more than half again by 2035, with 80% of it being met by fossil fuels; these primarily exist in politically unstable regions, and primary consumer nations may not trust market forces and the international system to ensure security of supply), **diseases** (the effects of communicable and contagious diseases are likely to slow economic growth significantly in some regions; the re-emergence of tuberculosis, malaria and cholera is likely; HIV/AIDS will remain prevalent in sub-Saharan Africa and central Europe), **changing demographics** (the balance between economically active and inactive citizens, and between the aging developed world and the younger developing nations, will grow sharper; stresses caused through increasing unemployment and age differentials will be only partially offset by immigration from the developing world to the developed), **environmental impacts** (two-thirds of the world are likely to live in an area of water stress, while the availability of arable land may decrease; these and other effects may drive mass migration), **mass displacements** (the forced movement of large numbers of people due to conflicts or crisis) and **urbanisation and human settlement** (60% of the world will live in urban areas by 2035, stretching cities' ability to cope and leading to growth in shanty towns and unplanned settlement; much of this settlement will be in areas of environmental risk, leading to an increase in humanitarian crises and fuelling mass migration).

Identity and interest

In certain countries, nationhood and ethnicity will continue to influence international relations, and diaspora communities will be important features of globalisation; nevertheless, ties to a particular nation-state or cultural group will more generally be acknowledged selectively as they are more or less useful. This will hold also for individuals' relationship to the state and its institutions, although personal security and citizenship will remain important. Instead, communities will form around the pursuit of common interests, and may not persist once their purpose has been served. The movement of more people around the world (the authors suggest) is likely to lead people to draw less heavily on their national and cultural origins and more on their more immediate interests and social contexts for the construction of personal narratives and identities.

This change will be driven in part by **access to information** (20% of the population of Africa will subscribe to net-enabled mobile phones by 2010: these and other instances of the spread of ICTs will support more of the world to access the wide range of material available through the internet), **communitarianism** (as civic support systems become increasingly pressured, local communities, family networks and systems of patronage may begin to provide utilities, personal security and other social services instead), **migration** (by 2050, it is likely that 230 million people will live outside their country of origin; increasing environmental insecurity and economic pressures will provoke increased migration), **dynamic diaspora** (better informational and transport links between members of diaspora and their ethnic or national communities of origin will reduce the need for members to integrate into their host countries, increasing social risks such as increases in trafficking and inter-communal violence), **growing cultural complexity** (increased movement of people for a variety of reasons will produce more cosmopolitan areas; despite the likely proliferation of sophisticated translation devices, English is likely to remain the dominant international language), **changing values** (secular and materialistic values are likely to be more prevalent in an interconnected and globalised world, while increased

cultural mixing is likely to lead to moral relativism and pragmatism; these two trends will be counter to some traditional communities and will persuade some that the sanctuaries of orthodox religion and "doctrinaire" politics are more comfortable places), and **material expectations** (with Western capitalism dominant and economic growth expected worldwide, expectations of cultural and material aspiration and progress will rise, supported by the spread of global telecommunications; failure to meet these expectations coupled with disaffection engendered through the visible inequalities that remain will ensure that marginalisation and social justice become major political issues).

Governance and order

The increasingly complex set of risks and pressures at large in the world over the next few decades will challenge the "robustness and resilience" of governments and other social institutions at every level. A growing awareness that local problems have global consequences and implications will lead governments to explore new ways and models of seeking international solutions to the complex and interconnected problems the world will face: where governments share a common interest, they are likely to work together to develop new international institutions, although a "supra-national" sovereign body is unlikely to arise. This spirit of international collaboration will be balanced against the imperative faced by each government to work primarily in the interests of its own population and the degree to which its national sovereignty is allowed to operate. As the arrangements that constitute international governance grow more complex, the likelihood of abuse and corruption within the system becomes greater.

The primary drivers within this area of focus are a **globalised economy** (the increasing interdependence of economic activity will expose local markets to external risks, giving support for protectionist and tariff-based responses where nations are threatened and leading to preferential bilateral agreements; trafficking, institutionalised criminality and illicit trade will remain features of the global landscape), a **US transition** (the dominant geopolitical position occupied by the US will ensure that its response to the rise of other economic powers and a move from a unipolar to a multipolar world will have a decisive effect on the success of any programme of international governance), **Chinese economic development** (the high level of foreign indebtedness to China means that its economic progress and consequently political orientation will have a significant effect on global markets; internally, this economic development is challenged by environmental, social, political and demographic issues), **international crime and illicit trade** (new markets in Asia and across national borders are likely to support growth in illicit economic activity; many states will rely on this activity to maintain liquidity in their economies), **transnational terrorism** (disadvantage and grievance will continue to provide terrorist movements with support, extending to middle-income groups in affluent countries; damage and casualties will remain low compared to other conflicts but the effects of terrorist activities will be magnified through the immense disruption caused to infrastructure and the psychological impact), **ungoverned spaces** (as a consequence of an inability to respond adequately to the new pressures faced the international community, failed states, provinces or cities where there is no rule of law will exist, providing centres for institutionalised criminal activity and bases for terrorist groups), **gender equality** (the disparity between societies approaching gender equality and those that are not will become greater), **chemical, biological, radiological and nuclear (CBRN) weapon proliferation** (access to technology enabling the production of CBRN weapons will increase: as in the present-day examples of Iran and North Korea, the international community will attempt to manage this in the gap between "legality and *realpolitik*"), **technological development** (innovation in science and engineering will be spread more widely across the globe, making regulation and control of new technologies problematic: the intended or unintended consequences of technological developments may be "catastrophic") and **humanitarian crises** (governments and international institutions will be under increasing pressure from populations sensitised by a global media working in the real and virtual worlds to respond to humanitarian crises, at least until compassion fatigue begins to make itself felt).

Knowledge and innovation

Commercial pressure will continue to be the primary driver for technological innovation, aside from those technologies sensitive or “niche” enough to be under the purview of government. Access to specialist information will become easier for a wide range of audiences, and maintaining commercial confidentiality will become more difficult for many innovators and entrepreneurs. Managing increasing volumes of information will test organisations with “ordered” approaches to knowledge-management. Tracking or predicting technological change will become increasingly difficult for decision-makers, technology-watchers and intelligence agencies, who will nevertheless have to respond to the implications of new technology despite the reduced opportunity for innovations to become embedded culturally within a society: this will require more resources for those agencies concerned. Technological advances are likely to be most rapid in the fields of ICT, energy, biotechnology, cognitive science, sensors and manufacturing: developments in quantum computing could threaten the security of military cryptographic techniques. These advances will not be available equally across the globe.

The drivers supporting this technological progress are identified as **commercial imperative** (R&D is increasingly likely to take place in commercial environments, with pressure to make best use of every development and a focus on interdisciplinary research as being most likely to provide innovation: this last approach will make it hard to predict the impact of any breakthroughs), **new innovation centres** (China, India, Brazil, South Korea, Taiwan and Israel are all identified as areas investing heavily in support for R&D activity), **labour mobility** (highly-skilled workers will be in demand globally, affording them opportunities to move around the world: the current “brain drain” from developing to developed countries is likely to become a “brain circulation” as other centres of research and innovation mature), the **growth of knowledge sharing** (trends in increasing international R&D collaboration, increasing numbers of non-native research students and the growth of internationally-owned patents will continue, the authors claim), **ICT growth and pervasiveness** (wireless and wearable ICTs will be available to those “who can afford it” before 2035 and computing power will grow³²), the **demand for new energy sources** (approaching the limit of hydrocarbon availability will stimulate research into alternative sources of energy such as biofuels, hydrogen, and possibly nuclear fusion), the **exploitation of extreme environments** (as the demand for energy sources becomes more urgent, the technology needed to facilitate the exploration of extreme environments will become cheaper, making it likely that polar and space environments will be increasingly exploited: as the space programmes demonstrated, this is likely to lead in turn to wider technological innovation) and **advances in simulation** (the range of social, biological, environmental and political processes that may be modelled will be significantly extended through the combination of social and behavioural sciences, mathematics and advanced computational powers to establish a new science of pattern recognition the authors refer to as “Combinatronics”: these new modelling tools will make major contributions to policy development and decision making, as well as blurring “the line between illusion and reality”).

The dimensions identified by the DCDC as areas that compose the future context of defence action (and their corresponding “hot topic”) are:

Resource:

“Energy competition”: pressure from developing economies and greater influence for producer countries.

Social:

“Media in society”: influence of media on calling governments to account and greater diversity in delivery mechanisms.

³² The authors do not explore how, in the absence of an explanation of the ways these support or drive knowledge and innovation, they might be better described as *products* of the technological progress they describe.

Political:

“Soft power”: globalisation and information technologies enable more groups to leverage non-military power.

Science and technology:

“The scramble for space”: a second, global space race, opening space up for military advantage and the exploitation of resources.

Military:

“The balance of military capability”: increasing differentiation in military capacity between affluent and low-income states.

The implications for policy action are examined within each dimension: there is no overarching conclusion, appropriately enough for a document reflecting an ongoing process.

4.7 UN Millennium Project ‘2007 State of the Future’ (2007)

Focus and motivation

The UN Millennium Project publishes a ‘State of the Future Report’ each year, in order to aid thinking about the future for policymakers. Rather than having a specific focus or problem to address, it is intended to support futures thinking more generally. Consequently, the range of topics covered by the report is broad, covering global environmental challenges, the 15 UN Millennium Challenges, an analysis of around 30 global trends to produce a ‘State of the Future Index’ (SOFI), future possibilities for education and learning by the year 2030, and the security risks of environmental degradation³³.

The degree to which each section is future-oriented varies. The ‘Education in 2030’ discussion and the SOFI are perhaps the two elements of the report most clearly addressing the future rather than describing the state of the present, and so are treated at greater length here than other parts of the report³⁴.

Methodology

The UN Millennium Project is a summary of a series of events, publications and consultations that have been facilitated by the Project’s “Nodes”: groups of individuals and organisations across the world who “interconnect global and local perspectives”. These activities have been taking place in various forms since 1996: since then, a cumulative total of 2,375 people have contributed to the reports, with 334 people contributing to the present report. These contributors are described as futurists, business planners, scientists and decision-makers³⁵. As the report summarises a variety of projects, there is no single overarching methodology: rather, each chapter presented in the report draws on a methodology specific to the task. However, broadly speaking, the majority of the consultative work carried out for the report was facilitated through various Real Time Delphi

³³ These areas are supported by supplementary information which, in addition to providing detailed explanations of the statistical methods used and the previous work upon which this report is based, also provides many global scenarios – on responses to terrorism, science and technology, and long-term planetary change – and responses to these obtained during several Delphi surveys. This supplementary information is not discussed specifically here although where appropriate material has been quoted from it.

³⁴ The remainder of the report deals more with present trends, taken from the work of other supra-national bodies such as the OECD or IPCC: it has the feel more of a progress report than futures work, an impression supported by the focus on “the future” rather than multiple futures. While “the future” in the main report appears as one that can be studied with confidence by extrapolating present trends, the many scenarios contained within the supplementary information provided demonstrate a more sophisticated view of futures work than perhaps displayed in the main report.

³⁵ The authors do not describe the ways in which participants’ identity was verified in the online consultations; however, names and affiliations of all participants are included in the supplementary information included with the report.

processes, outlined below. Here we discuss only the SOFI and the chapter dealing with education, as the two chapters dealing most clearly with the future.

The SOFI is intended to be a measure of the 10-year outlook for the future, indicating simply whether the future (as seen at a certain point in time) appears to be “better” or “worse” than the present. The value of a single measurement lies in its communicative power amongst policy makers, as well as its capacity to reflect changes in the underlying relationships between the variables that are analysed to produce it. However, the authors are careful to recognise that representing many factors with a single number can “lead to loss of detail” and that the “apparent precision of an index can easily be mistaken for accuracy”.

The index is the result of a Real Time Delphi process³⁶, an online study in which participants selected variables they feel ought to contribute to a SOFI, decided the weighting that should be assigned to each, and what plausible “best” and “worst” values might be reached by these variables over the next 10 years³⁷. Thirty-three variables were presented to the participants, based on the outcomes of previous years’ Delphi processes: 29 of these were used to produce the final index.

The index was refined through a trend impact analysis, examining the likelihood of 92 futures trends on the SOFI: this provided a way of assessing the strength of any trend in the direction of the SOFI. Each trend was given a “best” and “worst” case prediction for 10 years’ time through the same Real Time Delphi process that contributed to the SOFI. These trends were then factored in to the SOFI to produce a refined index of prospects for the future, enabling the sensitivity of the SOFI to be revealed through including particularly high-impact events.

The Education chapter presents the outcome of a Real Time Delphi survey among 213 experts from around the world: these experts were selected by the international team members of the Millennium Project. The panel were asked to rate, in order of likelihood, 19 possibilities considered to be likely influences on education by 2030. These possibilities were sourced from MIT, technical and education-focused publications and journals, newspapers, the UN Food and Agriculture Organisation, the WHO and research centres. The report presents a brief discussion of each possibility, considering the possible events that could bring it about, the negative and positive consequences that could arise, and the factors that might prevent it from happening.

Outcomes

Executive summary

It might be unusual to treat the executive summary of a report as an outcome: however, in this case it provides a useful précis of the state of the present, providing a context for later outcomes using data from UNESCO, OECD and other global sources not referred to elsewhere in the report. It is included here as it covers themes touched on within other scenarios discussed earlier, as well as providing a set of touchstone measures for discussing change on a global scale, and raising the question of what bearing views held on the present have on the construction of possible futures.

³⁶ Participants were shown the anonymised responses of other participants in the Delphi process, the number of responses received to date, and for numerical questions the mean response, when submitting their answers. They could return to their own response at any time to change their response (hence “real time” as this opportunity replaces the “second round” of a traditional Delphi). On submitting their response, the statistics and responses made available to other participants were immediately updated to reflect any changes. Any responses appearing a predefined distance from the median response were automatically flagged and the participant contacted to confirm their answer: in this way, several typographical errors were captured and confidence in outlying responses preserved.

³⁷ Online sources for all variables are given in the supplementary information provided with the report.

Broad themes include:

- global economy – income disparity
- increasing urbanisation
- global decrease in conflict
- spread of AIDS into new regions (eastern Europe, and Central and South Asia)
- expectation of increased life expectancy to 73 years for those born in 2025
- decrease in global mortality and fertility rates (population peak of 9.3 billion in 2050)
- climate change – increasing CO₂ emissions from developing Asia
- increased number of people affected by natural disaster
- global nature of crime and terrorism
- spread of technology and positive impact on decision-making.

Global Challenges

The 15 Global Challenges described are intended to provide a framework for assessments of humanity's global and local prospects. Established through an ongoing Delphi process that began in 1996, these are challenges too large to be met by any one institution or country. They are listed here for context: however, the discussion of each only addresses the future insofar as they propose actions for meeting these challenges. There is no particular order to their presentation: each is as high a priority as the next.

- achieving sustainable development for all
- providing sufficient clean water for everyone, without conflict
- bringing population growth and resources into balance
- ensuring the emergence of genuine democracy from authoritarian regimes
- making policymaking more sensitive to global long-term perspectives
- speeding the global convergence of information and communications technologies that work for everyone
- encouraging ethical market economies to help reduce the gap between rich and poor
- reducing the threat of new and re-emerging diseases and immune micro-organisms
- improving the capacity to decide as the nature of work and institutions change
- reducing ethnic conflicts, terrorism, and the use of weapons of mass destruction through shared values and new security strategies
- ensuring that the changing status of women improves the human condition
- stopping transnational organised crime networks from becoming more powerful and sophisticated global enterprises
- meeting growing energy demands safely and efficiently
- improving the human condition through accelerated scientific and technological breakthroughs
- incorporating ethical considerations into global decisions more routinely.

State of the Future Index (SOFI)

The methodology used to arrive at the SOFI has been outlined above. The variables used to arrive at the index, ranked by participants in order of importance, are included in the endnotes to this document¹. The index is represented graphically within the report (Figure 1): it suggests that prospects for the future improved rapidly during the years either side of the millennium, with a slower but still positive change predicted for the next 10 years.

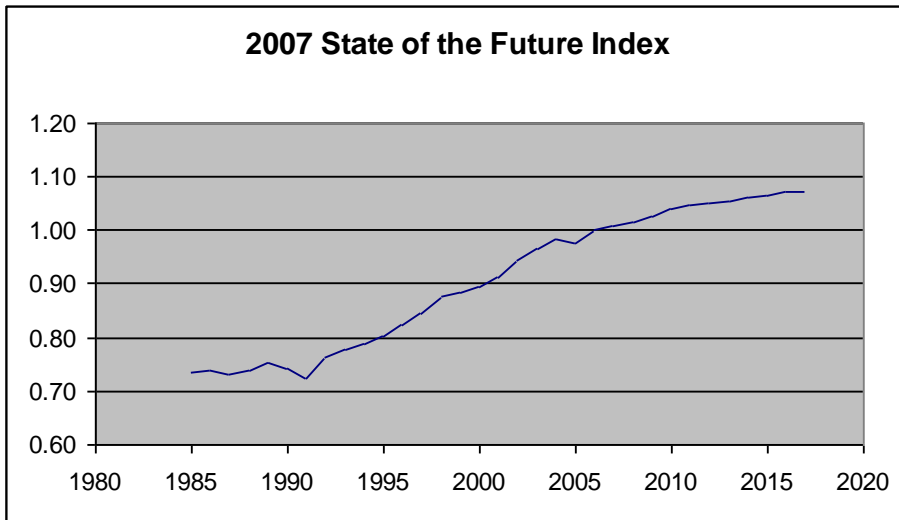


Figure 1: 2007 SOFI, from the data accompanying the UN Millennium Project '2007 State of the Future' report (Glenn and Gordon 2007)

This index was further refined by factoring in the results of a trend impact analysis, as described above. The trends examined in the analysis are included in the endnotes to this documentⁱⁱ. Factoring these variables into the SOFI produced a graph with a similar shape to the previous, "surprise-free" SOFI (Figure 2), sharing a continued upward trend described as "encouraging". However, when the impact of a single, large negative event was factored in, the effect on the SOFI was dramatic (Figure 3): the authors factored in a terrorist attack they modelled as 75% likely and killing twice the number of people otherwise expected to die ("200% impact") and saw a drop in the SOFI back to levels of 10 years ago. They do not explore in detail the ramifications of this finding except to highlight the impact on general prospects for the future such an improbable yet plausible event could have.

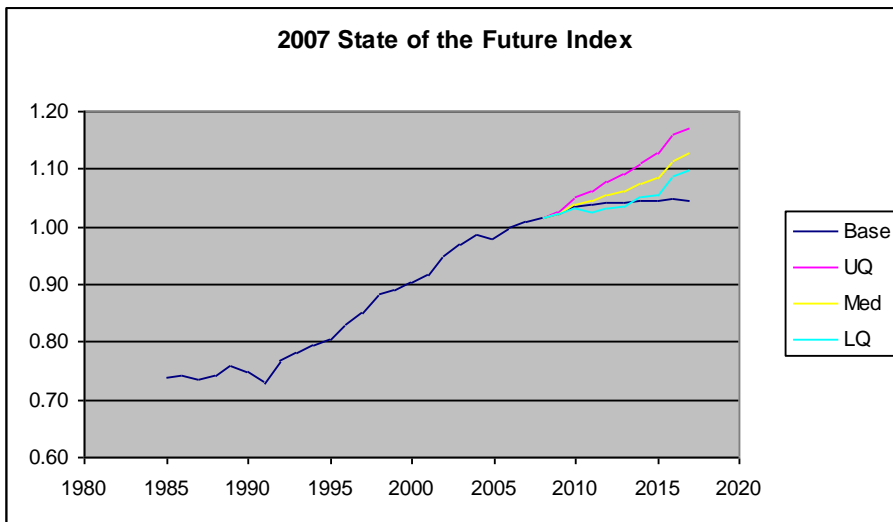


Figure 2: 2007 SOFI with results of trend impact analysis factored in, from the data accompanying the UN Millennium Project '2007 State of the Future' report (Glenn and Gordon 2007)

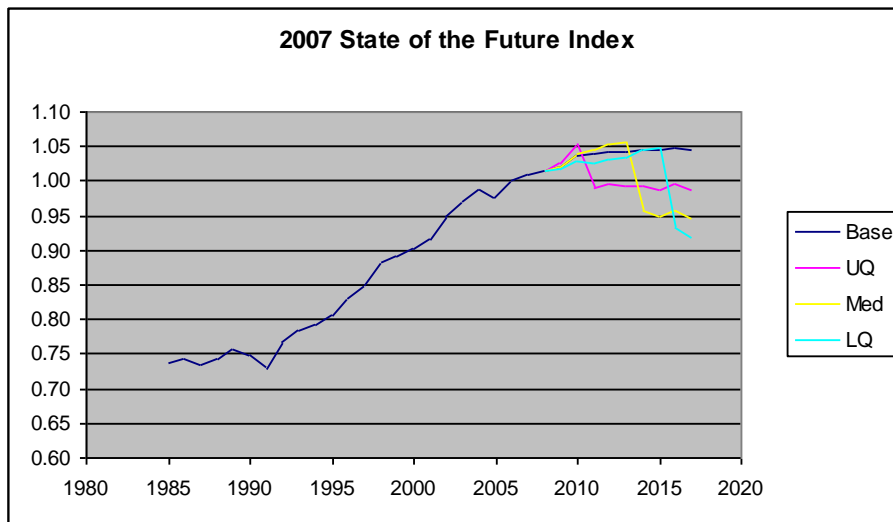


Figure 3: 2007 SOFI with results of trend impact analysis factored in, including catastrophic terrorist attack, from the data accompanying the UN Millennium Project '2007 State of the Future' report (Glenn and Gordon 2007)

Further possibilities for education and learning by the year 2030

The 19 possibilities for education and learning by 2030³⁸ that the experts were asked to consider are below. They are ranked here in the order in which the experts ranked their likelihood of having a significant impact on education:

- Web 17.0
- integrated life-long learning system
- chemistry for brain enhancement
- just-in-time knowledge and learning
- use of public communication for pursuit of knowledge
- use of simulations
- 'e-eaching'
- means for keeping adult brains healthier longer
- individualised education
- improved individual nutrition
- global online simulations
- national programme for improving collective intelligence
- portable artificial intelligence devices
- smarter than human computers
- programs aimed at eliminating prejudice and hate
- continuous evaluation of individual learning processes designed to prevent people from growing unstable or becoming mentally ill
- complete mapping of human synapses
- genetically increased intelligence
- artificial microbes enhance intelligence.

The report contains little discussion on the role of education, or the social contexts in which it may operate in 2030: it appears to be focused more on assessing the technical likelihood of such possibilities existing than it is on examining the requirements of education in 2030. Nevertheless, many of the proposed options are commonly discussed in more education-oriented fora, as well as among geneticists and computer science researchers.

³⁸ The way in which the topics are presented here necessarily omits much of the discussion that enlarges each in the Millennium Project report.

Emerging environmental security issues

The final chapter of the report identifies climate change, and the consequences for national and international security associated with climate change, as a major issue on the agenda of world leaders and international security organisations. In particular, the importance of the environment to conflict resolution and prevention, and the role played by technological developments in monitoring environmental threats are highlighted.

While climate change and its effect on all areas of human existence is certainly a major factor in any consideration of the future, this particular section of the report is essentially a summary of the monthly reports produced by the Millennium Project on emerging environmental issues with the potential to affect security or political activity. These reports, included with the supplementary information, are comprehensive and well-sourced, detailed, relevant and cover a wide range of areas relevant to the action on the environment: policy, research, safety and risk, geopolitical, governance, biodiversity and the repair of military damage to the environment are just some of the topics touched on. Nevertheless, the summary chapter within the '2007 State of the Future' report does not directly address the future, being rather an update on the present state of the debate, and as such, although it is interesting and would be highly relevant in other contexts, will not be discussed in more detail here.

5 Common ground or convention?

The reports above address very different areas: the context in which the consumer electronics market will operate, UK security concerns, sustainability and geopolitics. These are the individual concerns of the various different groups producing the reports discussed in this paper. Each of their insights into the forces that might influence the future is conditioned by this original focus. In a sense, each organisation's particular set of concerns can be thought of as a kind of lens, through which the various trends they discuss are seen: examples of what Slaughter (2004) describes as "problem-oriented" futures work. Consequently, different trends receive a greater or lesser degree of emphasis within each report, depending on the context within which each group is working.

Nevertheless, although the methodological approach and motivation of each group differs, as might be expected, there are some areas which all reports consider vital to understanding the forces shaping future circumstances. Depending on the approach and perspective of each group, these may variously be thought of as drivers, trends, 'megatrends', or assumptions, but they feature in various guises in every report as elements of civilisation through which forces of change can be understood, and as forces whose path can be foretold from our current knowledge of their circumstances.

One quality of life in the present occupies a central position in discussions of the future in these diverse scenarios. All writers see the need to acknowledge the effects of '**globalisation**'. Within the reports, the way in which this term is used varies. Generally, it is used to refer to an important new feature of the economy, highlighting the effects that advances in communications and logistics technologies have had on markets across the world. However, it also speaks to a supposedly increasing homogenisation of world consumer culture, is cited as provoking nationalistic and religious reaction, and carries with it an additional sense that what is becoming global is a culture with its roots in the affluent 'West', rather than a new, truly global culture³⁹. It may also reflect a conception of the world as a complex, interconnected system, in which the idea that national boundaries could form the natural end-point for the effects of a society's actions is discredited: this global perspective is demonstrated, perhaps, through the common acceptance that increasing affluence in parts of the world will lead in increasing deprivation in others.

While the notion of 'globalisation' as an overarching driving force for change is one seen in all reports, it is also represented throughout as a pervasive quality of all trends and drivers⁴⁰. Any consideration of security, governance, demographic change or any other driver contains here an appreciation that they have a global scope, regardless of the scope of the original grounding topic.

Broadly, the remaining major common drivers can be grouped into the commonly-used headings outlined in the table below. It is worth noting, perhaps, that although there are a number of trends noted in only one or two reports, there are very few direct contradictions between groups.

³⁹ This is of course not to say that such a culture might not be in the process of being formed: this characterisation is derived from reviewing the reports rather than our own observations.

⁴⁰ For example, the authors of the NIC report describe it as "a force so ubiquitous that it will substantially shape all the other major trends in the world of 2020" (NIC, 2004)

Common heading used across scenarios	Some areas covered by the term in specific scenarios
Economy	Globally interconnected markets Continued worldwide growth Services and knowledge growing segment of affluent economies Importance of BRIC economies Innovation in science, engineering vital Move towards sustainable free market
Science & technology	Biotechnology, small-scale engineering, communications and networking technology continue to develop at an accelerated pace Disruptive effect of new forms of technology Science presents new ethical challenges 'Exponential' development of technology
Society	Rise of fundamentalist religion Changing relationships and identities Tension between social provision and free market Increasing personalisation (of media, products, education) Lack of enthusiasm for consumerism Attention given to quality of life
Demographics	Aging populations in affluent countries Inter-continental migrations occasioned by conflict, lack of resources, climate change or economics Global inequality
Politics	Governance (national and supranational) Democratic and decentralised approaches more widespread Media role in accountability of officials Challenges to role of international institutions
Security	Rise of fundamentalist religion (particularly Islamist groups) Scarce resources increasingly root of conflict Rise of 'cybercrime' Catastrophic terror attacks 'Soft power': cultural and economic power
Environment	Climate change accepted Effects of ecological degradation and climate change manageable through new technologies and policy change

Table 2: Common drivers across reports

Additionally, there are some drivers of note that are not used as frequently. The ideas of '**knowledge**', '**community**' and '**identity**', rather than being aspects of (say) politics or society, were treated by some groups as primary drivers. In other words, they were seen as ideas with useful explicative power that could be used to understand trends such as changing social roles or new security threats more effectively than considering them as aspects of 'economy' or 'environment'.

Each report stresses the importance of considering the interrelations between these drivers, rather than viewing them as isolated groups of events. For example, the connections between ecological degradation, demographic change and security is described a number of times.

This degree of congruence in disparate groups' work reinforces Schwartz's (2004) notion of the "Orthodox Future", a shared vision of the way key trends are expected to develop. There is a common core of beliefs underpinning all the scenarios here, despite the differences at the edges.

Questions we might be asking ourselves in developing a long-term vision for education in the context of social and technological change, then, may be: To what extent do these common beliefs offer a context for considering future educational change? To what extent are these common beliefs ones to which we would want to subscribe or to challenge? What are the sources of evidence that might challenge or problematise these accounts?

5.1 Radical discontinuities

Finally, there is general agreement also that there may be certain events that fracture the future narratives set out in certain scenarios. These events tend to be referred to as “shocks” or “radical discontinuities”, and although methods of including them within a particular methodology vary, there is a consensus around the scope and type of these events. Some examples:

- war and conflict
- ecological collapse
- famine
- episodic or emerging diseases
- global geopolitical or economic shocks
- natural catastrophe
- terrorism
- loss of trust in technology
- global pandemic
- radical changes in the structure of a population.

6 Focusing on technological futures

6.1 Ideas of technology in previous scenarios

When we read through the futures scenarios presented in the previous section it is hard to distinguish between the accounts offered of sociological and cultural change and the accounts of technological and economic change. For example, 'technology' is given a fundamental role in the movement of goods within a globalised economy, or described as underpinning a change in workplace practice as workers take advantage of new forms of mobility. It is implicated in military action, in civil security, in the dissemination of information, in the provision of new kinds of crops, in the movement of demographic groups from continent to continent, in medical advances, in the provision of new energy sources and in supporting the actions of the marketplace. 'Technology' is identified frequently as having a special role to play in ameliorating or preventing the consequences of unsustainable development, aging populations and indeed any undesirable situation it is perceived as having helped to create.

It would be fair to say that ideas of unspecified but influential 'technological change' underpin all of the societal changes discussed in the reports. Yet the forms it might take, or the ways in which it might act as such an enabler, are rarely discussed in detail. 'Technology', in many of the reports summarised above, appears sometimes to stand simply as a label for processes currently unknown or unrealised. Indeed, in some cases, 'technology' appears broadly to stand for the work of universities and R&D departments: the creation of 'knowledge' or the fostering of 'innovation' serving to signify scientific and technical development in the most general sense. To a large extent, technology is discussed as a primary economic driver: put crudely, for some authors, more technology leads directly to economic growth. This is an indication perhaps of the extent to which the ideas around the fundamental role of 'knowledge' in future economies have become accepted: the 'knowledge-based economy' is, it seems, a given for many authors.

This tendency to use 'technology' to stand for diverse forces and activities is, in itself, interesting and worthy of examination as it helps us to understand the broad contexts and assumptions within which diverse technological developments, innovations and tools may be 'socialised' into social and cultural practices.

A general theme apparent throughout all the reports, for example, is the potential for 'technology' to pose risks to society. The canonical example of this kind of technological paranoia is the widely-cited threat of 'grey goo', or the uncontrolled replication of nanotechnology leading to a blanket across the earth. But there are many other areas of technological development which are often presented as possible threats. For example, developments in artificial intelligence may lead to 'smarter-than-human' intelligence and conscious machines not friendly to humanity. New forms of industry may give rise to new environmental difficulties, polluting our world in novel and unavoidable ways. Genetically-modified organisms may have unknowable and undesirable effects on the food chain. Communications and network technologies in particular are seen as having great potential for negative impacts on society, enabling new forms of 'cybercrime', their use by criminal and terrorist elements for spreading viruses, forming 'botnets' (networks of computers used to propagate viruses and spam), subverting intellectual property rights through piracy, or stealing the identities of those using online services⁴¹. Novel forms of cognitive disease, in the form of attention disorders or 'information overload' are seen as potentially arising from

⁴¹ Of course, in many ways these crimes are not new. Fraud, dissemination of terrorist ideology and practice, vandalism and the unauthorised use of resources are already crimes, and the types of activity described as "cybercrime" are present-day issues as much as they are problems for future law-enforcement agencies: nevertheless, they are treated as special cases due to the use of these technologies and the perception that these technologies may amplify the risks or impact of such activities.

the use of communications or network technologies. The global social networks they support might threaten traditional familial or geographical relationships, undermining existing social structures. But it would be unrepresentative to characterise the place of technology within these futures as predominantly negative. On the contrary: underlying much of the discussion of 'technology' in these scenarios is the assumption that it will be humanity's saviour.

For example, advances in technology will help us to avoid facing up to the consequences of living unsustainably, by giving us access to resources that were previously inaccessible, and enabling us to make more efficient use of them. Sequestration technologies as a viable solution to our excessive production of carbon dioxide are mentioned in a number of reports (most prominently, and unsurprisingly, within the Shell report), while nuclear power might become a more palatable alternative source of energy through new methods for dealing with the waste material generated. Networking technologies could change our work and consumption patterns, with consequent beneficial changes in the way we use transport in urban areas. Biotechnology will give us crops that grow without nitrates.

Technological advances will not just enable us to change the world for the better, we will be able to change ourselves for the better also. 'Smarter-than-human' intelligence may be around the corner, but we will at least be able to raise the bar for the machines: 'smart drugs' and other cognitive enhancements will eventually give way to genetically-manipulated increases in intelligence. Our bodies will last for longer and work better, due to advances in medicine and bioscience. Communications technologies will bring previously isolated groups of people into contact with each other, leading to a better appreciation of different perspectives and offering the promise of a truly global community.

What this reading of the place of 'technology' in these future scenarios implies is that accounts of 'technological futures' cannot helpfully be separated from accounts of sociological, cultural and economic futures. Indeed, this would be supported by longstanding research in the sociology of technology which challenges the concept of 'technology' as a discrete element external to and impacting on social life with predetermined 'impacts'.

However, while not wishing to isolate 'technology' as a discrete and non-social element, we do think that it is helpful to present some of the dominant accounts of the potential trajectories of technological development over the next 15-20 years, and to analyse some of the potential affordances that such development might offer. This is because these forecasts are dominant accounts of the future that will mobilise investment, research and development activity and which will work hard to bring such affordances into reality.

6.2 The need for new categories

In this section, in addition to referencing ideas from the scenarios summarised previously, we widen out our discussion to engage with ideas of science and technology futures drawn from a wider diversity of sources⁴². Although we are not discussing here the sociological

⁴² These sources include scans such as the Ipsos MORI Sigma scan (www.sigmascan.org), the Stanford Delta scan (humanitieslab.stanford.edu/deltascan), the BT Technology forecast (www.btplc.com/Innovation/News/timeline/TechnologyTimeline.pdf) and the technology suffixes in the Siemens report; magazines, including the New Scientist (www.newscientist.com), the Economist Technology quarterly (www.economist.com/science/tq), Seed (seedmagazine.com), MIT Technology Review (www.technologyreview.com) American Scientist (www.americanscientist.org), Wired (www.wired.com), WorldChanging (www.worldchanging.com); blogs such as pasta&vinegar (liftlab.com/think/nova), IFTF's Future Now (future.iftf.org), the BPS research digest (bps-research-digest.blogspot.com), from here to singularity (fromheretosingularity.com), choosing tomorrow (choosingtomorrow.blogspot.com), engadget (www.engadget.com), slashdot (slashdot.org), bldgblog (bldgblog.blogspot.com) and Warren Ellis (www.warrenellis.com), among others. Of course, the inclusion of any particular source is not necessarily an endorsement of their worldview or opinion.

and cultural contexts in which technical and scientific innovation occur, one principle appears to be characteristic of much of the technical innovation discussed here and elsewhere, and that is an understanding of the importance of an interdisciplinary approach to research and development. Many recent innovations in science and technology have been made possible through collaboration between disciplines that may not have historically worked closely together. As a consequence, many historic categories and divisions are becoming less useful for describing academic research and scientific development. As novel areas of investigation and discovery appear, too, old ways of dividing scientific fields cease to be the best ways of describing this new work, and new terms arise.

We hope to recognise and respond to this terminological fluidity in the discussion below by organising accounts of technological innovations into three broad, inclusive categories: **automation**, **ubiquitous computing** and the **brain/world interface**. These categories describe likely areas of innovation within technology, rather than providing a taxonomy for understanding the totality of current technical endeavour (given the rate of change in the technological landscape, any attempt at an exhaustive catalogue of particular projects and ideas would necessarily be incomplete). In particular, the absence of, say, 'intelligent agents' or 'personal robotics' as explicit areas of interest flagged up below does not indicate a belief that either will cease to progress or be highly relevant to life in the future. Rather, the presence of (for example) 'automation' as a category indicates a belief that innovation and developments falling under that category will inform and support existing areas – including intelligent agents and personal robotics.

Rather than replicate uncritically the divisions used across the various groups describing the future, or attempt a comprehensive and exhaustive list of every possible or likely innovation mentioned in our sources, these categories have been chosen to enable a re-examination of the activities, accomplishments and advances they describe: it is hoped their comparative unfamiliarity might support looking at the various innovations and trends contained within them afresh. Additionally, rather than confront the impossibility of providing ever-more precise and specialist definitions of technical activity, the categories are intentionally wide-ranging and have a broad scope: the activities that might be considered within them cover many fields of activity that currently might be considered separately. And, finally, they have been constructed to allow for a clearer differentiation between the technical innovation and its implementation. We have been careful to attempt to make a distinction between genuine technical or paradigmatic innovation, and the novel application of existing technology. So, for example, while biofuels might make an appearance on some groups' lists of future technological areas of interest, here its absence is a reflection of our belief that, while the societal and ecological impact of work in this area might be very great, the technology and science underpinning that work is well-established and so not directly relevant to our current purpose.

The focus of this section of the review is primarily on technology, rather than science. However, although this is not the forum for a detailed discussion of the complex relationship between the two, it is worth calling attention to two broadly novel areas of science that have already demonstrated their potential to challenge established notions of science's proper sphere of activity and are likely to lead directly to innovations in a more technological sphere. These two areas we are calling 'synthetic biology' and 'experimental mathematics', two terms increasingly common among the research community, though doubtless some members of that community might take issue with our definition of each here, and each definition is subordinate to the fluidity of terminology mentioned above.

Synthetic biology, in its broadest sense, is a term that can encompass all efforts within the biosciences that progress not only our understanding of the processes that underpin life, but also our ability to use this understanding to rearrange the elements of life in ways that alter the properties of the organisms they constitute. This is a domain that has already disrupted our ideas of how to define life, and of what medicine might now be capable of, and has the potential to affect many aspects of existence. Although biologists and chemists have in some sense been synthesising naturally-occurring compounds for decades if not centuries and while the last few decades have seen huge progress within all the

biosciences, it is only in the last few years that chemists, biologists and engineers have been able to build on this previous work and begun to be able to make new arrangements of genes within cells, with the aim of designing and engineering biological systems that have never before appeared in nature. In essence, synthetic biology represents a radical new approach to bioscience, taking the approach represented by engineering as a discipline and applying it in the genetic domain. This approach could yield huge benefits across a wide range of areas: most obviously, medicine, in the form of gene therapy techniques, but also more radically in the development of computational resources that operate on the molecular level.

As with synthetic biology, we use the term 'experimental mathematics' in its widest sense, not only encompassing mathematical proofs arrived at solely through computers, or the empirical verification of hypotheses formulated mathematically, nor even as a way of describing the insight and conjecture that precedes a mathematical proof, but to stand also for the many points of coincidence between the domains of physics and mathematics. From the need for physics to turn to mathematics in order to support developments in string theory to the insights gained in number theory from quantum physics, the congruencies between the two disciplines form the basis of a huge number of applications to the real world, perhaps most obviously in traditional domains such as economics and computer science, but also underpinning innovative new approaches within such disparate realms such as bioscience, human geography and information theory.

By highlighting these two domains particularly, we hope to draw attention to an important shift in the way some areas of science position themselves towards the world. While other scientific domains continue, of course, to progress and to make an immeasurable contribution to the development of new technologies, we would suggest that changes of approach within these two fields demonstrate a more fundamental shift in practice⁴³. Whereas the traditional role of biology might be briefly summarised as to describe, catalogue and understand the natural world, within the domain of synthetic biology an explicit aim is to use the understanding so gained to be able to manipulate the basic elements of life and create new forms of organism – a shift to construction, rather than description. Within experimental mathematics, the move from theorem and proof as the primary means of exposition to the admissibility of conjecture (strictly defined), a recognition of the value of empirical testing of mathematical hypotheses and a willingness to share the process of mathematical discovery, not just the final outcome – all these set it apart from mathematics as traditionally conceived and practiced.

These crude descriptions of complex scientific endeavour are, of course, caricatures. Biologists have been actively manipulating life since Mendel (or perhaps even earlier, when dogs were first bred to hunt or cows for yield). And the role of heuristic reasoning and hypothesis in mathematics has always been central to its pursuit: Gauss himself claimed his method of arriving at mathematical truths was "through systematic experimentation" (Epstein and Levy 1995). The purpose, then, of drawing them in such broad strokes is simply to highlight the role of novel forms of scientific practice in supporting the development of new technologies, and to ground the categories of technological development described below within broader trends of thought: the realisation that areas of existence traditionally assumed to be the province of philosophy (consciousness, life, identity, reality, etc) are now, through these two domains and their associated disciplines, open to empirical assessment for the first time in history, and the power of interdisciplinarity.

Before we move on to a summary of what we see as the primary categories of technological innovation, it might be appropriate to pause briefly to reiterate our desire to encourage the re-examination of technological development through this categorisation, and to address

⁴³ While this shift in practice might reflect a fundamental change in approach on the part of those working within a particular domain, it is not our intention to suggest that this constitutes a paradigmatic change in the discipline in any Kuhnian sense: the distinction here is between forms of practice rather than theory.

the consequent omission of two labels common to the majority of technological forecasts: 'nanotechnology' and 'neuroscience'. First, while it is undoubtedly true that the ability to engineer substances on the nanometric level has enabled many advances and given rise to many possibilities throughout many domains, it is precisely the wide-ranging nature of this impact that makes 'nanotechnology' less useful as a label for a discrete domain of scientific and technological practice. Rather, it is a common quality of all areas of science and technology that innovations within them are likely to involve working on this minute scale. Second, it is not our intention to present the relationship between science and technology in a hierarchical fashion (instead we would hope that their complementary nature is apparent): with this in mind, including neuroscientific work within one of our categories rather than as a discrete category in itself does not reflect an understanding of that domain as anything other than of vital importance.

So, to reiterate: the three broad categories that we feel the technologies most likely to have a distinctive impact on society and education in the future can be usefully grouped under are:

- Automation and artificial intelligence
- Ubiquitous computing
- Brain/world interfaces

6.3 Automation and artificial intelligence

By viewing artificial intelligence as one end of a continuum that begins with automation, we focus on the practical application of machine intelligence rather than becoming sidetracked by the epistemological issues associated with the artificial intelligence debate. Additionally, we circumvent the need to employ the problematic phrase 'smarter than human', often used by those addressing the future of machine intelligence, with its attendant difficulties⁴⁴. The line between automation and artificial intelligence is blurred, with many present-day instances of automation (such as spam filtering, or tracking personal consumption preferences on e-commerce sites) mimicking elements of human cognition: the kinds of automated process likely to be mobilised in society, and education, in the next few decades are closer to this kind of simulacrum of intelligence than any epistemologically-troubling 'true' or 'human' intelligence.

Nevertheless, the field of artificial intelligence has shown already its application in a vast number of fields. There is not space here to detail every advance made in the field: instead, we offer a brief overview of some areas likely to continue to develop, grouped according to the degree to which human intelligence and characteristics are modelled.

At one end of the scale might be placed explorations of group or 'swarm' intelligence (SI). Systems employing SI consist of autonomous, comparatively unsophisticated agents, the interactions between which, governed by simple algorithms, give rise to more complex, emergent, collective behaviour – similar to the ways in which birds flock, ants form colonies and fish move in schools. The agents might be real or virtual: film studios have used flocking techniques to simulate the behaviour of large numbers of computer-generated actors⁴⁵, while researchers have constructed robots capable of linking together physically to form a larger 'swarm-bot' capable of negotiating different environments (Gross et al, 2006). Systems employing this kind of intelligence could have application in exploration of potentially hostile terrain, or their potential for self-assembly and regulation might be used to construct structures in space or to manage relationships between satellites in orbit⁴⁶.

⁴⁴ If 'smarter' indicates greater facility for certain cognitive processes, surely existing computers are already 'smarter' in some respects? Or does 'smarter' imply some degree of humanity – but why would another kind of intelligence conform to human measures of intelligence? And so on...

⁴⁵ For example, the firm Massive (www.massivesoftware.com) produced software used to simulate crowd activity in the Lord of the Rings films.

⁴⁶ See, for example, this article from the European Space Agency: www.esa.int/gsp/ACT/ai/op/swarm.htm.

Similar to this approach, of seeing emergent behaviours arise from simple interactions, is the use of evolutionary algorithms in design, whether in product design⁴⁷, models and simulations, or the design of artificial life⁴⁸. Essentially this approach mimics the process of evolution in the wild by generating a number of designs, some with random mutations, selecting those designs that fit some criteria (perhaps an intelligent agent with a particular aptitude for a certain task, or a car profile with a certain level of air resistance) and beginning the process again with that population.

At the other end of the scale might be those applications that are designed to mimic more closely the kind of intelligence we associate with individual humans. This might include assistive robotics, creating robots capable of forming some kind of relationship with a human, or conversation bots who could act as company representatives. These examples are currently a long way removed from the mainstream: in many ways, however, they might be seen as an extension to the kind of service commonly available on websites such as Amazon, inferring consumers' taste and preferences in order to provide recommendations for other purchases, or Google, whose search results might ask "did you mean to search for...?" when a query looks as if it might have been typed in error. Software agents, or 'intelligent agents' in current jargon, have huge potential in fields requiring the management of complex data, such as financial markets, air-traffic control and logistics. Intelligent agents are used more and more frequently in the computer games industry to provide interactions with in-game characters with a higher degree of realism.

Examples such as this illustrate the potential for mechanised data analysis to grow into something more closely resembling the kind of artificial intelligence we recognise from science fiction. Advances in mathematical modelling and heuristics enable computers to handle large amounts of data, making it possible to create systems capable of human degrees of perception (recognising faces in a crowd, or recognising characters: these involve a level of 'understanding' or meaning-making to be successful), or to model complex structures such as biological cells or the climate of the earth. This capacity to handle large amounts of data and make 'sense' of it will become increasingly important as bandwidth and data storage costs fall, more of the data that describes our lives exists on external memory devices.

6.4 Ubiquitous computing

This category attempts to foreground attention to the categories of technological and social developments which may play a significant role in networking relationships between individuals, collective and environment.

Ubiquitous computing, also called 'ubicomp' or pervasive computing, among other terms⁴⁹, has been an object of research and aspiration since the end of the 20th century. In its traditional form, it describes a world in which information processing is not a computational task associated with a particular location or single machine, but is instead integrated completely into everyday objects and activities through a network of many small computational devices. The classic 'ubicomp' vision is of a seamless computing infrastructure combined with massive increases in processing and storage power, accessible via miniaturised devices and 'natural' interfaces that are distributed and integrated into the individual and their environment. This infrastructure connects the individual constantly

⁴⁷ The Singapore-based firm Genometri (www.genometri.com) uses genetic algorithms to 'grow' a series of alternatives for designers and manufacturers.

⁴⁸ For example, the Polyworld project (more details at www.beanblossom.in.us/larryy/Polyworld.html).

⁴⁹ For example, Adam Greenfield coined the term "everyware" to describe the paradigm (Greenfield 2006).

with 'the network' (the convergence of systems we currently see as distinct, ie internet/telephone/TV and so forth)⁵⁰.

This 'vision' begins to open up the possibility of distributed mass collaboration, connecting the individual to mass networks and enabling the completion of new activities as in the concepts of 'analyst networks' presented in some science fiction⁵¹ hundreds/thousands of individuals are combined together to achieve a massive task. Such forms of working begin to require the development of automation of micro-payments and this sort of activity flags up how these three broad categories identified here are likely to inter-relate with each other in important ways⁵². Examples such as this begin to require a re-examination of notions of identity and intelligence and to require us to begin to explore ways of understanding or interrogating intelligence as distributed and collective.

In this context, 'computation' is no longer the property of discrete machines, such as 'computers' or 'notebooks', but something that all devices (potentially all objects) have as a property (from mobile telephones at one extreme to RFID readers at the other). Distinctions between 'cyberspace' and 'realspace' may be further eroded as we move towards an 'internet of things' (made possible by each 'real' object being associated with a virtual space). Potentially, the distinction between 'the network' and the 'non-networked' or between 'connected' objects and disconnected objects may erode, as all materials have distributed intelligence built in.

In this environment, bandwidth begins to be seen as a utility to be managed in the same way as other utilities and the distinction between the domain of digital technology and the practices of everyday life becomes increasingly difficult to police. In this environment, the notion of identity as constantly connected and constantly visible to the network also raises questions of the relationships that may emerge between public/private, and between personal and collective property. The potential for using Bluetooth wireless technology to harvest data on movement in public spaces and early examples of the use of mobile phone cell data in criminal cases are already opening up these possibilities.

There are those, however, who contest the 'seamless infrastructure' future vision and who instead argue for an attention to the ways in which 'infrastructure' is almost always unevenly distributed. At a fundamental level, for example, Bell and Dourish (2006) argue for attention to be paid to the way in which energy supply continues to have local characteristics and to be unevenly distributed and unevenly available (although energy long since became seen as a 'utility'). They also suggest that "the future may already be here" in ubiquitous computing, suggesting that the widespread prevalence of mobile phone technology and of, for example, smart travel cards, of RFID readers and so forth constitutes massive already existing ubiquitous computing resource that only 10 years ago we would not have imagined. This "ubicomputing of the present", they suggest, may present a more reliable vision upon which to build our understanding of any future development of ubicomp as a necessarily uneven, locally contested and heterogeneous phenomenon.

6.5 Brain/world interface

This category attempts to foreground attention on all of the ways in which the relationship between the mind and the external world is mediated through the use of emergent technologies. This includes a huge spectrum of mediating devices and practices.

At one end of the spectrum, as the body is the primary means of mediating between the brain and the external world, this category of developments requires us to pay attention to the ways in which mind and body may be enhanced over the coming years. It focuses

⁵⁰ See the European Ambient Networks project (www.ambient-networks.org), the Wireless World Initiative (www.wireless-world-initiative.org) and the MIT Communication Futures Programme (cfp.mit.edu/index.html).

⁵¹ See 'Rainbow's End', Vernor Vinge, 2006.

⁵² See, for example, Amazon's 'Mechanical Turk': www.mturk.com/mturk/welcome.

attention, for example, on the potential development of brain enhancing or mood changing smart drugs taken either consciously in food or water supplies (consider that we already have a precedent in the fluoridisation of drinking water). Similarly, developments in bodily prosthetics – either to replace existing limbs or as aesthetic or cultural enhancements – begin to be a focus of interest in this category of developments. The ready availability of cochlear implants and pacemakers suggest that the boundaries between ‘humanity’ and ‘technology’ may be relatively easily breached if areas of clear need and benefit are identified.

One area of particular interest here also relates to the ‘ubicomputing’ and ‘automation’ categories, namely potential developments in ‘prosthetic memory’ : as we are able to use recording devices combined with massive storage power to document and store records of our encounters, in what ways might this adapt or mediate the relationship between mind and world? Where some developers are enthusiastic about the capacity to ‘outsource’ memory, others suggest that this account ignores the multilayered nature of memory that anchors ‘meaning’ to context and which would make analysis of such records particularly challenging⁵³.

Further along the spectrum of brain/world interfaces, we see developments in the traditional objectives of interaction design that are characterised by moves towards more ‘natural’ interfaces (such as the shifts towards brain control, voice recognition and gesture and away from the mediating tools of keyboards and screens) which attempt to remove the perception of mediation between mind and world⁵⁴. There is some contention, however, over whether ‘older interfaces’ such as keyboards will be so easily done away with given that time, effort and cultural identities have become tied up in the keyboard as an interaction device. We are increasingly likely to see, however, the development of novel interfaces that mimic ‘real’ experiences through haptic interfaces such as those that allow surgeons to practice operations in safe environments.

At the furthest end of the spectrum, we may also see the emergence of fully immersive simulated environments, in which we interact either with a ‘virtual’ world (although, as discussed above, these distinctions become increasingly problematic) or with other people. Today’s developments in virtual worlds such as Second Life or the multiple massively multiplayer online games, when combined with developments in ‘natural interfaces’ and sensor technologies may offer the opportunity for ‘as real’ interactions with globally distributed individuals. Should this then become combined with developments in automation and artificial intelligence (discussed earlier) the boundaries between ‘real’ and ‘virtual’ experiences, and between human and human/machine encounters become harder to distinguish and maintain.

⁵³ See Susan Greenfield’s ‘Tomorrow’s People’ for an interesting discussion of the diverse forms of augmentation or enhancement we might see developing and for a critique of the ‘outsourcing of memory’ account.

⁵⁴ See, for example, www.technologyreview.com/BioTech/17842 or www.cs.washington.edu/homes/pshenoy/BrainControlledRobot.html.

7 Questions for educators

To what extent should education 'inherit' its futures?

While reading these future scenarios and discussions of technological futures, we encouraged the reader to consider the questions: What might be the role, nature, purpose and organisation of education in the context of these diverse scenarios? What risks or opportunities emerge for education in these contexts? We also encouraged the reader to explore the questions: what alternative futures might we consider? What questions, concerns, voices and trends are being overlooked or ignored in these accounts?

Before offering some of our own responses to these questions, we also want to ask another: to what extent should education and educators 'inherit' its futures from other sectors such as business, defence, international development?

What is interesting, in reading these future scenarios, is the extent to which education (or more often 'learning') is often seen as a neutral and unproblematic process that has simple relations of cause and effect on the world. The link between educational investment and economic benefits, for example, is uncritically assumed in many accounts. The messy processes of teaching and learning and the difficulties of ensuring relations between the two are often absent. The assumption that education must adapt to respond to social changes is unchallenged.

We might want to ask, however, whether there is something distinctive about the process of future visioning from an educational perspective given education's potential role in developing the capacities, sensibilities and consciousness of individuals and societies. Too often, education is presented in a passive, responsive role to social and technological change, its identity is constructed as one of adaptation to the forces that surround it. Another question we might ask instead, therefore, is: to what extent is education essentially and fundamentally about constructing futures, about building the contexts within which the forces of 'politics/technology/economics/society' might operate? What role does education fundamentally have as, itself, a 'driving force' in these futures?

To commence a process of preparing long-term visions for the future of education, without exploring the role education has in constructing 'futures', would be a missed opportunity. Underpinning any account of educational futures, therefore, may be a need to discuss the role we understand education to be able to play in constructing diverse futures, and the potential limits of such a role.

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ⁱ Trends used in development of SOFI

- Population lacking access to improved water sources (percent of population)
- Literacy rate, adult total (percent of people aged 15 and above)
- Levels of corruption (15 largest countries)
- School enrolment, secondary (percent gross)
- Poverty headcount ratio at \$1 a day (PPP) (percent of population) (Low and Middle Income Countries)
- Countries having or thought to have plans for nuclear weapons (number)
- CO₂ emissions (global, kt)
- Unemployment, total (percent of total labour force)
- GDP per unit of energy use (constant 2,000 PPP \$ per kg of oil equivalent)
- Number of major armed conflicts (number of deaths >1,000)
- Population growth (annual percent)
- R&D expenditures (percent of national budget)
- People killed or injured in terrorist attacks (number)
- Energy produced from non-fission, non-fossil sources (percent of total primary energy supply)
- Food availability (cal/cap)
- Population in countries that are free (percent of total global population)
- Global Surface Temperature Anomalies
- GDP per capita (constant 2,000 US\$)
- People voting in elections (percent population of voting age)
- Physicians (per 1,000 people) (surrogate for Healthcare Workers)
- Internet users (per 1,000 pop)
- Infant mortality (deaths per 1,000 births)
- Forest lands (percent of all land area)
- Life expectancy at birth (years)
- Women in parliaments (percent of all members)
- Number of refugees (per 100,000 total population)
- Total debt service (percent of GNI) (Low and Mid Income Countries)
- Prevalence of HIV (percent of population)
- Homicides, intentional (per 100,000 population)

In addition, several new variables were suggested by participants, which will be considered for inclusion in the report for 2008: these, grouped into broad categories, were:

War and Weapons

- Total global arms trade
- Overall level of armament (or as percentage on expenditures?)
- Number of small arms produced and/or in global circulation
- Number of people under secular regimes in Muslim countries

Energy

- The fraction supplied by nuclear energy
- Amount of carbon sequestration
- Amount of solar power beamed to Earth from orbiting space solar power arrays and integrated into electrical grids
- Production of energy and resources from lunar regolith and asteroids

Space

- Investment in commercial development of near-Earth space
- Average number of people alive outside the atmosphere
- Number of annual human spaceflight takeoffs weighted by seats
- Number of humans to visit space (defined as staying in space less than 25 hours)
- Number of humans to live in space (defined as staying in space for 25 hours or more)

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- Amount of private sector capital invested in space transportation and space habitat construction companies
 - Global government non-military space expenditures

Governance

- Measures of transparency/secretcy in government
- Measures of corruption
- Levels of popular radicalisation or resentment against secrecy (independent of any other ideological concerns)
- Percentage of politicians educated in social sciences; in logical and critical thinking; in benign ethics and common sense

Health

- Health impact of air pollution - in terms of mortality and health costs
- Deaths from person to person communicable diseases

Socio/economic

- A measure of domestic inequality (GINI coefficient)
- Availability of qualified labour force
- Education quality
- Research and development availability
- Measures of technology innovation
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ii Trends factored into SOFI

- Inclusion of other indices: eg the UNDP HDI (human development index), the TI corruption index, the WEF competitiveness index, the WB governability indexes, the Heritage Foundation index of economic freedom, among others
- A nuclear accident such as Three Mile Island (causes many nuclear nations to de-nuclearise)
- A very good, fast \$150 laptop computer becomes available everywhere
- Advent of a 'teachers without borders' movement (50,000 new teachers in the field)
- A pandemic of the scale of HIV/AIDS
- At least 10 countries introduce effective policies designed to increase birth rates to avoid population implosion
- Automation and robotics increase productivity 25% in enough countries to make 'jobless' economic growth
- Availability of a cheap effective anti-aging therapy
- Bad weather (storms, hurricanes, floods) cause widespread crop failures in at least one year
- Canada begins to export water
- Carbon sequestration used by 25% of carbon-based industries
- Cell phone evolution and wireless internet leads to massive increases in internet access
- Concentration of the media (50% of all TV and newspapers in the hands of three or so firms globally) creates agenda and shapes public opinion
- Convergence in communications and nanobiotechnology significantly improve public health
- Conversion of significant desert areas into green lands adding 5% to global arable lands
- Cost effective desalination or other techniques increases safe water supply by 20% globally
- Debt forgiveness by developed world (debt reduced by 50% overall)
- Degradation/desertification of the soil causing losses in arable land of 3%
- Developed nations commit the resources necessary to end AIDS and treat HIV
- Development of fast-growing trees satisfies demand for wood without reducing the acreage in forests

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- Development of improved methods of food distribution that result in reducing the number of hungry people by 30%
 - Economic development in China and India increase the CO₂ burden by 20%
 - Economic expansion of at least 5% from new fields such as applied nanotechnology
 - Economic growth rates in China and India fall to half of current levels
 - Effective control of the illegal weapons trade including export and use of land mines
 - Emergence of new Islamic leaders, who stress historic Islamic role in science and multicultural respect, makes it feasible to silence advocates of terrorist acts
 - Energy costs drop 25%
 - Energy costs rise by 25%
 - Establishment of international police institutions and methods leading to a 25% reduction in violent crime
 - First orbital solar power satellite feeds electric grid on earth
 - Gene therapy: effective and widespread application of human genome knowledge to disease cures
 - General belief that TV programs influence behaviour and encourage crime
 - Global climate causes frequent floods in some regions polluting the water; drought in others, makes water 5% less available on the whole
 - Global economic depression resulting in drop of GDP per capita by 15%
 - Global engineering solutions initiated to reduce greenhouse gasses (eg iron added to ocean surfaces) prove inadequate and are abandoned
 - Global partnerships for development between rich entrepreneurs and those in areas where people live on less than \$2 per day
 - Global tele-education literacy programs available via hand-held devices
 - Growth of solar, wind power, other 'green' energy sources reduces burning in energy production by 5%
 - Health care costs continue to rise at a rate faster than inflation
 - Implementation of effective means for limiting production and proliferation of weapons of mass destruction
 - Improved biological and chemical sensors make disease detection and hence bio-WMD deterrence more effective
 - Improvements in the system of food transport and distribution reducing food waste by 10%
 - Incentives for increasing birth rates are introduced in countries with declining birth rates
 - Increasing decision failures of governments due to inability to manage complex systems
 - Increasing drug resistance to diarrhoea-like diseases, TB, and malaria
 - Increasing globalisation drives GDP/cap growth rate 5%
 - International Criminal Court proves to be a successful institution for trying indicted political figures
 - International media increases exposure of totalitarian actions to the point that international pressure for change becomes more effective
 - International programs designed to improve infant mortality and maternal health prove effective
 - International sanctions for countries that cut forests unnecessarily
 - International surveillance system and national arresting authorities in regular and cooperative contact
 - Intransigence by nuclear powers in reducing their arsenal
 - Invention and commercialisation of new types of arms and surreptitious detection devices used to interdict terror activities
 - Investments designed to slow climate change result in slowing GDP/cap growth rate by 5%
 - Large-scale reforestation programs adopted by most critical countries
 - Legalisation of some currently outlawed drugs
 - Literacy rate of women in developing countries reaches 85%
 - Low cost anti-aging therapies increase life expectancy 20%

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- Major computer fraud discovered and leads to introduction of certain controls on content and usage of internet
 - Major terrorist attack lead to widespread economic depression
 - Many countries establish pro-employment policies such as building of public infrastructure, national parks, etc
 - Many countries stiffen limitations on number of refugees they will accept
 - Massive, nearly global surveillance system to monitor weapons and weapons-related materials and equipment
 - Nanotech and biotech new industries account for 5% growth addition to world economy
 - National policies that encourage exportation of jobs result in higher unemployment in some countries
 - New agricultural practices reduce water consumption 10% per unit of agricultural production
 - New genetic varieties of fast growing trees and plants are developed
 - New products for human nutrition (eg essentially free vitamin capsules) reaches majority in developing countries
 - New technologies used in detecting criminal behaviour; new surveillance micro cameras, psychological profiles, etc
 - Nuclear powers announce refusal to reduce their arsenals
 - Organised crime funds major terrorist activities
 - Policies to stop terrorism reverse the trend toward liberalisation of civil liberties in the majority of countries
 - Precision guided missiles become available to developing countries and terrorists
 - Production increases from high tech agriculture including biotech crops, improved irrigation and soil conservation, gains of 10% in productivity
 - Programs that encourage energy production from nuclear fission plants are encouraged almost everywhere
 - Prohibition of rough violence in media in the same way as tobacco advertisements in some countries today
 - Reasonably priced pharmaceuticals increasingly available to poorer countries in need
 - Refugees: water shortages, political instability, natural disasters, and other such forces continue to generate refugees.
 - Rise of trade wars, new isolationist policies limiting trade to current levels
 - Rising energy prices cause poor, energy impoverished countries to borrow 20% more from rich countries
 - Security guarantees that effectively inhibit invasions of smaller states (such as US guarantee for Kuwait), reducing the incentive for small states to acquire 'last resort' retaliatory capabilities
 - Simple, cheap, long-lasting contraceptives are available
 - Simple, very low cost, small water purification technologies available in the poorest regions
 - Social marketing programs prove effective in changing public behaviour
 - Social programs in many countries (including programs to support the growing elderly population) impede GDP/cap growth rate by 5%.
 - Social Security in the US and several other countries is funded by newly issued bonds and thus public debt solves the problem of inadequate funding of Social Security programs
 - Stockpiles of nuclear weapons in the US and Russia further reduced by 90%
 - Tele-citizens; more than 10,000 people from poorer nations who live in richer nations help develop their original countries via international tele-commuting
 - Telecommunications and medical informatics enable local general practitioners, medics, and nurses to provide increasingly high quality local services
 - Terrorists contaminating water supplies; supplies remain unusable for decades
 - Terrorists thought to have acquired nuclear weapons
 - The age of nuclear proliferation is here: essentially any nation that wants nuclear weapons can have them
 - Transnational organised crime grows to 8% of the global economy