

**Strategic Futures Thinking:
meta-analysis of published material
on Drivers and Trends**

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Executive Summary

Background and aim

In April 2001 the PIU tasked the Centre for Defence Analysis to conduct a meta-analysis of the published body of 'strategic futures' work. The aim of this analysis was to synthesise a view describing the key drivers for change that might be expected to affect the UK policy over the next decades. The analysis was also to give an assessment of the different approaches used in Futures thinking, their treatment of uncertainty and to indicate the degree to which their views on drivers agreed or diverged.

Studies considered

Just over 50 studies, all conducted in the last five years, were selected as being both of sufficiently high level to inform policy and relevant to UK interests. Of these, thirteen were identified as the core set on the basis that they had sufficient breadth from which to adduce a minimum essential set of six overarching key drivers for change. The core studies were:

Study Name	Organisation
Military Assessment 2000	Canadian National Defence Dept
Chatham House Open Horizons	Royal Institute of International Affairs
CIA: Global Trends 2015	Central Intelligence Agency
ECFSU 2010 Drivers	European Commission Future Studies Unit
Insight	Defence Evaluation and Research Agency
Madingley Scenarios	National Health Service Confederation / Institute of Health Service Management / International Hospital Federation
The Future Strategic Context for Defence	UK Ministry of Defence
OUBS Millennium Project	Open University Business School
The Future and How to Think About It	PIU Strategic Futures
Shell Global Scenarios 1998-2020	Shell
UNU Millennium Project	United Nations University
USAF 2025	United States Air Force
Which World? Scenarios for the 21st Century	World Resources Institute

Methods of analysis, use of sources and treatment of uncertainty

The clear picture to emerge is one of considerable difference between the studies in the manner by which they have undertaken their analysis and the degree to which it is explicitly documented. Only six of the core studies explicitly documented the method used. The scenario-based approach was common: ten studies generated at least two scenarios each.

Treatment of uncertainty is naturally an important element in all futures work. An encouraging eight of the thirteen core studies made explicit statements on the uncertainty inherent in the inputs. Similarly, all of the core studies made at least some statement – even if very general – on uncertainty in the outputs. Some studies went into more useful detail, providing either indicative confidence limits or dividing the outcomes into the relatively fixed and uncertain. However, one made statements in a way that implied no – or minimal – uncertainty. All but one study included explicit discontinuities or 'wild cards' in their analysis.

Key drivers

The core studies identified several dozen trends that are going to shape the global future. There is reasonable – albeit not universal – agreement in the shape and direction of these trends. Analysis and cross-correlation showed that the trends could be grouped thematically into the following minimum set of key drivers:

- Demographics.
- Environmental Change.
- Economics.
- Science and Technology.
- National and International Governance.
- Perceptions, Beliefs, Values and Attitudes.

This list is not in any priority order. Indeed, all are as important as each other and all impact in different ways. They are also not necessarily isolated from each other and most are, in fact, linked. For example: infectious disease, food distribution and medical science affect population shifts, whilst there is the inherent link between IT/communications technology and economic globalisation.

One of the clearest overall deductions that can be drawn from looking across the driver set is that it appears that those in the developing world will continue to suffer. They will be more likely to experience a lack of wealth and food and experience starvation, more extreme weather, more pollution, scarce water supplies and they could potentially be denied access to IT technology while the developed world will continue to thrive economically and technologically. However, the ageing of populations in the developed world may well go some way to redressing the balance as the developed world comes under increasing strain in other areas.

A second common theme revolves around the continuing fragmentation and devolution of the nation state together with the empowerment of non-state or trans-state groups and ever more permeable national borders. In the developed countries, at least, a tendency towards post-modernist values concentrating on benefit to the individual or close social grouping could reinforce increasing distrust in, and detachment from, traditional government and the electoral process.

Just over half of the core studies originated in the domains of security or international politics. This is unsurprising, since ‘environmental scanning’ for trends that might lead to risks to the UK’s wider interests is very much part of their everyday business. We do not believe that this has led to significant bias in either identifying the drivers comprising the minimum key set or in the global trends within them. Futures work that concentrated on a near-term national or even departmental focus would be expected to have a different balance of trends within the drivers.

Generation of outcomes

The elicitation of trends and drivers is only part of the futures generation process. Most of the core studies reviewed created outcomes, in the form of scenarios or ‘worlds’. There was a strong convergence across the studies in the drivers they chose to develop the outcomes, the key ones being international and national governance, economics and technology. There was some correlation in outcomes across studies when the same method and driver set were used, although each study produced outcomes not seen in others.

To be of value to policy makers, futures studies must extrapolate trends and their interactions to produce coherent and defensible visions of the future against which policies, plans and strategy can be tested. The spread of outcomes should cover the major uncertainties, even if they are only

subjectively assessed, which impact the policy issues. The techniques of scenario-based planning appear to be the most promising way of making progress towards this goal. Although it is possible to work with just a trend or two, using more in a scenario provides richer outcomes. Drivers help in the sorting of themes: keeping some constant whilst varying others in which uncertainty needs to be explored. Scenario construction is discussed in sections 2 and 6 and annex C.

Scenario-based planning can be used:

- To provide a springboard for creative thinking about threats and opportunities.
 - To build consensus and buy-in for a policy line through its mutual development.
 - To test the robustness of a policy, plan or strategy against a number of agreed excursions.
- The first two of these have to be participative activities.

Utility of this work to policy makers

Policy makers should not use this report to infer a consensus for any quantitative prediction for a particular trend. If such predictions are required then specific studies (modelling) should be considered on their own merits. There is a considerable diversity in the degree to which the reviewed studies have addressed the uncertainty in their identified trends and outcomes (possible scenarios or 'worlds' extrapolated from trends). Additionally, most of the published work makes only qualitative statements about the outcomes or, where quantitative data are given, their format is different between studies.

This report lists qualitative trends that form a relatively robust and comprehensive base from which to generate strategic scenarios or 'worlds' to inform policy development or to test strategy and plans. There is a consensus on the most important global drivers for change and reasonable – but not universal – agreement on the nature and direction of the trends within each driver.

This report presents a technical assessment of the approaches used by the core Futures studies against best practice. Several of the scenarios, worlds and even findings produced by the core studies could be re-used by policy makers. However, it is important to be aware of the methodological strengths and weaknesses of each study, as well as its original purpose, before trying to apply it in another domain.

It is important for policy makers to remember that, even when derived from defensible trends, a scenario or world produced by the futures generation process is just that; a future, not *the* future. Some futures are more plausible than others, but the interactions between different trends in the real world makes a formal assessment of their likelihood impossible. Robust policy will remain valid over a broad reach of possible scenarios and, where possible, will insure against the major discontinuities or wild cards. It will generally be more coherent to have an agreed overarching set of scenarios within which Departments can develop in more detail those aspects of particular relevance to them.

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1 Introduction

1.1 Background

In April 2001 the PIU tasked the Centre for Defence Analysis to conduct a meta-analysis of the published body of strategic Futures thinking work in order to synthesise a view describing the key drivers for change that might be expected to affect UK policy over the next decades. The analysis was also to give an assessment of the different approaches used in Futures thinking, their treatment of uncertainty and to indicate the degree to which their views on drivers agreed or diverged.

1.2 Aim

The aim of this project is to produce a report describing the key drivers for change that might be expected to affect the UK policy baseline over the next decades. This is intended to provide background material for subsequent PIU work and policy development in this area.

1.3 Approach

The basic approach has been one of a sophisticated literature review and analysis. That is, to scan the published body of Futures work, select studies of sufficient relevance and stature, extract and assess the key elements, synthesise a description of the current state of the art and to present the results as a basis for further futures thinking. This research task has many similarities with the DERA Project 'Insight' study undertaken from 1995 to 1997, the aim of which was to identify the key drivers of global security in the period from 2015 to 2040. Key aspects of that study's approach to the classification and treatment of driver-trend material are of enduring value in wider strategic analysis, and have offered a robust starting point for this PIU research task.

1.4 Definitions and core concepts

1.4.1 Many of the studies used similar words to describe the Futures process, but there is a wide variation in how they were interpreted. For the purposes of this report we use the following:

- **Input data:** Observations, raw data, empirical evidence, sources etc. that are then analysed / synthesised to produce trends. An example of input data would be mean summer temperatures for the last 50 years.
- **Trends:** Trajectories, extrapolations, projections, and possibly even predictions, which are continuous and (usually) monotonic. An example trend would be 'The increasing proportion of the World's population living in developing countries'.
- **Drivers:** Used here to identify the meta factors or groups of trends that share a common theme. An example would be 'Demographics'.
- **'Wild cards':** (Relatively) abrupt changes of particular significance, these include potential catastrophes and other high-impact, low-probability events, sometimes termed 'wildcards'. An example would be the Chernobyl accident.
- **Outcomes:** A generic term for predictions, future 'worlds' and scenarios. These usually draw on a number of trends and events.

1.4.2 Most Futures studies appear to have used a working model along the lines of:

Input data ⇒ Trends & Drivers ⇒ Outcomes ⇒ Predictions & Explorations.

1.4.3 The original scope of the task focused on identifying important trends and drivers. However, their utility in and applicability for deriving useful outcomes is an important factor in defining a key set and so this was examined as part of the review. Also, since trends and drivers are usually the means to the ends of predictions or speculations about the strategic effects they might cause (e.g. in workshops), we have included a review of how trends are subsequently used or abused and identified best practice.

1.5 Sources used

1.5.1 In all, just over 50 studies were selected as being both of sufficiently high level to inform policy and relevant to UK interests, these are listed at annex B. All of the studies have been conducted in the last five years and the majority in the last three. Of these, thirteen were identified as the core set on the basis that they had sufficient breadth from which to adduce a minimum essential set of six overarching key drivers for change. The other 38 studies tended to be more focused on one or a few issues and contributed trends that could be accommodated within the driver set. The core studies selected were:

Study Name	Organisation
Military Assessment 2000 [1]	Canadian National Defence Dept
Chatham House Open Horizons [2, 3]	Royal Institute of International Affairs
CIA: Global Trends 2015 [4]	Central Intelligence Agency
ECFSU 2010 Drivers [5]	European Commission Future Studies Unit
Insight [6]	Defence Evaluation and Research Agency
Madingley Scenarios [7]	National Health Service Confederation / Institute of Health Service Management / International Hospital Federation
The Future Strategic Context for Defence [8]	UK Ministry of Defence
OUBS Millennium Project [9]	Open University Business School
The Future and How to Think About It [10]	Performance and Innovation Unit Strategic Futures
Shell Global Scenarios 1998-2020 [11]	Shell
UNU Millennium Project [12]	United Nations University
USAF 2025 [13]	United States Air Force
Which World? Scenarios for the 21st Century [14]	World Resources Institute

Table 1 – Core studies

1.5.2 These studies are hence a mix of work by UK and international teams, from government, academia, strategic-level institutes and the private sector.

1.6 Report structure

The remainder of this report comprises 6 main sections. The first, section 2, discusses the treatment of uncertainty in the various stages of the generic futures process described above. The next two sections deal with identifying the key driver set and, the heart of the report, a description of the important trends under each driver heading. Section 5 contains a review of futures generation methods and outcomes. Section 6 identifies best practice in the use of Strategic Futures material in policy and strategy development. The study's conclusions and annexes containing a glossary and more detailed background information follow this.

2 Uncertainty Management Best Practice

2.1 Strategic Futures thinking and managing uncertainty

2.1.1 Introduction

Not all Futures thinking deals adequately or explicitly with the treatment of uncertainty in its sources and – through analysis methods – its outputs. Using both our own experience and that of others in the available source materials (listed in annex B), we have extracted and synthesised a set of relevant ‘best practice’ guidelines. This best practice is described below – with some more detailed discussions in annex C - and the criteria summarised below. We have then used these to assess the degree to which the published material reviewed deals with uncertainties in its sources and its outputs.

2.1.2 Context

Looking to the future is not easy. The further one looks the more uncertainty there is. Extrapolating from currently discernible trends can offer some insights but provides only a limited understanding of what might happen, since ‘trends are not destiny’ [14]. Much that we currently do not foresee or expect will occur, and we must be modest in our expectations of Futures Studies to deliver insights [15 p.4]. The ability of humans to change current trends or generate new events has been well demonstrated in the past and is perhaps the most likely continuation into the future [16 p.i]. Hence our ability to *predict* or to *prescribe how the future will be* is relatively poor. However, all is not lost, for we can use a variety of tools in existing methodological ‘toolkits’ to *explore* how different situations might affect postulated plans. Undertaking this robustness analysis and examining our sensitivities to future uncertainties is perhaps the most valuable outcome and use of Futures Studies.

2.1.3 Relative uncertainty across the drivers

Later sections in this report describe the core driver set distilled from previous Futures Studies. It is perhaps unsurprising that the degree of uncertainty will vary across these drivers, i.e. we will perceive greater uncertainty in some drivers compared to others. ‘In general, it seems that technology forecasting has a better record than forecasts about human behaviour, which remains various and often quite unpredictable. There has also been a tendency to over-estimate the capacity of governments to do things, or even to see the need to do certain things. What has often been under-estimated is the capacity of people acting as individuals or in small loose groups to do things, relying on their own common sense’ [2].

2.2 Desirable attributes of the use of sources

There are a number of desirable attributes for the way the sources are used, including:

- Explicit criteria for the identification, selection and use of sources (both textual and human).
- Listing of data sources (both textual and human) [e.g. 15 pp.35-36].
- Seeking an appropriate breadth and depth of material.
- Appropriate use of a combination of desk-based research (textual sources) and interviews (human sources).

- Review of previous studies.
- Explicitly described sampling methodology where all the material cannot be covered [17].

2.3 Desirable attributes of the analysis

The desirable attributes for the analysis include:

- Explicit documentation of the methodological steps taken (ideally also to include discussion of those other steps considered but not pursued and the reasoning associated with this).
- Peer reviewing – e.g. publishing on the web and asking for comments [17]. Where openly published, the ease with which the data can be read, e.g. through the use of open / common standards as opposed to proprietary data storage structures [17]. Explicit documentation of the degree of peer reviewing undertaken.
- Explicit statement of the uncertainty in the outputs: e.g. 'Indicator values should not be interpreted as predictions or forecasts. They are based on statistics and expert judgement. No formal modelling has been undertaken within this project, but consistency checks have been applied to ensure that difference indicators are telling the same story' [15 p.26].
- Explicit statement of the purpose of the outputs, i.e. what they have been intended to be used for. This might also indicate what they should not be used for.
- The outputs should contain not just a spot estimate but confidence limits to show the dimensions and spread of uncertainty, or general descriptive caveats.

2.4 Toolkit of methods

2.4.1 A variety of methods is available to conduct Futures Studies. The intelligent analyst (and customer) is aware of these methods and seeks to employ the best method(s) for the task at hand. There is no single test to decide which method(s) should be applied, and no method is best applied in all circumstances (there are no 'silver bullets'). What is required is an intelligent and experienced examination of the available alternatives, in order to match the method(s) to be used to the particular needs of the customer and his/her situation. Each method used will generate particular insights, and where the resources are available the use of several methods together will provide an even wider understanding upon which to base decisions. It is reasonable to suggest that those decisions based upon different perspectives are likely to be more robust to future uncertainty [16 p.v]. The 'method toolbox' available to practitioners is under constant development across the globe, with new methods and variations published frequently.

2.4.2 Where the degree of perceived uncertainty is relatively minor, methods such as extrapolation, forecasting and modelling are relatively strong. The strength of these methods lies in their simplified formulation of the problem and where possible the abolition of future uncertainty [18 p.12].¹ These lead to *predictions* (often single-point estimates but occasionally with an indication of the spread of any remaining uncertainty).

¹ The drive to abolish uncertainty might include such simplifications as the presence of a consensus, the treatment of people as passive objects and the pre-emption of future decisions.

2.4.3 However, these methods are less able to adequately represent those situations that are unpredictable and complex. Where the ability to *predict* is poor, it is instead possible to *explore* the potential futures. Such exploration usually ‘stresses the uncertainty about the direction and nature of future developments’ [15 p.1]. This has led most practitioners towards the use of scenarios [7] since whereas forecasts can be perceived as offering ‘spurious precision’ the use of multiple scenarios permits exploration of the range of uncertainty [2]. ‘None of these scenarios will necessarily represent the precise future, but they offer the parties involved the possibility to evaluate the impact of different scenarios on the enterprise and to monitor critical indicators and tendencies. [Scenarios] represent alternative images rather than simply projecting the present based on known trends... The scenario model develops the ability of decision-makers to evaluate and re-evaluate their strategic possibilities and make the right decisions, even in situations of uncertainty. This creates a culture of readiness for change’ [19]. Some suggestions on the best use of the scenarios method – and its outputs - are given below.

2.4.4 Having noted that a variety of methods are available to the practitioner, annex C focuses upon the scenario method, since it is widely used in Futures Studies where the uncertainty is relatively high.

2.5 Careful use of analysis outputs

2.5.1 Having considered how best to employ the methods this section will now examine what care needs to be taken in handling the outputs from the analysis – be it based on scenarios or other methods.

2.5.2 **Possibility not prediction:** Use of scenarios requires acceptance that they describe points in ‘a *possibility space* – a set of plausible futures that span a range of conceivable outcomes’ [15 p.4]. They are thus descriptions of what *could* happen rather than predictions of what *will* happen, and do not exclude the possibility of alternative futures beyond themselves. They enable exploration rather than prediction [15 pp.1-4] and can be used as a means of stimulating discussion [20 p.19]. ‘Figuratively speaking, the scenario line of thought suggests a perception of the future as a space. The scenarios fill this space. The space, rather than the scenarios themselves, is the more interesting. Where do we want to go to within this space? Where, in this space of potentialities, does the enterprise wish to position itself? The choice is strategic, rather than a question of prediction’ [21]. The opportunity is to test policy options against a range of futures [20 p.3] rather than to see which future will happen. ‘Scenarios tell you what the worldview which you have developed may do to you. Typically, they will also show you things that you have undervalued, overlooked or been hypnotised by to the exclusion of reality. They give you a sense of the resilience that you must build into your system, if you can, or the signs to watch out for if you cannot. What scenarios are not is an exhaustive description of the future, firm projections or a recipe for immediate action... [You] need to integrate this form of enquiry with others, and ... you will also need to convince the staff in the organisation of the validity and relevance of what emerges from this’ [2].

2.5.3 **Desirable attributes:** Having defined a range of desirable scenario attributes above it would clearly make good sense to look for the presence of these in the scenarios underpinning any work. We have sought to make an assessment of these attributes for the core studies examined in this study – and this is reported below. However, a previous study concluded sombrely that ‘Scenarios in the sense of coherent, systematic, and internally-consistent descriptions of possible

futures are very rarely used. One result is that there is a general lack of transparency and comparability across different studies' [16 p.3].

2.5.4 **Quantification:** Some parts of the analysis might include quantification – e.g. of descriptive statistics that can show at-a-glance some of the key differences between the scenarios. Including this quantification can lead to difficulty: values might have been constructed as broad (single point) estimates to illustrate the scenarios' relative distinctiveness, but instead be read by a naïve reader as a forecast, a relatively firm prediction. It is recommended that such quantification is 'treated with care and ... published with circumspection' [2].

2.5.5 **Relative uncertainties:** 'The drawback of looking at drivers of change separately is that it does not provide a complete picture. What would the future look like if some combination of these developments occurred? ...[Although] there is broad consensus about some likely future trends, the cumulative effect of even small uncertainties means that the range of plausible future worlds is very large.' It can then be useful to differentiate between the different degrees of uncertainty in the results by dividing them into 'things we can be relatively sure of', 'dimensions of uncertainty' and 'shocks' [10].

2.6 Pull-through of scenarios work

2.6.1 Having considered the care needed in general, what can be done to enable the most fruitful use of the outputs from scenario-based analysis, and what can the scenarios themselves be used for?

2.6.2 **Communication:** Firstly, it appears clear that scenarios can create a framework within which interested parties can achieve common understanding and clear communication. Where possible, this is an inclusive process – i.e. the interested parties are involved in the development of the scenarios, so that there is a common 'framing [of] ideas about what the future may be like' [15 p.4]. 'Given that there can be no ex ante authoritative picture of the future (and historians will say that there is no correct ex post version of events either), it is more prudent to encourage people and organisations to generate their own picture of future developments. But this requires a certain level of commitment to go through to the effort of picturing the future. Without engagement, scenarios planning risks becoming an empty exercise' [16 p.41].

2.6.3 **Sensitivity analysis:** Secondly, the scenarios can be used to widen thinking beyond a single 'predicted' future, to test current and proposed policies, plans and strategies [7]. This is called *sensitivity analysis* and *robustness testing*. It seeks to determine the sensitivity of the plan to different potential futures, and to test the robustness of the plan across the range of futures (see below) [20 p.3]. Sensitivity analysis seeks to determine the degree to which the results change with changes in the (key) inputs. 'The differences between the scenarios are created by considering differing outcomes of the relative uncertainties' [7]. It is a method for checking that 'all of the important contingencies have been considered' [16 p.36]. For example, the analysis might consider the use of different time horizons to see whether and, if so, how the results are sensitive to the timeframe. This would acknowledge that scenarios and analysis set in later timeframes are increasingly speculative [15 p.5]. Since there might be many dimensions or categories of change their careful identification and selection of which ones to test should be conducted with care [15 p.5]. In particular, taking a subset for analysis and leaving others unexamined is often necessary due to limited time and resources.

2.6.4 **Robustness testing:** When the future is relatively certain and a single prediction can be relied upon, it is usual to seek a plan that is optimised against that prediction. However when there is a high degree of uncertainty the use of scenarios, sensitivity analysis and robustness testing moves away from the overly simplistic single prediction towards a more sophisticated ‘possibility space’ [15 p.4]. Instead, it hunts for ‘robust strategies’ [15 p.3] and plans that are robustly insensitive to future variability – at the cost of a loss of optimality against any one scenario. The aim is to summarise the results overall, looking for whatever similar outcomes exist under all scenarios, and the variations resulting under other scenarios [15 p.2].

2.7 Overall caveats

2.7.1 There are a few overriding caveats on the output from attempts to manage uncertainty in Futures Studies. Firstly, there should be a recognition of ‘the limitations of and dangers inherent in any ... exercise aimed at predicting the future. Predictions are usually wrong, often misleading and sometimes positively counterproductive. ... The process of thinking about the future may be more important than the results (a key lesson from scenario exercises – the process of building scenarios is where the real learning comes, not reading the end-result)’ [10].

2.7.2 Secondly, such ‘[research] ... faces a number of difficulties: the complexities of the issues; the pace of development; and a lack of reliable data. All limit the validity of current studies’ [15 p.21].

2.7.3 Finally, it appears there are ‘[four] major sources of error: the increasing difficulty in making assumptions about individual behaviour; the changing role of government (no longer necessarily the major driver of change); the problem of time scales, which are often over-optimistic; [and] the loss of faith in our ability to produce continual progress’ [2].

2.8 Assessment of Core Study Set

2.8.1 Aim

2.8.2 Having synthesised a set of relevant ‘best practice’ guidelines, this section now uses these to assess the degree to which the core studies examined in this study deal with the uncertainties in their sources and outputs.

2.8.3 This section will contain the summary assessment of the degree to which the above guidelines have been addressed by the core studies – and any implications this has on what follows in this report. It provides the overarching assessment whilst the detailed per-study assessment is available at annex D. The assessment will look across the studies to identify the strengths and weaknesses in the use of sources and the analysis. It concludes with a high-level assessment across the studies. The aim is not to find a ‘best’ or ‘worst’ study. Rather, it is to indicate – against the criteria listed here – where they are relatively weak or strong and to inform the reader of this report as they consider later sections that are based upon materials from the core (and sectoral) studies.

2.8.4 Sources

The factors assessed in the treatment of uncertainty in the sources are:

- Explicit criteria for the identification, selection and use of sources (both textual and human).
- Listing of data sources (both textual and human).
- Use of a combination of desk-based research and interviews.
- Explicit review of previous studies.

2.8.5 Analysis

2.8.5.1 The factors assessed in the overall treatment of uncertainty in the sources are:

- Explicit documentation of the methodological steps taken.
- Explicit statement of the purpose of the outputs.
- Explicit statement of the uncertainty in the outputs.
- Outputs contain statements to show dimensions and spread of uncertainty.

2.8.5.2 Where scenarios were developed, the following factors were assessed:

- Breadth (measured as the number of scenarios created).
- Tests undertaken for self-consistency and coherence.²
- Highlighting of discontinuities / wild cards (i.e. were any identified?).
- Equivalent effort on each scenario (assessed as the relative detail given in each scenario, where detail on the effort spent was not explicitly stated).
- Presence of a qualitative narrative / storyline.

2.8.6 Sources uncertainty assessment

2.8.6.1 **Sources criteria:** It was rare for these studies to explicitly list their criteria for identifying, selecting and using sources. Some criteria can be inferred at a general level, but it was quite common for studies to overlook this area altogether.

2.8.6.2 **Listing of sources:** Three studies (ECFSU, Insight, Madingley) contained explicit lists of both textual and human sources. The CIA study listed some interviewees but no textual sources whilst UNU and USAF did the converse. Human sources were often described according to broad descriptive groups: the simplest being just 'experts' (CIA), whilst others (OUBS, PIU, UNU, USAF) broke this into smaller clusters such as politicians, academics, commerce, and futurists. Five studies (Canadian, Chatham House, MOD, PIU, Shell, Which World?) gave no overall listing of either textual or human sources, indicating perhaps no perceived need to do so for their intended readerships. However, two of these studies (MOD, PIU) did make some spot references to texts.

2.8.6.3 **Combination of research types:** Five studies (Canadian, Chatham House, MOD, Shell, Which World?) provided insufficient information to determine whether they had used both textual and human sources, though the other eight (CIA, ECFSU, Insight, Madingley, OUBS, PIU, UNU, USAF) appear to have done so.

² Although plausibility is an important consideration it was clear to the review team that the intended user of the scenarios would better assess this.

- 2.8.6.4 **Review of previous work conducted:** One study (Canadian) provided insufficient information to determine whether it had done this. Of the remaining twelve, half (Chatham House, CIA, MOD, Shell, UNU, Which World?) appear to have taken their own in-house previous work as the (sole?) starting point, whilst the other half (ECFSU, Insight, Madingley, OUBS, PIU, USAF) appear to have undertaken a wide-ranging review.
- 2.8.6.5 **Statement of uncertainty in inputs:** Eight (CIA, ECFSU, Insight, Madingley, MOD, PIU, UNU, USAF) of the studies made explicit statements on the uncertainty in the inputs, another (Shell) had a discussion but did not make an uncertainty statement. Three (Chatham House, OUBS, Which World?) did not make any explicit statement, and in another (Canadian) it was not clear what inputs were used.
- 2.8.6.6 **Sources – summary:** The published works from these studies often failed to state why they sought particular sources and which ones they eventually used. An encouraging eight of the thirteen made explicit statements on the uncertainty inherent in the inputs. Three of these studies (ECFSU, Insight, and Madingley) used both human and textual sources, provided a full list of each, and undertook an extensive review of previous work. The PIU and USAF studies would have joined these if they had listed their sources in full.

2.8.7 Analysis uncertainty assessment

- 2.8.7.1 **Method documented:** Only six of the core studies explicitly documented the method used (ECFSU, Insight, Madingley, OUBS, UNU, and USAF). Whilst another two (CIA, PIU) described it in outline, the remaining five (Canadian, Chatham House, MOD, Shell, Which World?) gave no explicit documentation of how they produced their outcomes.
- 2.8.7.2 **Statement of outputs purpose:** All of the core studies described what they – and their outputs - were trying to achieve, though some gave more useful detail on the specific role of the outputs as opposed to the study as a whole.
- 2.8.7.3 **Statement of uncertainty in outputs:** Encouragingly, all of the core studies made at least some statement – even if very general – on uncertainty in the outputs. Some studies went into more useful detail, providing either indicative confidence limits (e.g. Chatham House), or split the outcomes into the relatively fixed and uncertain (e.g. Madingley). The final study (OUBS) claimed to predict the future, boldly stating *'It describes in graphic detail the future you will soon encounter'* [9] – effectively stating there to be no – or minimal – uncertainty: this is discussed further below.
- 2.8.7.4 **Dimensions and spread of uncertainty illustrated:** There was little common ground across the core studies here. While the PIU study explicitly listed dimensions, five (Canadian, Chatham House, Insight, MOD, Shell) listed major sources / key driving issues, and another five (CIA, ECFSU, Madingley, UNU, USAF) expressed the uncertainty through the dimensions of the scenarios (one of which – ECFSU – identified explicit pivot variables). One study (Which World?) made only a general statement whilst the OUBS study even stated the relative likelihood of the different scenarios.
- 2.8.7.5 **Scenario breadth:** Three of the studies (Canadian, MOD, PIU) did not generate any scenarios. Of the remaining ten: Madingley and Shell developed two apiece; Chatham House and Which World?, three apiece; CIA, OUBS and UNU, four apiece; ECFSU created five and USAF created eight (downsized to four and then

increased to six). Insight had two methods: the first produced four candidate worlds, whilst the second generated a tree containing dozens of intermediate worlds ending in five scenarios.

2.8.7.6 **Tests for self-consistency, coherence:** Of the ten studies that produced outcomes, half (Chatham House, CIA, Madingley, Shell, Which World?) made no explicit description of any tests for the self-consistency or coherence of the outcomes – though three of these (Chatham House, Shell, Which World?) did not describe their methods either. The remaining five studies (ECFSU, Insight, OUBS, UNU, USAF) each had their own unique approach.

2.8.7.7 **Discontinuities / wild cards:** Identification and description of discontinuities and wild cards is patchy across the core studies. Eight studies (Canadian, CIA, ECFSU, Insight, Madingley, OUBS, PIU, Which World?) assessed and/or included discontinuities / wild cards / turning points, noting that Madingley included them in its inputs only, and the ECFSU contained them in the initial list of factors before the scenarios were created. Chatham House and Shell discussed wild cards but did not include any in their scenarios. The USAF study included them (retrospectively) in the backcasted³ scenario narratives. The MOD study recognised that its analysis did not identify shocks. Finally, there was no apparent identification or discussion of wild cards in the UNU study's scenarios work.

2.8.7.8 **Equivalent effort across the scenarios:** All of the studies that produced outcomes appear to have given equal weight to the construction of their outcomes.

2.8.7.9 **Scenario narratives:** All of the studies that produced outcomes contained scenario narratives, though the length, detail and contents vary. For example, Madingley had headlines and per-dimensional summaries, OUBS had limited direct narrative but a wealth of supporting discursive material and USAF had comprehensive narratives including backcasted views from the future to the present.

2.8.7.10 **Analysis – summary:** The clear picture to emerge is one of considerable difference between the studies in the manner by which they have undertaken their analysis and the degree to which it is explicitly documented. Encouragingly, all of the core studies made at least some statement – even if very general – on uncertainty in the outputs. In the other areas examined here, five studies (ECFSU, Insight, OUBS, UNU and USAF) all documented their methods, tested the outcomes for self-consistency and it appears that all, bar UNU, included discontinuities / wild cards in their analysis.

2.8.8 **Assessment – conclusions**

2.8.8.1 Perhaps unsurprisingly, there is a considerable diversity in the degree to which these core studies have addressed the uncertainty in their inputs and outcomes. Only eight of the thirteen studies made explicit statements on the uncertainty inherent in their inputs, but all thirteen made at least some statement – even if very general – on the uncertainty in their outputs.

2.8.8.2 It has been difficult to undertake a fully balanced assessment due to the inconsistent quality of the source material: for example, some of the studies provided little explicit documentation of their methods. It is unclear whether this

³ Taking a specified future point, backcasting involves creating a sequence of events from this future point backwards in time, usually to the present.

absence of documentation is a tailoring of the source materials to their intended readers, and/or an accidental or deliberate obscuration of what was done, e.g. to prevent methods from transferring into the public domain.

2.8.8.3 The ECFSU, Insight and Madingley scenarios were particularly strong (compared to their peers here) in their handling of uncertainty in the inputs, and the ECFSU, Insight, OUBS (but see below), UNU and USAF all documented their methods, tested the outcomes for self-consistency and included discontinuities / wild cards in their analyses.

2.8.8.4 Finally, it is necessary to report on the differences between the perceived uncertainty in the studies. Nearly all studies accept that they cannot predict, and seek only to describe spaces or possibilities. The exception – in its tone and forthrightness – is the OUBS study, which asserts that having involved over a thousand of the world’s largest organisations that it can describe the future that these organisations *are pushing towards*. (The OUBS study uses scenarios to describe potential futures, and does not simply predict a single future. However, it is the qualitatively different tone that sets it apart from its peers.) Indeed, this might be exactly the case – but the future towards which they are pushing is of course only one of many that might occur, and to forget this risks taking these outputs without the caveats and sensitivity required and expressed elsewhere in this chapter. Why might the future not be as these people and organisations see it? This is a large debate, but it is hoped that the following points help illustrate the point:

- The study *has* consulted widely with existing organisations – probably (the listing of sources is patchy across the studies so it is unclear whether any other study has done more consultation than OUBS) the widest consultation amongst the core studies. The OUBS study has not consulted with organisations that did not / do not yet exist. From the trends-drivers analysis in section 3, it appears that there will be a significant growth in small business enterprises and that these seem set to be the power houses of future economies, overturning the dominance of (probably some of) the current large organisations consulted. There appears no guarantee that these small organisations will share the same goals or visions as those consulted.
- The study has not extracted the multitude of possible trend / event combinations, amongst which probably lie unforeseen driving synergies that will lead the future to diverge from that we can currently foresee when expressing it either in sets of individual trends / drivers, or as a series of scenarios / worlds / outcomes. The Chatham House work (‘SHOCKS AND PARADIGM BUSTERS – or, why do we get surprised?’ on the CD-ROM in [2].) on why the future has not turned out why previous predictions thought it would makes an especially sobering and yet illuminating read.
- As reported above, there is not a comprehensive listing of sources in this study. The study might not have consulted smaller organisations that are likely to grow in significance. These can be both commercial entities as discussed above, and other empowered small agents (ESAs) – see [22 p.5].

In summary, the OUBS study stands aside from the others in its tone and forthrightness. It is recommended that those who intend to use the results of this or any other study need to do so with caution, being aware of the strengths and weaknesses of the work, as well as its original purpose, before trying to apply it in another domain.

3 Distillation of key driver set

3.1 Correlation and analysis of sources consulted and key drivers

3.1.1 All of the core studies that were examined in this project described the trends and drivers that were going to shape our global future. This section collates these into a minimum key driver set.

3.1.2 Key drivers were identified by cross-correlation across those in the core studies. This identified the most prominent and recurrent themes, and showed which were study-specific due to their viewpoint and approach. This analysis provided a way of identifying which drivers were *key* to shaping the *global future* that we are concerned with here and which were merely key to particular studies. A copy of the cross-correlation matrix can be seen in annex E.

3.2 The key driver set

There are six key drivers that are cited in most of the existing studies, in one form or another. It should be noted that these key drivers have not been listed in any preferential order. Indeed, all are as important as each other and all impact in different ways. Grouping trends by theme is a useful analytical device, but does not imply that the drivers are independent. In fact, most are linked. For example, infectious disease, food distribution and medical science affect population shifts. Another example is the inherent link between IT/communications technology and economic globalisation. The six key drivers are:

- Demographics.
- Environmental Change.
- Economics.
- Science and Technology.
- National and International Governance.
- Perceptions, Beliefs, Values and Attitudes.

3.3 Analysis of sources consulted and key drivers

3.3.1 Some studies cited drivers that were more relevant to their own viewpoint and concerns but could not necessarily be considered as global 'drivers' on their own. However, the local drivers in question can all be subsumed into the key driver set. For example, those studies that originated from the defence sector identified the proliferation of, the invention of new forms of, and the application of military technology as a key driver. From a global perspective, that particular driver component falls under the key driver of 'science and technology' - although it also has implications for 'national and international governance' and is affected by the process of economic globalisation which falls under 'economics'.

3.3.2 Another example of taking a global view can be seen where studies that were undertaken with a particular region in mind cited certain other regions as being key drivers. Again, this can be understood from their point of view – it is obvious why the EU might see the role of the US as a key driver. However, this driver is study specific and we must ensure a global view. Thus this specific driver would fall under the more general area of 'international relations' which is part of 'national and international governance'.

4 Driver discussions

4.1 Introduction

4.1.1 This section gives a more detailed overview of the key drivers that have been identified in section 3. In particular this section will address three aspects of each driver:

- What defines each driver and what are its components?
- What are the trends that are included in each driver?
- What are the 'wild card' events that might arise within this driver?

4.1.2 'Wild cards' are defined as being sudden discontinuities and shocking events that have a low probability of arising but a potentially very high impact.

4.1.3 For each driver, tables are given to show how frequently each trend and wild card was cited in the studies that were examined. These frequency indicators have been divided between the 'core studies' and other smaller, 'sectoral' studies that only examined one or two drivers, or even only one aspect of a driver.

4.2 Driver 1 - DEMOGRAPHICS

4.2.1 **Driver description and components:** Demographics is concerned with changes in population sizes, composition and population patterns. The components of this driver are:

- The growing global population.
- The balance in population growth between the developing world and the developed world.
- The balance between young and old in both the developing and the developed world.
- Migration pressures created by population shifts.
- Infertility.
- Life expectancies.

4.2.2 A review of the thirteen core future studies produced ten specific trends and three 'wild card' events that are all part of the demography driver. The ten trends are:

- Increasing global population.
- Decreasing percentage of global population living in developed world.
- Increasing (and vast majority) of the percentage of the population living in the developing world.
- Increasing number of older people as a percentage of the population in the developed world.
- Increasing number of younger people as a percentage of the population in the developing world.
- East Asia and Africa becoming the most populous parts of the world.
- Growing pressures to migrate from the developing world into the developed world.
- Increasing life expectancy, especially in the West.
- Increasing number of dependants in the developed world.
- Increasing infertility.

4.2.3 Of these trends global population is perhaps the easiest to quantify and make projections for. Indeed, a review of the core studies shows that most of them have given specific global population projections. The problem, of course, is that each of these global projections is concerned with a different timeframe so it is difficult to compare them directly. However, a brief collation of the data given in five of the core studies (shown in figure 1) helps to give an overall projection of how global population will grow over the next fifty years [3, 4, 5, 10, 14]:

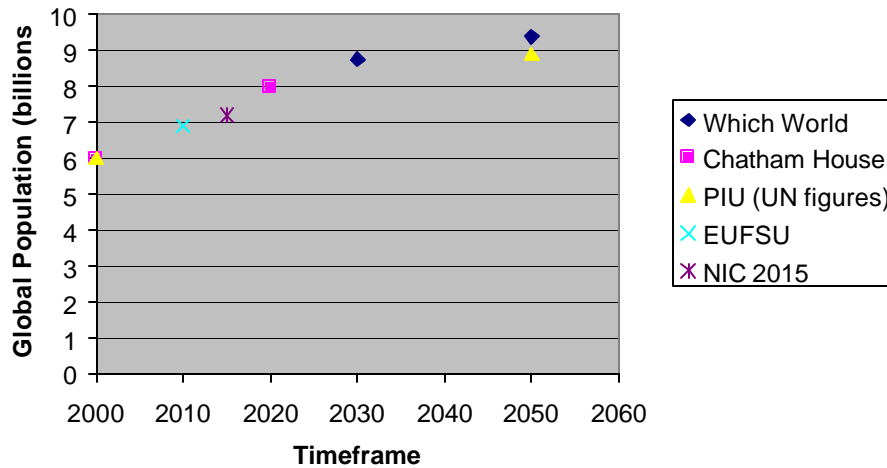


Figure 1 – Collation of Population Projections

4.2.4 Clearly, the global population is set to increase up to around 9 billion in 2030 and to continue rising, all be it at a reduced rate, beyond that. More important than this overall projection, though, are the trends in population patterns and compositions. Of particular importance is the trend towards a growing percentage of the world's population living in the developing world coupled with a falling number living in the developed world. This imbalance will also be married to the converse trends towards an 'ageing' or 'greying' population in the developed world and a population in the developing world that is getting younger, or 'youthing'. One study estimated that 34% of those living in the EU will be 65 or over by 2050 [10]. In fact, all bar one of the core studies that cited demography as a key driver have highlighted the fact that the vast majority of the world's population will live in the developing world where birth rates will be higher. Indeed, it seems clear that some 90 – 95 % of the world's population will probably be born in the developing world over the next quarter of a century – so that by 2020 only one fifth of the world's population will live in the developed world [10]. In particular, the populations of East Asia and Sub-Saharan Africa should boom. Population estimates have included that 1.75 billion people will live in Sub-Saharan Africa alone by 2050 [10], India's and Pakistan's populations will be 1.2 billion and 195 million respectively by 2015 [4] whereas the EU's population will begin to decline after 2025, having peaked at 390 million [5].

4.2.5 It is clear that a 'push-pull' situation could be easily created with the young population of the developing world migrating to the developed world to fill the gaps left by the developed states' greying populations.[4].

4.2.6 Clearly, these 'greying' populations, created by declining birth rates and increased life spans, will create significant problems for the developed world. The burden on employment and welfare is addressed in the 'economics' driver summary but

figure 2 gives a clear indication of the proportion of dependants with which the developed world will have to deal. The figure was drawn from one of the core studies. None of the other core studies offered any comparable data for this particular trend.

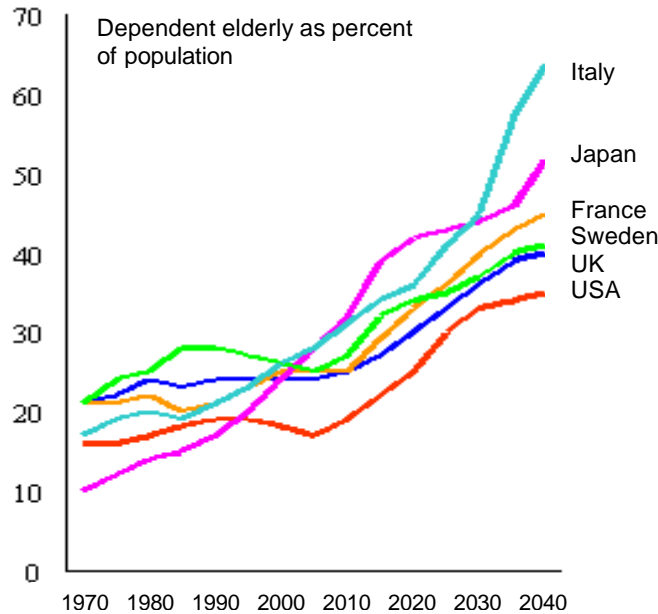


Figure 2 – Percentage of populations who will be elderly dependants [3]

- 4.2.7 Infertility is likely to increase, particularly in the developed world. On the other hand, global life expectancies will probably increase at the same time. Thus this trend toward a dependant population⁴ in the developed world will be unavoidable. In fact it is even thought by one source that the global population could go into decline after 2040 if infertility rates continue to increase [10].
- 4.2.8 Table 2 shows how frequently each trend appeared in the core and sectoral studies. If there is agreement among the source material on the nature of the trend, then it is labelled 'convergent'. If there is disagreement on the nature of the trend, then it becomes 'divergent'. Demography was touched on by all but two of the core studies, with reasonable consensus on trends and their directions. Population projection is an established art and several studies gave quantitative predictions that are generally in good agreement. It is interesting to note that those core studies that originate from the political and security domains (seven of the thirteen core studies) have *all* highlighted the greying population in the developed world as a key trend.

⁴ This term 'dependent population' refers to the number of elderly people who will depend on the state to provide for them, in terms of pensions, healthcare etc.

DEMOGRAPHICS DRIVER TRENDS	TREND TYPE	FREQUENCY (13 CORE STUDIES)	FREQUENCY (38 SECTORAL STUDIES)
Increasing global population.	Convergent	69%	18%
Decreasing percentage of global population living in developed world.	Convergent	23%	0%
Increasing (and vast majority) percentage of population living in developing world.	Convergent	54%	11%
Increasing number of older people as a percentage of the population in the developed world.	Convergent	69%	29%
Increasing number of younger people as a percentage of the population in the developing world.	Convergent	38%	3%
East Asia and Africa becoming the most populace parts of the world.	Convergent	8%	0%
Growing pressures to migrate from developing world into developed world.	Convergent	31%	3%
Increasing life expectancy, especially in west.	Convergent	31%	8%
Increasing number of dependants in developed world.	Convergent	23%	16%
Increasing infertility.	Convergent	15%	5%

Table 2 – Demographics trends

4.2.9 **Driver ‘wild card’ events:** ‘Wild cards’ are defined as being sudden and shocking events that have a low probability of arising but a potentially very high impact. A review of existing future studies highlighted three potential wild card events within this driver. They are listed in the table 3.

DEMOGRAPHY WILD CARD EVENTS	FREQUENCY (13 CORE STUDIES)	FREQUENCY (38 SECTORAL STUDIES)
Massive migration from developing world into developed world.	8%	0%
Europe and Japan fail to cope with challenges of ageing population.	8%	0%
Collapse of the sperm count.	8%	3%

Table 3 – Demographics wild card events

4.2.10 **Driver confidence / reliability statement:** In light of what has been discussed above it is clear that demographics is a reliable driver whose trends can be predicted with a relatively high degree of confidence. This is mainly because relatively accurately quantified population projections can be made and it is from these projections that the trends are derived.

4.3 Driver 2 – ENVIRONMENTAL CHANGE

4.3.1 **Driver description and components:** Environmental change is concerned with all aspects of the altering environment. This includes both natural changes and the impact of human activity. The components of this driver are:

- Climate and atmospheric change.
- Pollution.
- Energy demands and fossil fuel consumption.
- Water and food resources.
- Urbanisation.
- Disease.
- Deforestation.

4.3.2 A review of the thirteen core studies produced twelve specific trends and five 'wild card' events that are all part of the environmental change driver. The twelve trends are:

- Global atmospheric temperature increases by 1- 5 °C over the next century.
- Increasing incidence of more extreme weather.
- Rising in global sea levels.
- Increasing global pollution, especially in the developing world, due to continuing massive reliance on fossil fuel energies.
- There were divergent trend statements on the state of the ozone layer:
 - Continued depletion of the ozone layer around the poles.
 - No improvement in state of ozone layer.
 - Or gradual, overall, regeneration of ozone layer.
- Increasing demand for water resources and greater variation in the quality of available water.
- There were divergent trend statement on food supplies:
 - Ample but continuing areas of starvation due to poor distribution of food.
 - Decreasing food supplies available to meet growing population demands.
- Greater demand on energy resources and the need to generate electricity.
- Fossil fuels:
 - Decreased reliance on fossil fuels (as a total percentage) for electricity generation.
 - Or increased need to develop and increase usage of sustainable energy sources.
- Increased deforestation.
- Increased need to develop and make increased use of sustainable energy sources.
- Emergence/ re-emergence of infectious disease on a large scale.
- Increased emphasis on need for 'cleaner' forms of transport in the developed world.
- Increased urbanisation and city growth across the world.

- 4.3.3 Clearly, there is much uncertainty within current futures studies over how the environment will change over this century, though what appears certain is that global atmospheric temperature will rise. To what degree is open to conjecture. Indeed, as indicated above, the margin is as wide as 1 – 5 degrees Celsius. Thus it is clear that global warming is taking place whilst it is also obvious that the trend is not a linear one and remains uncertain in extent. [3, 4, 10, 13]
- 4.3.4 Other trends within environmental change are also difficult to quantify in extent. The core studies seem to assert that global pollution will probably increase, all be it 'in varied sectors' [13]. In other words, some parts of the world will probably increase, comparatively, in their output of pollution whilst others might begin to fall. As with demography, the distinction in these two patterns will, by and large, be between the developing and the developed world. The developed world will be more likely to exploit sustainable resources and renewable energies, which will produce less pollution per unit. By contrast, developing nations will become more inclined towards using cheaper forms of industrial advancement that rely more on the use of more polluting resources, such as fossil fuels and Chloro-Fluoro Carbons (CFCs) [13]. With the populations in these developing areas growing as well, that would suggest an increased demand for industry and transport which are two of the major sources of pollution.
- 4.3.5 The degree of pollution, though, depends largely on how much the world continues to rely on fossil fuel energy sources and it seems clear, from looking at the core studies that usage will increase. For example, 'Total oil demand will increase from roughly 75 million barrels per day in 2000 to more than 100 million barrels in 2015, an increase almost as large as OPEC's current production' [4]. Indeed, four of the core studies have highlighted this continuing trend to use more and more fossil fuel resources [3, 4, 11, 13], although two also stated that the overall percentage of fossil fuel consumption in electricity generation would fall [4, 11]. There is a significant degree of uncertainty over the impacts of pollution. For example, three of the core studies have said that the ozone layer around the poles will continue to degrade [3, 4, 13]. However, one of those studies has suggested that the rest of the ozone layer will regenerate [4] and an OECD paper has suggested that there will be 'no improvement' in the state of the ozone layer [23].
- 4.3.6 One trend that is not in doubt is that there will be a greater stress on fresh water resources in the future. As the climate changes and populations grow, water will become scarcer in certain parts of the world. Again, the developing world will feel the gradual drought the hardest, particularly Sub-Saharan Africa and parts of the Middle East [4, 8]. As well as water becoming scarce, increased pollution is likely to mean that the quality of fresh water will decline in some areas. More acidic rain resulting from increased use of fossil fuels, in particular, would adversely affect natural water supplies.
- 4.3.7 These areas that are likely to suffer water shortages may well also be the victims of starvation. Of the three core studies that made predictions about water shortages, two stated that global food supplies will be ample but that starvation will still occur because those supplies will not be distributed evenly [4, 24]. The third study suggested that overall global food supplies will actually decrease, again leading to starvation [10].
- 4.3.8 It seems likely that the trend towards more frequent extremes of weather in most parts of the world will continue. Rainfall patterns will probably change also, bringing increased incidences of floods with them. Increased deforestation in certain parts of the world, such as South Asia, will also heighten the risk of

flooding in these areas. The other impact of deforestation in these parts will be to force local inhabitants away from using wood as a basic fuel towards using oil, gas and electricity [3].

- 4.3.9 Future outbreaks of disease, as now, will be more likely where populations are less well fed, where the weather is more extreme and where water supplies are poor and insufficient. Thus the continued impact of AIDS and the emergence of new diseases or the re-emergence of old ones will pose serious risks for local populations [4, 8]. For example, it has been projected that the population of South Africa will drop from the current 43 million to 38.7 million by 2015 (despite the overall population boom in Africa) due to the spread of AIDS [4]. It has also been projected that by 2010 Asia will have more AIDS victims than Africa [8] and that AIDS effects will reduce GDP by 1% per annum and consume more than half of health budgets [4]. Moreover, if there are likely to be significant numbers of migrants leaving these areas and coming into the developed world then together with increased tourism, this increases the risk of diseases spreading to the developed world.
- 4.3.10 Whilst there is a possibility of migrants moving from the developing to the developed world, there will certainly be a migration of a different kind; from rural areas to urban areas. Indeed, the reasons for migrating from the countryside to the city are much the same as those for moving into the developed world. As those in the developing world come under increased stress from water and possibly food shortages they will seek to find work, wealth and improved lifestyles in urban areas. This is one environmental trend that is convergent across all studies that cited it because the process is already underway and those of the core studies that have mentioned the process are in agreement. The pattern seems clear: cities across the world, in both developing and developed countries will grow in size and population density and 'by 2015 more than half of the world's population will be urban' [4].
- 4.3.11 **Driver trends data:** This driver was again cited by most of the core studies. There was general agreement on the inputs, trends and that these would produce detrimental outcomes. There were also significant areas of disagreement between studies on the level of impact of environmental change. It is interesting to note that the political and security originated core studies have all highlighted the scarcity of water as a significant trend within this driver.

ENVIRONMENTAL CHANGE DRIVER TRENDS	TREND TYPE	FREQUENCY (13 CORE STUDIES)	FREQUENCY (38 SECTORAL STUDIES)
Global atmospheric temperature increasing by 1- 5 degrees Celsius over next century.	Convergent	38%	8%
Increasing incidence of more extreme weather.	Convergent	54%	11%
Rising global sea levels.	Convergent	38%	0%
Increasing global pollution, especially in the developing world, due to continuing massive reliance on fossil fuel energies.	Convergent	31%	5%
Alterations in the state of the ozone layer: 1) Continued depletion of the ozone layer around the poles. 2) No improvement in state of ozone layer. 3) Gradual, overall, regeneration of ozone layer.	Divergent	Overall 31% 1) 23% 2) 0% 3) 8%	3%
Increasing demand for water resources and greater variation in the quality of available water.	Convergent	77%	11%
Food supplies: 1) Ample, but continuing areas of starvation due to poor distribution of food. 2) Decreasing food supplies available to meet growing population demands.	Divergent	Overall 30% 1) 15% 2) 15%	Overall 8% 1) 5% 2) 3%
Greater demand on energy resources and the need to generate electricity.	Convergent	31%	0%
Fossil fuels: decreased reliance on fossil fuels (as a total percentage) for electricity generation. Increased need to develop and increase usage of sustainable energy sources.	Convergent	46%	3%
Increasing deforestation.	Convergent	23%	0%
Increasing need to develop and increase usage of sustainable energy sources.	Convergent	31%	8%
Emergence/ re-emergence of infectious disease on a large scale.	Convergent	31%	5%
Increasing emphasis on need for 'cleaner' forms of transport in the developed world.	Convergent	8%	13%
Increasing urbanisation and city growth across the world.	Convergent	31%	8%

Table 4 – Environmental change trends

4.3.12 **Driver ‘wild card’ events:** Five potential wild cards have been cited for this driver (see table 5).

ENVIRONMENTAL CHANGE WILD CARD EVENTS	FREQUENCY (13 CORE STUDIES)	FREQUENCY (38 SECTORAL STUDIES)
Major disruption in global energy supplies.	8%	0%
Asteroid impact on earth.	8%	3%
Massive environmental disaster leading to extensive and long-term pollution.	8%	3%
Worldwide epidemic.	23%	0%
Ice cap breaks up – oceans rise one hundred feet.	0%	3%

Table 5 – Environmental change wild card events

4.3.13 **Driver confidence / reliability statement:** Environmental change is one driver that can only be discussed with a low to medium degree of confidence, at best. The reasons for this have already been alluded to above. Suffice to say, though, that because the various strands of environmental change (fossil fuel usage, climate change, pollution, urbanisation etc.) all impact upon each other, if there is uncertainty surrounding one of these trends then the uncertainty will only grow as we move to look at subsequent trends. Moreover, given that the strands of environmental change are so interconnected then any uncertainty in one will lead to uncertainties in the others.

4.4 Driver 3 – ECONOMICS

4.4.1 **Driver description and components:** This driver concerns all strands of economic change but focuses on fundamental global economic patterns. This driver also includes changes in business, trade, brand and workforces. The components of this driver are:

- Economic globalisation.
- Global economic growth.
- Balance between the rich and poor.
- Changes in business: brand, management structures, and image.
- The workforce.
- Trade.

4.4.2 Eleven trends and three wild card events have been highlighted within this driver:

- Increasing economic globalisation.
- New 'knowledge economy' providing the main driving forces behind continued growth.
- Continuing de-integration and out-sourcing within companies.

- Continuing global economic growth.
- Widening gap between the rich and poor.
- Increasing trade and flow of goods.
- Ageing workforce in the developed world.
- More educated workforce.
- Shifting management structures within companies and decline of 'low skilled' jobs due to growth of IT in the workplace.
- Increasing taxation burden on workforce in developed countries, to deal with ageing populations.
- Increasing emphasis on brand and image.

4.4.3 The process of economic globalisation is likely to continue. Increasing interactions between companies, falling costs, more open flows of information, new ideas and multi-cultural values will all contribute to companies, governments and consumers becoming increasingly entwined, with IT and communications technology facilitating the process [4].

4.4.4 This increasing flow of business will help to drive continuing global economic growth: 'All of the economic output of the world in 1900 occurs in about two working weeks in 2000, it will fit into about one week in 2015 and two working days in 2020' [3]. 'Even the relatively pessimistic forecasts assume average annual growth of 3% in the period to 2030' [8]. One of the core studies has asserted that this rate of growth will probably be highest in Asia where China and India will be the likely leaders of that growth [4]. Whether or not this is so, it seems clear from looking at the core studies that the whole world will not necessarily benefit from this continued growth. In fact, it seems clear that the already rich will probably benefit most whilst the poor will get left behind. Moreover, this pattern will probably be reflected both across the globe and within states also. Again, the greatest deficit will be between the developing and the developed worlds: 'the per capita gap between mid-eighteenth century Europe and India was around 5:1; the gap between Switzerland and Mozambique is now 400:1' [7]. Figures 3 and 4 emphasise the trend:

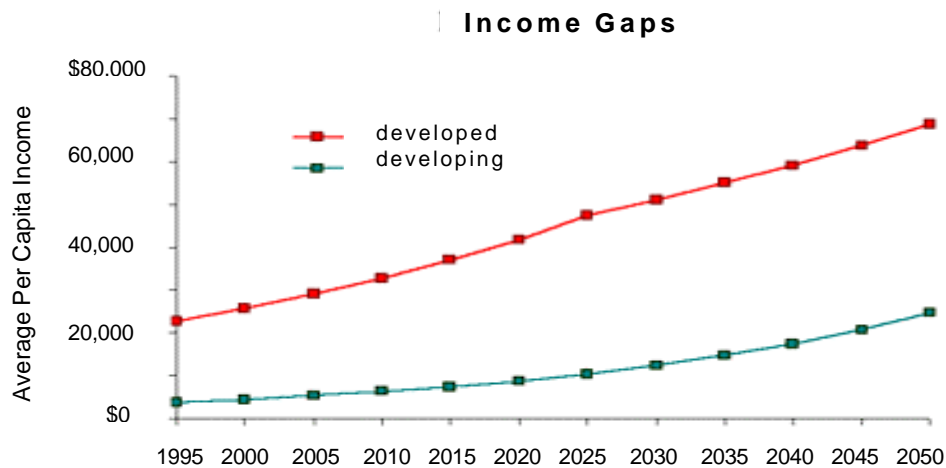


Figure 3 - The increasing income gap between developing and developed worlds [25]

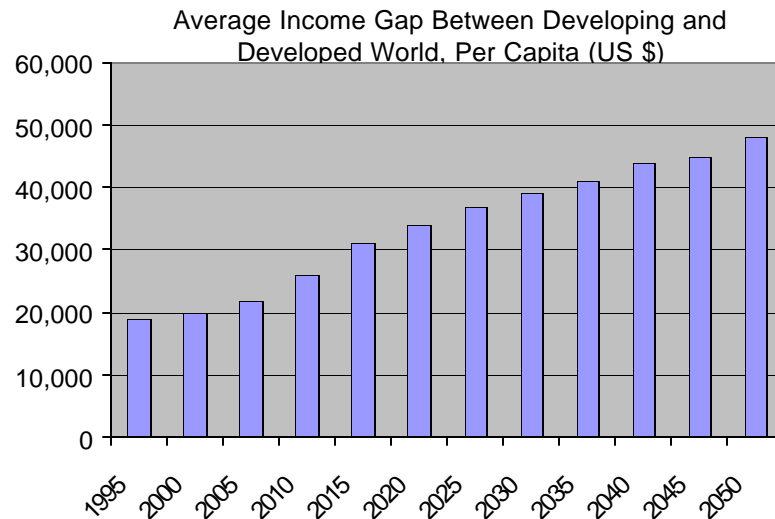


Figure 4 – Income gap

- 4.4.5 Trends that are already emerging within the business world will also continue over the coming decades. Already companies are tending more and more towards de-integrating their structures and towards using outside sources to carry out work [3, 7]. This represents a marked shift away from the traditional industrial economy where companies 'once resembled castles or walled cities; closed, self-sufficient and able to command their surroundings. Now, the need for integration has been replaced by something closer to a modern metropolis, with a myriad of specialist entities operating in a web of mutual support' [3].
- 4.4.6 The growth, spread and increased reliance on IT and communications technology will mean that the majority of jobs in the workplace have become necessarily more technical and, as a result, workers will be required to be more highly educated and skilled. 'In 20 years the UK workforce will be the most highly educated in our history' [26]. As this trend towards more skilled jobs continues, many low-skilled jobs are likely to disappear. The same will be true of middle management posts because as companies and businesses become more and more reliant on IT and communications technology (as discussed in the next section) management structures will alter. Those management posts that remain seem likely to be focused more and more on dealing with increased bureaucracy, such as dealing with contracts, suppliers and support staff [27].
- 4.4.7 The greying populations in the developed world will undoubtedly put an increased strain on workforces in those countries. The available number of young graduates and other young employees will fall whilst existing employees will probably be forced to retire later in order to sustain the companies. As the number of retired people does go up, the strain on national economies will become heavier and heavier and the potential tax burden will rise to cover the need for increased welfare [3, 7, 8, 9].
- 4.4.8 On the output and productivity side there will probably continue to be increased emphasis on brand and image. How a product and a company is perceived is likely to be crucial to their success and increased choice for the consumer should spur on this process. It will not just be companies and businesses that will need to carefully craft their image; the same is likely to be true of governments and institutions. If current trends continue, governments in particular will increasingly find themselves needing to keep abreast with new forms of telecommunications

not just to enhance their own image but also to, in a sense, 'sell' their products and services. As driver 6 will discuss, people seem to be becoming increasingly adopting more 'laissez faire' attitudes to their political allegiances and interests in government. The need to keep people interested will, almost certainly, be all the more crucial. [3, 11, 28]

4.4.9 **Driver trends data:** Table 6 shows how economic globalisation was the commonest trend within this driver. It is interesting to note here that those core studies that originated from the political and security domains all highlight the three trends with the highest frequencies in the table below: continued growth, increasing globalisation and widening gap between the rich and poor.

ECONOMICS DRIVER TRENDS	TREND TYPE	FREQUENCY (13 CORE STUDIES)	FREQUENCY (38 SECTORAL STUDIES)
Increasing economic globalisation.	Convergent	85%	37%
New 'knowledge economy' providing the main driving forces behind continued growth.	Convergent	46%	16%
Increasing in number of small/medium enterprises driving national economies.	Convergent	23%	16%
Continuing global economic growth.	Convergent	77%	13%
Widening gap between the rich and poor.	Convergent	77%	3%
Increasing trade and flow of goods.	Convergent	54%	18%
Ageing workforce in the developed world.	Convergent	31%	13%
More educated workforce.	Convergent	15%	13%
Shifting management structures within companies and decline of 'low skilled' jobs due to growth of IT in the workplace.	Convergent	23%	21%
Increasing taxation burden on workforce in developed countries, to deal with ageing populations.	Convergent	46%	5%
Increasing emphasis on brand and image.	Convergent	15%	8%

Table 6 – Economics trends

4.4.10 **Driver 'wild cards':** Four wild cards have been identified for this driver. They are shown in table 7.

ECONOMIC WILD CARD EVENTS	FREQUENCY (13 CORE STUDIES)	FREQUENCY (38 SECTORAL STUDIES)
US economy suffers a sustained downturn.	8%	3%
Emerging market economies fail to reform their financial institutions.	8%	0%
China and India fail to sustain high growth.	8%	0%
Stock market crash.	8%	3%

Table 7 – Economics wild card events

4.4.11 **Driver confidence / reliability statement:** Economics is a driver that can be discussed with a medium to high degree of confidence. In a sense it is similar to demography in that future global trends can be predicted and quantified with a relatively high degree of accuracy. This is certainly true of the more general global economic trends but the other trends that have been cited above that are concerned with business and workforces should be considered with a slightly greater degree of uncertainty because they are more complex trends.

4.5 Driver 4 – SCIENCE AND TECHNOLOGY

4.5.1 **Driver description and components:** This driver covers all aspects of scientific and technological development and the applications of those developments. It also deals with the changing applications of existing technologies. The components of this driver are:

- The spread of, growth of, access to and increased reliance on information technology (IT) and communications technology.
- The impact of new and emerging technologies such as biotechnology, nano-technology and artificial intelligence.
- The growth of the media.

4.5.2 Of the six drivers, science and technology holds a place of particular importance because the trends that will occur in this driver will facilitate many of the trends and potential events in other drivers. We have already discussed processes such as economic globalisation, increased trade, pollution and urbanisation. These will all be affected, and in some cases dependent on, technological and scientific developments. A review of existing futures material has highlighted eleven trends and five wild cards within this driver:

- Growth of IT/communications technology (increased technological globalisation) and greater sophistication of computers.
- Access to technology: Increasing access to IT and communications technology or creation of a 'knowledge gap' as information access is restricted to those who can afford it.
- Increasing reliance/use on IT/communications technology in business, medicine, industry and leisure.
- Increasing use of biotechnology (including genetic engineering), particularly in medicine.
- Increasing use of artificial intelligence.
- Increasing use of nano-technology and miniaturised technologies.
- Greater reach of the media.
- Increasing reliance on IT/communications technology in western military (especially the US).
- Greater use of 'asymmetric' military technologies in developing countries and by paramilitary groups.
- Use of vastly improved, more robust and renewable materials.
- Continuing US dominance in the field of technological innovation.

- 4.5.3 As the majority of the core studies have asserted, the trends within this driver that are undoubtedly going to have the highest impact on the shaping of the global future will be those surrounding IT and communications technology. Indeed, it is no surprise that a review of table 8 shows just how many core and sectoral studies have highlighted one or more trends surrounding this rapidly growing and expanding technology.
- 4.5.4 The main ways in which IT/communications technology will shape the future world are through an increased reliance on the technology itself in the field of work, at home, in medicine, in the military, in transport, in engineering and in every other sector. With the Internet providing the lynchpin of the system, the world will become more 'connected' than ever over the coming years: 'the planet will be embedded in a largely unbroken system of data exchange by 2020' [3]. Access to this global information system will be widespread. However, there is a concern, highlighted by one core study, that access may become more and more restricted to those who can afford the technology. We have already discussed how the world's poor are likely to get left behind in economic terms and it could be that they would suffer in knowledge terms as well. If this trend were to occur then the divide between developed and developing would become all the more difficult to transcend [4].
- 4.5.5 Increasing access to telecommunications technology will also mean that access to media will grow and grow. More and more people around the globe will be able to know what is going on in the world around them and will probably be able to access that knowledge in a way that allows them to see what they wish to know first. The numbers of news channels and websites will grow and become more diverse. Ultimately, people, even in the same part of the world, will not necessarily be dependent on the same media sources. The role of the media as a whole, as the supplier of this information, will however be all the more crucial [7, 13].
- 4.5.6 There is no doubt, though, that where IT/communications technology is available it will continue to be used more and more. The technology itself will vastly improve and become more 'user friendly' as well [13]. The same pattern will be true of other new and emerging technologies. Three such technologies in particular have been highlighted for greater future use: biotechnology, nano-technology and artificial intelligence. Biotechnology seems certain to take on an increasingly important role in the field of medicine but it will also be of use in other areas such as in crime detection and food production. For example, if current trends continue, the mapping of the human genome will open up vast opportunities for genetic engineering and gene therapy. It should also become possible to construct replacement organs and it might even be possible to augment an individual's brain functions through biotechnology. It 'is at least possible that over the next 10 – 20 years we may know enough about the human genome to move from a medical system based on "diagnosis and cure" to one based on "predict and prevent"' [10]. It may even be possible to use gene therapy to improve people's learning abilities and reverse the effects of memory loss [29]. There also remains the possibility of increasing food production in areas subject to starvation through the use of genetically modified foods.
- 4.5.7 Similarly, the spread of nano-technology has the potential to 'change the way almost everything – from vaccines to computers to automobile tyres to objects not yet imagined – is designed and made' [4]. Artificial intelligence (AI) continues to offer great potential. Basic forms of AI are already used in some road cars and in other areas such as robotics. As with nano-technology, as the technology

becomes cheaper and easier to use it will, doubtless, spread to many sectors [4, 29].

4.5.8 In the wider field of technological development the US will continue to be one of the leading players. This will be especially true in the field of military technology. Here the US, closely followed by her allies, is set to advance its armed forces well into the information age by integrating IT and communications technology into all the branches of its forces and its support networks. This technological dominance will give the US and her allies a unique position from which it should be able to dominate the global scene with its conventional military forces. However, this will mean that less developed nations will be more likely to continue to seek subconventional technologies with which they can arm themselves. These technologies could range from ballistic missiles to terrorist bombs or Internet viruses. What will underpin all such technologies, though, is that they will seek to avoid the conventional strengths of the US and her allies and to play on the weaknesses of these forces in order to deliver political results. The strategy is not a new one but it will certainly become a more common one for any (potential) adversary of the US or other developed nations [1, 4, 8].

4.5.9 **Driver trends data:** Table 8 shows that the increased growth and reliance on IT and communications technology is highlighted in both a large proportion of the core studies and the sectoral studies. It should also be noted that this driver was the most frequently cited in the sectoral studies.

SCIENCE AND TECHNOLOGY DRIVER TRENDS	TREND TYPE	FREQUENCY (13 CORE STUDIES)	FREQUENCY (38 SECTORAL STUDIES)
Growth of IT/communications technology (increased technological globalisation) and greater sophistication of computers.	Convergent	92%	45%
Access to technology: 1) Increasing access to IT and communications technology. 2) Creation of a 'knowledge gap' as information access is restricted to those who can afford it.	Divergent	Overall 85% 77% 8%	Overall 82% 45% 37%
Increased reliance/use on IT/communications technology in business, medicine, industry and leisure.	Convergent	62%	53%
Increased use of biotechnology (including genetic engineering), particularly in medicine.	Convergent	54%	22%
Increased use of artificial intelligence.	Convergent	46%	11%
Increased use of nano-technology and miniaturised technologies.	Convergent	31%	11%
Greater reach of the media.	Convergent	46%	5%
Increased reliance on IT/communications technology in western military (especially the US).	Convergent	23%	3%
Greater use of 'asymmetric' military technologies in developing countries and by paramilitary groups.	Convergent	31%	3%
Use of vastly improved, more robust and renewable materials.	Convergent	23%	11%
Continued US dominance in the field of technological innovation.	Convergent	23%	3%

Table 8 – Science and technology trends

4.5.10 **Driver ‘wild card’ events:**

SCIENCE AND TECHNOLOGY WILD CARD EVENTS	FREQUENCY (13 CORE STUDIES)	FREQUENCY (38 SECTORAL STUDIES)
Viruses become immune to all known treatments.	8%	3%
Self-aware machine intelligence.	0%	3%
Sweeping medical breakthrough is perfected.	0%	3%
Faster than light travel.	0%	3%
Foetal sex selection becomes the norm.	0%	3%

Table 9 – Science and technology wild card events

4.5.11 **Driver confidence / reliability statement:** Along with demography, science and technology is one of the most reliable drivers because developments that are to occur in this area can normally be predicted from current developments. This driver is unique in that some of the trends are in fact specific technological goals that are being actively sought. A good example of this is the desire to improve IT technology and to exploit it as far as possible in the workplace. Thus this driver can be discussed with a relatively high degree of confidence and reliability.

4.6 Driver 5 – NATIONAL AND INTERNATIONAL GOVERNANCE

4.6.1 **Driver description and components:** This driver deals with all aspects of governing within and between states. In particular it addresses the key concerns that states will have to face and whom they will have to deal with in the future. The components of this driver are:

- Control of state borders.
- Interactions between states and between states and non-government organisations (NGOs).
- Internal and external threats to state security.
- Proliferation of military technology.
- Shifts in global power.
- Internal domestic issues for state governance.

4.6.2 A review of the current futures thinking produced twelve trends within this driver:

- Decreasing control of states over borders.
- Increasing frequency of dealings between states and non-state groups.
- More internal and external, diverse and subconventional threats to state and non-government organisations security.
- Increasing difficulty of regulating information flows within and between states.

- Proliferation of military technology, particularly small arms and weapons of mass destruction (WMD).
- Continuing economic and military dominance of US.
- Shifts in global power; emergence of other global powers (state and non-state).
- More emphasis on co-operation in the international system.
- More administrations and increased democracy as more ethnic groups push for greater autonomy.
- Changing nature (growing sophistication) of crime; more use of new technologies (especially IT/communications and biotechnology) to both propagate and combat crime.
- Increasing pressure on developed world's health services and welfare due to ageing population.
- Increasing emphasis on domestic issues that concern the individual every day (transport, education, crime etc.).

4.6.3 How the world of the future is going to be governed is a matter that is open to significant debate but what is more certain, after reviewing the core studies, is the nature of the challenges that governments of the future will face. From both within and outside their own borders, states will begin to face an increasingly diverse range of challenges. Indeed, one of the most crucial will be retaining statehood itself. The impact of new information technologies, previously discussed, will mean that national borders are becoming easier to circumvent. For the governments concerned, the task of regulating these flows will become all the harder as the rates of flow increase. It will not just be information that will be crossing state boundaries regularly though. Migrants, trade, criminal organisations and military technologies will all attempt to permeate national borders with an increased frequency [4, 8, 30].

4.6.4 In addition to dealing with permeable borders, governments will also have to adapt in other ways. Eight of the thirteen core studies point to the fact that governments will increasingly be required to deal with non-state actors. This, also, is a result of the fact that the world is becoming more closely integrated. Indeed, many non-state actors will gain increasing power as they continue to exploit favourable global economic conditions to make more profit and thus enhance their political weight [8]. As well as co-operating with non-state groups there is some limited indication (three of the core studies highlight it) that states will be increasingly required to deal with and co-operate with each other over a much wider range of policy issues than today. This will be done both within and outside of existing international organisations and forums. Indeed, it would seem more beneficial, in this increasingly globalised world, for states to co-operate with each other over issues that affect common borders and other common areas of interest [4, 8].

4.6.5 Internal and external security threats to states will also become more diverse. Already individual criminals, organised criminal groups, terrorist groups and paramilitary organisations are making use of new and emerging technologies to make their activities more sophisticated. Only a handful of the core studies have highlighted such security issues but it can be said with a high degree of confidence that security threats will become more diverse because the trend is already taking place. Weapons are already proliferating across borders, particularly around the former Soviet Republics, whilst criminal organisations are increasingly making use of the Internet and mobile communications to facilitate their crimes. However, states will also be able to exploit technology in order to meet and combat these

challenges. For example, DNA profiling evidence will prove increasingly vital in criminal trials as will more sophisticated detection, surveillance and monitoring devices in the wider field of crime prevention [4, 8, 22, 30].

- 4.6.6 One of the more common trends (highlighted by eight of the core studies) within this driver is a move towards greater democracy and increased devolution. Groups such as ethnic minorities will increasingly feel that they deserve greater say in how they are governed and who governs them. Increasing tendencies towards more individual values (discussed in the next driver) will facilitate this process. The Internet is already proving that it too can provide a major platform for specific groups to get their 'message' out into the world and in delivering foreign news. Increased media coverage also means that any such groups who come under significant hardship will have a voice across the globe. This does not necessarily mean that every ethnic group will suddenly start demanding its own state. Far from it, what is more likely to happen is that ethnic groups will demand more representation in government and all areas of society. However, it should not be ruled out that some, more extreme groups would seek to employ more drastic methods for their cause [1, 3, 4, 5, 7, 8, 10, 13, 22, 30].
- 4.6.7 As well as potential security threats there are also indications that states will come under increased strain domestically as they try to deal with a more demanding electorate. This trend will probably be more prevalent in developed democratic states where people will have more choice and heightened individualistic sensibilities. They will be likely to place a greater demand on the quality of the public services they receive. In particular, transport, health, wealth and crime look set to become major issues that governments will have to deal with to satisfy their electorates. Indeed, the pressure on these issues will only increase as the populations in developed countries become 'greyer' and as the climates in those areas become more unpredictable and produce bouts of extreme weather [3, 4, 5, 7, 8, 10].
- 4.6.8 **Driver trends data:** Table 10 shows that there is much uncertainty surrounding national and international governance and there seems to be a reluctance in the studies reviewed to discuss the material. There is a greater number of wild cards cited for this driver than any of the others, possibly reflecting the discontinuous nature of potential security crises. This driver is also significantly influenced by some trends identified in the next driver discussed, 'perceptions, beliefs, values and attitudes'.

NATIONAL AND INTERNATIONAL GOVERNANCE DRIVER TRENDS	TREND TYPE	FREQUENCY (13 CORE STUDIES)	FREQUENCY (38 SECTORAL STUDIES)
Reduced control of state over borders.	Convergent	38%	11%
Increased dealings between states and non-state groups.	Convergent	69%	5%
More diverse and subconventional threats to state and NGOs security (internally and externally).	Convergent	38%	8%
Difficulty of regulating information flows within and between states.	Convergent	23%	3%
Proliferation of military technology, particularly small arms and WMD.	Convergent	31%	3%
Continued economic and military dominance of US.	Convergent	15%	0%
Shifts in global power; emergence of other global powers (state and non-state).	Convergent	23%	3%
More emphasis on co-operation in the international system.	Convergent	31%	0%
More administrations and increased democracy as more ethnic groups push for greater autonomy.	Convergent	62%	3%
Changing nature (growing sophistication) of crime; more use of new technologies (especially IT/communications and biotechnology) to both propagate and combat crime.	Convergent	23%	13%
Increased pressure on health services, welfare due to ageing population in developed world.	Convergent	38%	16%
Increased emphasis on domestic issues that concern the individual every day (transport, education, crime etc.).	Convergent	31%	16%

Table 10 – National and international governance trends

4.6.9 **Driver ‘wild card’ events:**

NATIONAL AND INTERNATIONAL GOVERNANCE WILD CARD EVENTS	FREQUENCY (13 CORE STUDIES)	FREQUENCY (38 SECTORAL STUDIES)
Collapse of the Middle East.	8%	0%
Formation of an alliance between China, India and Russia.	8%	0%
Formation of an international terrorist alliance.	8%	0%
Collapse of US/Europe relations.	8%	0%
Collapse of the UN.	15%	3%
Use of WMD by rogue state / sub-state group.	31%	3%

Table 11 – National and international governance wild card events

4.6.10 **Driver confidence / reliability statement:** National and international governance is a driver that can only be discussed with a medium level of confidence because the trends within the driver are so subject to the sixth driver (perceptions, beliefs, values and attitudes.) Moreover, this driver is difficult to understand because it

depends so heavily on *people* as opposed to natural or scientific systems and because attitudes and outlooks can change so quickly it remains difficult to discuss this driver with a high degree of confidence.

4.7 Driver 6 – PERCEPTIONS, BELIEFS, VALUES AND ATTITUDES

4.7.1 **Driver description and components:** This driver is concerned with the outlook of people. It is concerned with how they think about and look upon the world around them. For this reason, education has been placed in this driver because the level and type of education received by individuals has a direct influence on their outlook. This driver also deals with other social issues such as family structures. The components of this driver are:

- Degree of social freedom.
- Level of education.
- Attitudes towards governments and institutions.
- Growth of individual values and shift away from traditional values.
- International awareness and national identity.
- Religious beliefs.
- Family structures.
- Role of the media in shaping perceptions.

4.7.2 As with national and international governance, there was less consistency between the thirteen core studies on the trends within this driver. The ten commonest were:

- Increasing social freedom and more choice for the individual.
- Increasing standard of education and literacy, and more widespread education.
- Increasing deferment from politics and institutions.
- Growth of individual values and the decline of traditional values; more empowerment for the individual.
- More stress on the individual.
- Shifting social structures; decline of the family and more remote (virtual) communities.
- Continuing importance of the media in shaping perceptions.
- Increasing international awareness.
- Declining feelings of national identity.
- Diversification of religious beliefs; drift away from traditional religions.

4.7.3 Of the trends given above, the commonest amongst the core studies is increasing standards of education. Across both the developed and the developing world, standards of education are rising and the proportion of literate and educated individuals is rising. Figure 5 clearly demonstrates the trend:

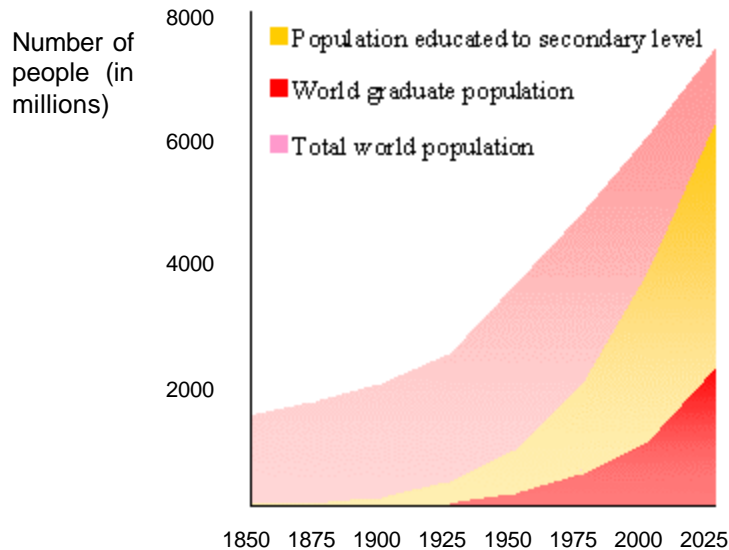


Figure 5 – Increasing global education levels [3]

- 4.7.4 Eight of the thirteen core studies have highlighted this trend. Greater numbers of educated and literate individuals means greater numbers of individuals who are able to use and benefit from information technology, should they have access to it. It should also mean that more and more people would be able to work competently within the new IT-centric working environment.
- 4.7.5 This inter-connecting of local, regional and global groups over information superhighways will have a consequent impact on social structures. Indeed, five of the core studies have highlighted the fact that traditional social structures are already changing and will continue to change. Traditional communities will probably fade away as individuals shift towards becoming members of several communities. The individual will be a member of their family community at home, they will then be likely to move into a different circle as they go to work and they will most likely socialise in a third community. When individuals go on-line they will then be entering a fourth kind of ‘virtual community’ where they will be able to interact with anyone else who is also on-line. As a few of the core studies have highlighted, this shift in social patterns should help to raise international awareness but it will also lead to decreasing feelings of national identity as people become more concerned about their place in certain groups rather than in the state as a whole. If this happens, as seems likely, individuals will tend to feel more detached from governments and political institutions and will probably feel less inclined to participate in the electoral process or in party politics. This process will be fuelled by a declining trust and faith in governments, in both the developed and developing world where corruption and other political scandal, that have been well covered by the media, have become more frequent [3, 4, 7, 8, 9].
- 4.7.6 The outlook of the individual will be all the more important in the future because peoples’ values are becoming increasingly focused upon themselves. There is already a tendency away from the traditional values of family, community and a loyal employee towards the post-modernistic values of job-satisfaction, portfolio careers, empowerment of the individual, personal wealth, personal health and individual rights. As this process continues, those who govern will be unable to think of people as ‘the masses’ anymore and they will probably need to think about the needs of groups of individuals [9].

- 4.7.7 The shift towards these more individualistic attitudes will probably bring with it the gradual decline in the numbers of people who actively follow traditional religions. The numbers of people attending Christian churches has been falling since the middle of the twentieth century and there is nothing to suggest that this trend will not continue. In place of the traditional faiths, new, more diverse and more numerous religions will arise and individuals will be free to choose which religion they wish to follow. Indeed, many may choose not to follow any religion as they may well seek fulfilment from other parts of their lives [31].
- 4.7.8 This choice between what religion, if any, individuals wish to follow demonstrates the evolution of another important trend. We have already mentioned the increasing emphasis on democratic values that is spreading across the world. This process will have an important accompanying trend: that of increased choice and social freedom for the individual. This trend is already well underway in the developed world and will be likely to spread into the developing world. Increasingly, people will be more at liberty to do what they want to do. The spread of information technology and the emergence of more and more companies competing for the same consumer markets will facilitate this process. Provided they have access, individuals will be able to go on-line and purchase goods, interact with others, gather information, or even seek medical advice whenever they wish and they will be able to choose from a wide range of companies and service providers when they do so. The individual will be more at liberty to move from job to job, without feeling any particular allegiance to one employer and will be more inclined to seek whatever training and further education they need to further their careers. Whilst, on the other hand, there will be an increased emphasis for employers to keep their employees happy through providing additional services and benefits. There will also be an increased emphasis on leisure and social time to balance out longer and more demanding working hours. Ultimately, there will be a much greater emphasis on 'doing what you want' in terms of careers, socialising and religion. This trend towards increased freedom and towards empowering the individual will probably mean that, as discussed, individuals will become more demanding of their governments as they become used to getting what they want, and getting it more rapidly. This sense of increased demand will probably create a curious situation where, as we have mentioned, individuals will feel more detached from their governments yet they will demand even more of them [10, 31].

4.7.9 Driver trend data

PERCEPTIONS, BELIEFS, VALUES AND ATTITUDES DRIVER TRENDS	TREND TYPE	FREQUENCY (13 CORE STUDIES)	FREQUENCY (38 SECTORAL STUDIES)
Increasing social freedom and more choice for the individual.	Convergent	31%	11%
Increasing standard education and literacy, and more widespread education.	Convergent	62%	11%
Increasing deferment from politics and institutions.	Convergent	31%	5%
Growing of individual values and the decline of traditional values; more empowerment for the individual.	Convergent	46%	11%
More stress on the individual.	Convergent	0%	8%
Shifting social structures; decline of the family and more remote (virtual) communities.	Convergent	38%	16%
Continuing importance of the media in shaping perceptions.	Convergent	46%	5%
Increasing international awareness.	Convergent	38%	0%
Declining in feelings of national identity.	Convergent	31%	0%
Diversification of religious beliefs; drift away from traditional religions.	Convergent	15%	3%

Table 12 – Perceptions, beliefs, values and attitudes trends

4.7.10 Driver ‘wild card’ events:

PERCEPTIONS, BELIEFS, VALUES AND ATTITUDES DRIVER WILD CARD EVENTS	FREQUENCY (13 CORE STUDIES)	FREQUENCY (38 SECTORAL STUDIES)
End of intergenerational solidarity.	0%	3%
First unambiguous contact with extraterrestrial life.	0%	3%
Growth of religious environmentalism.	0%	3%

Table 13 – Perceptions, beliefs, values and attitudes wild card events

4.7.11 Driver confidence / reliability statement: Like national and international governance, the outlook of the individual is difficult to predict with a high degree of confidence and it should be discussed with only a medium level of reliability. This is partly because outlooks can be so diverse and partly because they apparently follow no logical pattern. Indeed, the outlook of the individual is formed from many complex thoughts, experiences, emotions and perceptions and this driver remains one that must be treated with some caution.

4.8 Summary of driver trends

- 4.8.1 One of the clearest overall deductions that can be drawn from looking across the driver set is that it appears that those in the developing world will continue to suffer. They will be more likely to experience a lack of wealth and food and experience starvation, more extreme weather, more pollution, scarce water supplies and they could potentially be denied access to IT technology while the developed world will continue to thrive economically and technologically. However, the greying of populations in the developed world may well go some way to redressing the balance as the developed world comes under increasing strain in other areas. Obviously, one way of reducing the strain on both worlds would be to create a managed migration of young people from the developing world to the developed world. However, this would be a massive task to undertake and not without problems of its own.
- 4.8.2 Another common theme revolves around the continuing fragmentation and devolution of the nation state together with the empowerment of non-state of trans-state groups and ever more permeable state borders. In the developed countries, at least, a tendency towards post-modernist values concentrating on benefit to the individual or close social grouping could reinforce increasing distrust in, and detachment from, traditional government and the electoral process.
- 4.8.3 Just over half of the core studies originated in the domains of security of international politics. This is unsurprising, since 'environmental scanning' for trends that might lead to risks to a nation's wider interests is very much part of their everyday business. We do not believe that this has led to significant bias in either identifying the drivers comprising the minimum key set or in the global trends within them. Futures work that concentrated on a near-term national or even departmental focus would be expected to have a different balance of trends within the drivers.

5 Review of futures generation processes and outcomes

5.1 Aims

The elicitation of trends and drivers is only part of the futures generation process. Of the thirteen 'core' studies identified, ten⁵ use their discussion of trends and drivers to create outcomes, in the form of scenarios or 'worlds'.⁶ The aim of this section is to identify relationships between the drivers used in the studies, the method employed and the outcomes produced. A summary table of those studies that produced outcomes can be found at annex F.

5.2 Review Approach

The review had three stages:

- Assessing the degree of common use of drivers.
- Evaluating whether the dominant drivers selected affect the outcomes.
- Examining whether the common use of a method leads to shared outcomes.

5.3 Scope and caveats

5.3.1 In the time available this review focused upon the ten core studies that generated outcomes.

5.3.2 The level of available information relating to the methods employed in each study to generate their futures is not consistent. Two of the ten studies did not provide explicit details about the methods used.⁷

5.3.3 Concerning the timeframe of this assessment, the outcomes discussed in this section look out to the 2050 timeframe. Although some of the studies elaborated scenarios further into the future⁸ it was felt that these would not usefully add to this review.

5.3.4 Finally, the majority of studies assessed here developed explorative scenarios, that is, those that portray outcomes that seem plausible extrapolations from the current trends. There were also some normative scenarios, those that describe the hoped-for future: these have not been addressed in this section.⁹

⁵ The ten studies are: Which World?; ECFSU 2010 Drivers; Insight; CIA World in 2015; Chatham House Open Horizons 2020 Scenarios; OUBS Millennium Project; Shell Global Scenarios 1998-2020; Madingley Scenarios; USAF 2025 Project; UNU Millennium Project.

⁶ The Insight report distinguishes between 'macroscopic descriptions of the systemic behaviour of international security, which we call "*worlds*", and detailed instantiations in a specific time or place, which in line with UK MOD usage, we term *scenarios*' [6 p.115].

⁷ The web pages for Which World? and the OUBS Millennium Project did not include an explanation of their methods.

⁸ As part of the UNU Millennium Project factors were collected that it was felt might significantly affect the future of humanity in the next 1000 years. These were developed into six scenario sketches to the year 3000.

⁹ The UNU Millennium Project developed a normative scenario set in 2050 with three alternative themes.

5.4 Degree of common use of drivers

5.4.1 Earlier sections of this report discuss which driver sets each study created in order to distil future trends. When generating outcomes based on these trends, some studies designated particular drivers as dominant. Others chose to depict the interactions of them all. The numbers of dominant drivers range from an all-encompassing seven to a minimum of two. However, there is some commonality that may be drawn out using the key driver set identified earlier in this report:

- 'International and national governance', is a key theme in all of the core studies.
- 'Economics' and 'technology' appear as dominant drivers in the majority of core studies.

5.4.2 As well as dominant drivers that are encapsulated by the key driver set, some studies have included additional dominant drivers with particular significance for either their organisation or the purpose for which the outcomes are intended. For example, the ECFSU study includes 'Enlargement of the EU' as one of its drivers, relating to its concerns about the future of Europe. While the issue of institutional bias and framing is outside the scope of these questions, it could provide additional insights into the futures generation process (see paragraph 5.10).

5.5 Do the dominant drivers selected affect the outcomes?

5.5.1 Reading across the ten core studies, there is some degree of similarity between a number of the outcomes described. The following section illustrates such instances and assesses whether this can be explained by commonality in the dominant driver set. Similar outcomes include the following:

5.5.2 **Increased division between the rich and poor, the haves and have-nots:** This is evident in terms of financial wealth (in the UNU's 'The Rich Get Richer', the ECFSU's 'Triumphant Markets', Which World's 'Fortress World', Insight's 'Web of Nations', USAF's 'Halves and Half-Naughts' or the CIA's 'Pernicious Globalisation'). Also with regards to information and access to technology (in the Madingley's 'Find my way'). All of these studies include 'international and national governance' as a dominant driver, and with the exception of the Madingley scenarios, 'economics' was also dominant. This suggests a strong correlation between these two drivers and this outcome. However, this is not to suggest that this is the only reason for this similarity, as there is considerable divergence between the other drivers used in the scenario generation.

5.5.3 **The empowerment of the individual to the detriment of institutions:** This appears in a number of scenarios. In the Madingley scenario 'Find my way', individual choice is exhibited through Internet groups and a mistrust of institutions. This idea is echoed in the Which World? 'Transformed World' scenario. In a number of the ECFSU scenarios (including 'The Hundred Flowers' and 'Shared Responsibilities'), public opinion and pressure are important dynamics. Similarly, in the Shell scenario 'People Power' the empowerment of the individual has resulted in considerable fragmentation and volatility. Again it is possible to discern some convergence between the drivers used. The ECFSU use a 'social cohesion' driver, Shell assesses the 'forces of wealth, choice and education', Which World? depicts 'social and political trends' and the Madingley scenarios consider 'social and cultural change'. With the exception of the ECFSU, 'technology' is a dominant driver common to these core studies.

5.5.4 **Changing global political-economic dynamics:** These are manifest in some of the scenarios. In the UNU 'Trading Places' and USAF 'King Khan' scenarios, the Asian governments come to politically and economically dominate Europe and the US. Both these studies use a very similar driver set (see section 5.7.3.3). Similarly, both the CIA's 'Post-Polar World' and the ECFSU's 'Turbulent Neighbourhood' present outcomes where China and Japan are jockeying for a position in Asia. The common dominant drivers used by these four studies are 'international and national governance', 'economics' and with the exception of the USAF study, 'social change'.

5.5.5 As the illustrations above demonstrate, in some instances, a relationship may be traced between the dominant drivers used and the outcomes generated. However, this does not provide the complete picture.

5.6 **Methods used**

The main methods used to generate futures are listed below together with the studies that used them.

- 2 or 3-dimensional Boston matrices of dominant trends (Chatham House, USAF, UNU, Insight);
- Creative workshops (CIA, Shell, Madingley);
- Shaping Actors-Shaping Factors / mini scenarios (ECFSU);¹⁰
- Field Anomaly Relaxation (FAR) technique (Insight);¹¹
- Computer modelling (UNU).¹²

5.7 **Does common use of a method lead to shared outcomes?**

5.7.1 Table 14 below summarises the relationships between similar outcomes and the common drivers and methods used.

5.7.2 Taking in turn those methods used by more than one study it is possible to investigate similarity in outcomes.

5.7.3 **Boston Matrices (2D and 3D)**

5.7.3.1 Boston Matrices were the most widely used method among the core studies. It involves identifying a number of dominant drivers (normally either two or three) and assessing how the possible combinations might interact to produce different outcomes.

5.7.3.2 Table 15 below depicts the dominant drivers extrapolated by the four core studies that used the Boston Matrix technique within their scenario generation method. The similarity between the chosen drivers is immediately obvious by reading across the (top three) rows of the table. Furthermore, as revealed in earlier sections of this report, the scenario-building community is generally working with a common set of trends and drivers.

¹⁰ The European Commission Futures Studies Unit, designed this method that produces partial, theme-specific scenarios that were then integrated into global scenarios.

¹¹ The Insight Project used this method to eliminate (or relax out) from the complete spectrum of possible outcomes, the combinations of outcomes that are inconsistent via pairwise comparisons.

¹² The UNU Millennium Project used a computer model (*International Futures*) to provide a quantitative backbone to their scenarios (created by 3D matrix) and ensure internal self-consistency.

Outcome	Common Drivers	Scenarios	Method Used
Increased division between rich and poor	International and national governance & Economics	UNU <i>Rich Get Richer</i>	3D Matrix
		ECFSU <i>Triumphant Markets</i>	Shaping Actors-Shaping Factors
		Which World? <i>Fortress World</i>	Not known
		Insight <i>Web of Nations</i>	3D Matrix / FAR
		USAF <i>Halfs and Half-Naughts</i>	3D Matrix
		CIA <i>Pernicious Globalisation</i>	Workshop
Empowerment of the individual	Social change & Technology	Madingley <i>Find My Way</i>	Workshop
		Which World? <i>Transformed World</i>	Not known
		ECFSU <i>Hundred Flowers & Shared Responsibilities</i>	Shaping Actors-Shaping Factors
		Shell <i>People Power</i>	Workshop
Changing global dynamics	International and national governance & Economics & Social change (with exception of USAF)	UNU <i>Trading Places</i>	3D Matrix
		USAF <i>King Khan</i>	3D Matrix
		CIA <i>Post-Polar World</i>	Workshop
		ECFSU <i>Turbulent Neighbourhood</i>	Shaping Actors-Shaping Factors

Table 14 - Summary of relationship between outcomes, drivers and methods

Study	Key Driver	Chatham House Open Horizons 2020 Scenarios	USAF 2025 Project	UNU Millennium Project	Insight
Drivers	Economics	Economic renewal	World Power Grid	Economic vitality	Globalisation of economic systems
	International governance		American World View	Level of harmonisation in world	Alliances and alignments
	National governance	Managing society		Social focus	Coherence of politics
	Science and Technology		ΔTeK		

Table 15 - Dominant drivers used in Boston matrices

5.7.3.3 Two similar outcomes have been generated by USAF 2025 and the UNU Millennium Project:

- Both the USAF 'King Khan' and UNU 'Trading Places' present a world where the current US and European dominance in political, economic and military terms has been surpassed by an Asian 'colossus' (China, Taiwan, Malaysia, Singapore and Hong Kong).
- Similarly, both studies postulate a future with a pronounced contrast between the 'haves' and 'have-nots', the USAF 'Halfs and Half-Naughts' and the UNU 'The Rich Get Richer'.

5.7.3.4 With the exception of these two examples, there is no additional correlation between the outcomes generated by studies using Boston matrices.

5.8 Creative workshops

5.8.1 These were used to develop the Madingley scenarios. Similarly, the Shell scenarios used facilitated strategy workshops to discuss the implications of the scenarios. The CIA 2015 project's scenarios were developed in a workshop environment where seven key drivers were assessed for potential interactions. As a technique for the generation of outcomes, 'creative workshops' is a very broad remit and it is therefore difficult to draw satisfactory comparisons between the outcomes in terms of the types of method employed. However, assessing the dominant drivers in table 16 below reveals a significant degree of convergence.

Study	Madingley scenarios	Shell scenarios	CIA 2015
Drivers	New technologies and more information	Technology	Science and technology
	New power structures	Liberalisation	Governance
	Social and cultural change	Choice	Social and cultural identities
	Living environment		Natural resources
		Globalisation	Global economy
		Education	Demography
		Wealth	Conflict

Table 16 - Dominant drivers used in workshops

5.8.2 Both the Madingley 'Find My Way' and Shell's 'The New Game' describe outcomes where new institutions have emerged.

5.8.3 In addition to Boston matrices and workshops, other methods were used to generate outcomes. However, as they were only used by single studies, they will not be considered further in this review.

5.9 Impact for futures generation

5.9.1 **'Dominant' drivers:** There is a considerable degree of convergence in the dominant driver set used to focus the development of outcomes for futures studies. Although the studies differed in the number of dominant drivers chosen, there are three that proved to be key across the set of studies: international and national governance; economics; and technology.

5.9.2 **Do the dominant drivers selected affect the outcomes?** Although there is some degree of correlation between the drivers used and the outcomes produced, this does not by itself adequately explain all instances of convergence of outcomes across the studies analysed. An analysis of other factors (for example, potential institutional framing bias) will be needed to understand the remaining differences between the studies' outcomes (see paragraph 5.10).

5.9.3 **Does the common use of a method lead to shared outcomes?** There are a number of different approaches that may be taken to generate future worlds or scenarios. However, the most popular method involved using two or three-dimensional Boston matrices to explore possible interactions of the chosen dominant drivers within the 'strategic planning space' (a term coined by the USAF study [13 p. 4] to bound 'what the study participants believe to be all the relevant

possible outcomes'). Some similarity in outcomes was noted where the same method and driver set were used. However, not all outcomes generated using the same method and driver set were similar. Hence use of the same driver set and method appears to lead to some commonality between studies, but each study will produce individual outcomes not seen in others.

5.10 Scope for further work

- 5.10.1 A further, more sophisticated analysis of futures generation methods and outcomes would probably lead to a greater understanding of the remaining uncertainties highlighted above. For example, an additional approach would involve clustering the outcomes and then looking at whether or not they were derived from the same or similar methods. If the approaches were alike this would suggest the interesting conclusion that the outcomes were a product of a common approach. If the approaches employed varied within each similar outcomes cluster, this would suggest a robustness of the results to the methods chosen i.e. that the consistently similar scenarios had been produced by a variety of methods.
- 5.10.2 A further dimension that might also be explored is the issue of possible institutional framing bias. Some of the studies analysed (including CIA, USAF, Insight and ECFSU) are from similar backgrounds that may be broadly grouped under the umbrella of a 'political' cluster of studies. By comparing their outcomes with the other studies, it would be possible to see to what degree the studies' institutional backgrounds have coloured or 'framed' or biased the futures generated, or focused the choice of dominant drivers.

6 Use of Strategic Futures material in policy and strategy development

6.1 Aim

This aim of this section is to provide a very short guide to using the material both in this report and in other futures studies – including those reviewed here. This report has highlighted a number of possibilities for the future, classified by driver headings and containing simple reliability statements upon which to make assessments. Reliability apart (since the final ‘proof of the pudding’ is in the future) how can futures studies:

- Avoid paralysis by analysis?
- Begin to use the uncertainty inherent in speculations about the future to advantage – aiding those interested in the development of strategies and policies that are *robust* (see section 2.6.4) against future contingencies?

6.2 The ‘So what?’ test

6.2.1 This report has looked at some possibilities or probabilities and even put a degree of structure on uncertainties about the future in the driver matrices above. So what? In themselves, these statements or predictions or projections are of little use and are open to critique by all as no one has a monopoly on knowledge about the future. To be of value, and not simply paralyse with uncertainty, futures studies need to understand how these different factors may act and interact to produce outcomes that have a meaning for those conducting the studies and the world in which they live.

6.2.2 **Question:** How can futures studies use these strands constructively to produce coherent visions of the future against which policies, plans and strategy can be tested?

6.2.3 **Answer:** Techniques of scenario planning are one way. A scenario can be considered to be a coherent and defensible picture of the future (see annex C for desirable attributes of scenarios). Scenario planning has been defined as ‘that part of strategic planning which relates to the tools and technologies for managing the uncertainties of the future’ [32 p.2]. Although it is possible to work with just a trend or two, using more in a scenario provides richer outcomes. Drivers help in the sorting of themes: keeping some constant whilst varying others - to explore the uncertainty in those.

6.3 Using Strategic Futures material for policy and strategy development

6.3.1 **Why use scenario-based planning?:** Three clear reasons are:

- As a springboard for creative thinking about threats and opportunities.¹³
- To build consensus and buy-in for a policy line through its mutual development.
- To test the robustness of a policy, plan or strategy against a number of agreed excursions.

The first two of these have to be participative and travelling together is as important as arriving. The last one could be done ‘remotely’.

¹³ But not legitimately to identify all alternatives. See [33].

6.4 Putting it all together

As well as chapter 2's guidance and suggested best practice on the management of uncertainty in the sources and outputs of futures studies, there are several key texts (e.g. [32, 35]) on what is required to undertake scenario based planning and how to integrate this into a strategic planning process. Whilst the reader needs to be aware of the considerable body of literature in this area, some clear points to consider in summary are:

- The need for iteration, to move towards answers through repeated attempts and several steps.
- The need to revisit at a later date, to scan the environment for changes that might affect the robustness (see section 2.6.4) of policies, plans and strategies.
- The need to gain the buy-in of the ultimate users (and their senior management) of the work – so that there is an acceptance of the process and the scenarios and outcomes generated. This has implications for whether and how the results (trend-driver material and outcomes) of others' futures studies can be used in one's own organisation.

7 Conclusions

7.1 What we have done

This study has completed the review and analysis of strategic Futures work commissioned by the PIU. The literature review covered 51 studies: a mix of work by UK and international teams, from government, academia, strategic-level institutes and the private sector. It focused in more detail upon thirteen core studies that had sufficient breadth from which to adduce a minimum essential set of six overarching key drivers for change.

7.2 Assessment of Futures work

7.2.1 Most Futures studies appear to have used a working model along the lines of: Input data ⇒ Trends & Drivers ⇒ Outcomes ⇒ Predictions & Explorations:

- **Input data:** Observations, raw data, empirical evidence, sources etc. that are then analysed / synthesised to produce trends. An example of input data would be mean summer temperatures for the last 50 years.
- **Trends:** Trajectories, extrapolations, projections, and possibly even predictions, which are continuous and (usually) monotonic. An example trend would be 'The increasing proportion of the World's population living in developing countries'.
- **Drivers:** Used here to identify the meta factors or groups of trends that share a common theme. An example would be 'Demographics'.
- **'Wild cards':** Discontinuities or (relatively) abrupt changes of particular significance, these include potential catastrophes and other high-impact, low-probability events. An example would be the Chernobyl accident.
- **Outcomes:** A generic term for predictions, future 'worlds' and scenarios. These usually draw on a number of trends and events.

7.2.2 The clear picture to emerge is one of considerable difference between the studies in the manner by which they have undertaken their analysis and the degree to which it is explicitly documented. Only six of the core studies explicitly documented the method used. The scenario-based approach was common: ten studies generated at least two scenarios each.

7.2.3 Treatment of uncertainty in inputs, identified trends and outcomes (possible scenarios or 'worlds' extrapolated from trends) is naturally an important element in all futures work. An encouraging eight of the thirteen core studies made explicit statements on the uncertainty inherent in the inputs. Similarly, all of the core studies made at least some statement – even if very general – on uncertainty in the outputs. Some studies went into more useful detail, providing either indicative confidence limits or dividing the outcomes into the relatively fixed and uncertain. However, one made statements in a way that implied no – or minimal – uncertainty. All but one study included explicit discontinuities or 'wild cards' in their analysis.

7.2.4 Some of the trends identified are (narrow or one-dimensional) predictions in their own right. Probability and confidence estimates, pulled through from inputs, may be made and, provided the assumption that other trends and drivers do not interact is valid, may be meaningful. Sometimes trends and drivers are combined (or uncertainty is expressed) by producing richer outcomes (scenarios or worlds) as a result of several interacting trends. This type of exploration may encompass

some or all input uncertainties – although it is usually not explicit and making probability estimates of a particular ‘world’ occurring is meaningless.

7.2.5 The elicitation of trends and drivers is only part of the futures generation process. Most of the core studies reviewed created outcomes, in the form of scenarios or ‘worlds’. There was a strong convergence across the studies in the drivers they chose to develop the outcomes, the most common being international & national governance, economics and technology. There was some correlation in outcomes across studies when the same method and driver set were used, although each study produced outcomes not seen in others. In the usually very participatory activity of generating scenarios and worlds, it appears to be more valuable to generate one’s own rather than use those from another study. This tends to promote the following success factors: gaining buy-in from the end-users and their senior management; and the ability to revisit (one’s own) outcomes.

7.2.6 Various methods were used, although two- and three-dimensional Boston matrices seem to have been the most popular. It has been difficult to undertake a fully balanced uncertainty assessment due to the inconsistent quality of the published material: for example, some of the studies provided little explicit documentation of their methods. This could be due to editing for the intended readership, and/or to accidental or deliberate obscuration of the process, e.g. to prevent proprietary methods from transferring into the public domain.

7.3 Key drivers for change

7.3.1 The core studies identified several dozen trends that are going to shape the global future. There is reasonable – albeit not universal – agreement across the published work of the reviewed studies in the shape and direction of these trends. Analysis and cross-correlation showed that the trends could be grouped thematically into the following minimum set of key drivers (not in any priority order):

- Demographics.
- Environmental Change.
- Economics.
- Science and Technology.
- National and International Governance.
- Perceptions, Beliefs, Values and Attitudes.

7.4 Robust futures

7.4.1 One of the clearest overall deductions that can be drawn from looking across the driver set is that it appears that those in the developing world will continue to suffer. They will be more likely to experience a lack of wealth and food and experience starvation, more extreme weather, more pollution, scarce water supplies and they could potentially be denied access to IT technology while the developed world will continue to thrive economically and technologically. However, the greying of populations in the developed world may well go some way to redressing the balance as the developed world comes under increasing strain in other areas. Obviously, one way of reducing the strain on both worlds would be to create a managed migration of young people from the developing world to the developed world. However, this would be a massive task to undertake and not without problems of its own.

7.4.2 Another common theme revolves around the continuing fragmentation and devolution of the nation state together with empowerment of non-state or trans-state groups and ever more permeable national borders. In the developed countries, at least, a tendency towards post-modernist values concentrating on benefit to the individual or close social grouping could reinforce increasing distrust in, and detachment from, traditional government and the electoral process.

7.4.3 Just over half of the core studies originated in the domains of security of international politics. This is unsurprising, since ‘environmental scanning’ for trends that might lead to risks to a nation’s wider interests is very much part of their everyday business. We do not believe that this has led to significant bias in either identifying the drivers comprising the minimum key set or in the global trends within them. Futures work that concentrated on a near-term national or even departmental focus would be expected to have a different balance of trends within the drivers.

7.5 Utility of this work to policy makers

7.5.1 **Policy makers should not use this report to infer a consensus for any quantitative prediction for a particular trend. If such predictions are required then specific studies (modelling) should be considered on their own merits.** There is a considerable diversity in the degree to which the reviewed studies have addressed the uncertainty in their identified trends and outcomes (possible scenarios or ‘worlds’ extrapolated from trends). Additionally, most of the published work makes only qualitative statements about the outcomes or, where quantitative data are given, their format is different between studies.

7.5.2 **This report lists qualitative trends that form a relatively robust and comprehensive base from which to generate strategic scenarios or ‘worlds’ to inform policy development or to test strategy and plans.** There is a consensus on the most important global drivers for change and reasonable – but not universal – agreement on the nature and direction of the trends within each driver.

7.5.3 **This report presents a technical assessment of the approaches used by the core Futures studies against best practice.** Several of the scenarios, worlds and even findings produced by the core studies could be re-used by policy makers. However, it is important to be aware of the methodological strengths and weaknesses of each study, as well as its original purpose, before trying to apply it in another domain.

7.5.4 **It is important for policy makers to remember that, even when derived from defensible trends, a scenario or world produced by the futures generation process is just that; a future, not *the* future.** Some futures are more plausible than others, but the interactions between different trends in the real world makes a formal assessment of their likelihood impossible. Robust policy will remain valid over a broad reach of possible scenarios and, where possible, will insure against the major discontinuities or wild cards. It will generally be more coherent to have an agreed overarching set of scenarios within which Departments can develop in more detail those aspects of particular relevance to them.

A Glossary of terms

AI	Artificial Intelligence
backcasting	Taking a specified future point (see <i>normative scenarios</i>), backcasting involves creating a sequence of events from this future point backwards in time, usually to the present.
CFCs	Chloro-Fluoro Carbons
CIA	Central Intelligence Agency
convergent trend	Where a trend is 'convergent' that is where the source material is in agreement about how this trend is proceeding. See also <i>divergent trend</i> .
core studies	Those studies with sufficient breadth from which we could adduce a minimum essential set of six overarching key drivers for change. See also <i>sectoral studies</i> .
DERA	Defence Evaluation and Research Agency
divergent trend	If there is disagreement in the source material on the nature of the trend, then it is labelled 'divergent'. See also <i>convergent trend</i> .
drivers	Used here to identify the meta factors or groups of trends that share a common theme. An example would be 'Demographics'. See also <i>key driver set</i> .
ECFSU	European Commission Forward Studies Unit
ESAs	Empowered small agents
EU	European Union
events	(Relatively) abrupt changes of particular significance, these include potential catastrophes and other high-impact, low-probability events, sometimes termed 'wild cards'. An example would be the Chernobyl accident.
exploratory scenarios	Exploratory studies seek to look forwards, into the future, to explore the range of (exploratory) scenarios that describe (a subset of) the perceived future uncertainties. [16 – annex F] See also <i>normative scenarios</i> .
input data	Observations, raw data, empirical evidence, sources etc. that are then analysed / synthesised to produce trends. An example of input data would be mean summer temperatures for the last 50 years.
IT	information technology
key driver set	<i>Drivers</i> that are cited in most of the existing studies, in one form or another.
method	The manner in which techniques and tools fit into the whole research project to approach a problem. (Derived from [36].)
MOD	Ministry of Defence
NGOs	Non-Governmental Organisations
NHS	National Health Service

normative scenarios	Unlike <i>exploratory</i> scenarios, a (single) desirable end state is specified and <i>backcasting</i> creates a sequence of events from this future end state backwards in time, usually to the present. [16 – annex F]
OECD	Organisation for Economic Co-operation and Development
OUBS	Open University Business School
outcomes	A generic term for predictions, future ‘worlds’ and scenarios. These usually draw on a number of trends and events.
PIU	Performance and Innovation Unit, Cabinet Office.
RIIA	Royal Institute of International Affairs
RMA	Revolution in Military Affairs
sectoral studies	Those studies that tended to be more focused on only one or a few issues (unlike the <i>core studies</i>) and contributed trends that could be accommodated within the driver set.
trends	Trajectories, extrapolations, projections, possibly even predictions, which are continuous and (usually) monotonic. An example trend would be ‘The increasing proportion of the World’s population living in developing countries’.
UNU	United Nations University
USAF	United States Air Force
wild cards	Sudden and shocking events that have a low probability of arising but a potentially very high impact.
WMD	Weapon(s) of Mass Destruction

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C Uncertainty Management Best Practice - addendum

This annex contains those elements of the best practice which focus on detailed aspects.

C.1 Scenario construction

C.1.1 **Desirable attributes of scenarios:** There are a number of desirable attributes that should be sought when constructing scenarios. These include:

- Self-consistency [15 p.1, 34].
- Plausibility [16 pp.i, 6]. 'A balance has to be struck between scenarios which appear plausible because they extrapolate current trends, and those which represent a break with the past and are deliberately more challenging to the conventional wisdom.' The challenge is to create a set of scenarios that are 'clearly separate and distinctive, but which [do] not break all bounds of plausibility'.
- Coherence (systematicity) [16 p.3].
- Relevance (to decision-making – identify the target audience), consistency (based on coherent assumptions), credibility (not over-estimating the rate of change), transparency (clear exposition of assumptions, clear methodology to allow comparisons between studies) [16 pp.4,34]. On relevance, it should be noted that 'small businesses addressing an unchanging world have a very different set of needs from large activities for which the world is constantly changing' [2].
- Breadth to 'cover a range of alternative outcomes which is sufficient: to make people think about the future; to present options; to examine the robustness of long-term strategies; and to indicate the boundaries of risks and chances' [16 p.4]. Any postulated 'base case' scenario should be accompanied by a statement on the advantages and disadvantages of declaring this particular scenario to be so assessed, together with encouragement to challenge the base case and think about the factors that could lead to alternative futures [20 p.3].
- '[Highlighting] key uncertainties, discontinuities, and unlikely or "wild card" events, and identifying important policy ... challenges' [4]. The listing of potential radical changes as 'wild cards' [20 p.3] or 'sideswipes' [16 p.3] or 'surprises' [16 p.36] can sensitise future decisions to these unlikely but severe outcomes. However, the 'roots of the disaster [should be] in the scenario logic' [2] for them to be credible. It is common for these wild cards to be described only in outline and set aside from the main scenario development.
- Openness and participation can aid the acceptance (buy-in) by the customer and stakeholders of the work that is based upon the scenarios [15 p.4].
- Where possible, equivalent effort should be allocated to creating each scenario [16 p.6] (with the exception of wild cards, see above).
- Non-preferential: If the scenarios are derived in as unbiased a manner as possible and are of a sufficiently broad number, it is possible / likely / desirable that the scenarios should not have been constructed to include de facto preferences. There should not be a suggestion from the scenario descriptions themselves (as opposed to analysis of the consequences of the scenarios) that decision-makers should try to steer towards any one of these scenarios [7].

- The presence of a narrative or storyline to explain the look and feel of the scenario to the reader in as clear and unambiguous a form as possible. Where appropriate (e.g. where the scenario will be used as the building block for more detailed (usually lower-level) work leading to modelling), the use of quantification to indicate the distinct features of the scenario.
- C.1.2 **Dimensions:** It is common to generate the scenarios by varying values of (orthogonal) dimensions: the practitioner's craft is in choosing the number of dimensions and the number of values on each [34]. Clearly, the more dimensions and the more values, the greater the number of scenarios. Undertaken without care this number would spiral and become unmanageable and it has hence been suggested that '[scenario] analysis is more useful when examining a particular issue or policy area' [10]. One option to reduce the number of scenarios examined is to select a (best) subset of the scenarios [16 p.35]. See sensitivity analysis in section 2.6.3 above.
- C.1.3 **Grounding:** Some methods ground their scenarios in the real world; others generate them from a set of conceptual associations (see e.g. [34, 15 p.5]).
- C.1.4 **Exploratory / normative:** Exploratory studies seek to look forwards, into the future, to explore the range of scenarios that describe (a subset of) the perceived future uncertainties. However, an alternative approach is the *normative* one, where a (single) desirable end state is specified and 'backcasting' creates a sequence of events from this future end state backwards in time, usually to the present [16 – annex F]. Users of analysis grounded on normative scenarios need to be especially careful to ensure that the scenarios created meet their needs, since generating a single future scenario is less robust (see section 2.6.4 above) than the exploratory approach which creates several scenarios.
- C.1.5 **Future decisions:** As described above, some methods pre-empt selected future decisions in order to reduce the degree of future complexity. In scenarios analysis it is instead better if the scenarios do not include 'adaptive responses' to future changes that might be made, but 'vulnerability and the *capacity* to adapt' are included [16 p.3].
- C.1.6 **Biases:** When constructing the scenarios it is advantageous to be conscious of having brought one's own frame of reference and '[looking] for ways of exposing what seems – systematically – to be unanticipated by many futurists' by comparing previous forecasts with the present. There exist 'some assumptions which were common to many of the forecasts that turned out wrong' [2]. When examining scenarios constructed by others it is prudent to recognise where possible any common and reinforcing perceptions that have been promoted by analysts with common values and with access to the same sources [2].
- C.1.7 **Testing:** Where possible, it is useful to test the scenarios. This is not a test that the scenarios are creating *a correct (singular) view of the future*. Rather, it seeks to verify that the scenarios fulfil some / all of the desirable attributes described above, but particularly that they are useable, self-consistent, fit for their intended (visioning / exploring) purpose and to permit constructive criticism to inject new ideas [16 pp.2,35]. The testing might be through an immersive experience where participants role-play or act out the scenarios to see how they feel [20 p.3, 37].

D Scoring of studies against uncertainty management best practice criteria

Study	Canadian National Defence Dept Military Assessment [1]	Chatham House 2020 Scenarios [2]
Sources (textual and human)		
Explicit criteria for ID, selection, use	Not in [1].	No.
Listing of sources	Not in [1].	No.
Combination of research types	Unclear from [1].	Unclear.
Review of previous work conducted	Unclear from [1].	Builds on own previous work.
Statement of uncertainty in inputs	Unclear what the inputs are (see above).	Not explicit. Stated 3 sources of complexity (not uncertainty).
Analysis		
Method documented	No.	Not explicit, though there is a listing of key assumptions and a statement of 3 pillars of progress. Text included on how to do scenario planning.
Statement of outputs purpose	To stimulate 'thought on the future requirement for, and possible shape of, the Canadian Forces as it confronts the future' [1].	To 'produce new scenarios to help us all consider how, by the year 2020, Britain and the world in which it operates will be strikingly different from today' [2 p.vi].
Statement of uncertainty in outputs	Not intended to be definitive or predictive. Recognises difficulty in undertaking long-range assessment and that uncertainty will 'defy precise characterisation' but aims to provide 'insurance against surprise' [1].	'Bars [on scenarios overview table] suggest the up- and down-side of these cases.' [2 p.17]. Accompanying paper ('SHOCKS AND PARADIGM BUSTERS - or, why do we get surprised?') reveals research into previous futures studies shows 4 major recurring sources of error.
Dimensions and spread of uncertainty illustrated	Identifies 9 major sources of change (drivers) [1].	2 key issues (economic renewal and managing society).
Scenario breadth	N/A – scenarios not developed.	3 ('two are in the success mode, while the third is one of failure' [2 p.3].
Tests for self-consistency, coherence	N/A.	None apparent in main text (method not explicit).
Discontinuities / wild cards	Yes (one – use of WMD).	Not apparent from (what can be inferred about) method nor scenarios, though accompanying paper on 'Shocks and paradigm busters' gives general details (not specific to this study) – see above.
Equivalent effort across scenarios	N/A.	Yes.
Scenario narratives	N/A.	Yes.

Table D-1 (part 1) – rating of core studies against uncertainty management guidelines

Study	CIA Global Trends 2015 [4]	ECFSU 2010 Drivers [5]
Sources (textual and human)		
Explicit criteria for ID, selection, use	Not explicit for textual sources. [4] described use of 'a range of non-governmental institutions and experts.'	Not stated.
Listing of sources	Some interviewees listed. No textual sources listed.	Yes [5 pp.109-117].
Combination of research types	Yes – workshops and from [4] it appears <u>probable</u> use of textual sources for trends.	Yes.
Review of previous work conducted	Refers to previous CIA study.	Yes [5 pp.53-73].
Statement of uncertainty in inputs	'The [judgements about demography and natural resource trends] are projections about natural phenomena, about which we can have fairly high confidence; the [other judgements] are more speculative because they are contingent upon the decisions that societies and governments will make' [4].	Yes – qualitative discussion of relative uncertainty across the drivers [5 pp.53-73].
Analysis		
Method documented	Series of workshops and interviews described in outline. [4] states 'The methodology is useful for our purposes, although admittedly inexact for the social scientist.'	Yes. [5 pp.87-92]
Statement of outputs purpose	Aim was 'to identify major drivers and trends that will shape the world of 2015... to rise above short-term, tactical considerations and provide a longer-term, strategic perspective' [4].	Aim was to produce 'a set of coherent and thought-provoking images of how the future of Europe might look ... [for reflection] on the changes ... and on the options' [5 p.9].
Statement of uncertainty in outputs	Identifies: no single dominant driver; variation across the globe; complex interactions of drivers. States 'we can make projections with varying degrees of confidence and identify some troubling uncertainties of strategic importance to the United States.'	Yes. 'Scenarios are not, and cannot be, either a projection of the future, or a prediction of the likelihood of a certain outcome.' [5, p.10]
Dimensions and spread of uncertainty illustrated	Scenario dimensions (effects of globalisation, nature of regional conflict).	Only through use of scenarios and use of 'pivot variables' that are highest in uncertainty and impact [5 p. 88].
Scenario breadth	4 scenarios (see above).	5 global scenarios from 25 partial scenarios and more minis.
Tests for self-consistency, coherence	None apparent – method described in outline only.	Partial scenarios (theme-specific) are based on plausible combinations of mini-scenarios by considering the pivot variables. In turn, global scenarios are selected as consistent combinations of partial scenarios [5 pp.87-92].
Discontinuities / wild cards	Yes.	'Possibility of shocks' incorporated in initial lists of factors [5 p.88].
Equivalent effort across scenarios	Yes.	Yes.
Scenario narratives	Yes.	Yes.

Table D-1 (part 2) – rating of core studies against uncertainty management guidelines

Study	Insight [6, 38, 39, 40, 41]
Sources (textual and human)	
Explicit criteria for ID, selection, use	Interviewed '100 key people including politicians, diplomats, academics, industrialists and technologists' [6 p.7].
Listing of sources	Listing of people consulted [6 pp. iii-vi]. List of textual sources in each driver in [6] and in focused case study reports [38, 39, 40].
Combination of research types	Yes.
Review of previous work conducted	One focused study was commissioned conducted a bibliographic survey of relevant material.
Statement of uncertainty in inputs	Range of views in each of the drivers with 'wide, and sometimes irreconcilable differences of opinion among experts' [6 p.17].
Analysis	
Method documented	5 approaches are outlined [6, pp.95-96] and 1 is demonstrated [6, pp.97-101] for combining trend-driver material into outcomes. Two scenario construction approaches are illustrated [6, pp.115-121] An extra method was described in [41].
Statement of outputs purpose	To 'establish the key drivers which are likely to influence global security from around 2015 until the middle of the [21 st] century ... [not to] produce a definitive view of future political/security events' [6 p.1]. 'It can never be a complete process giving a definitive result or method' [6 p.137].
Statement of uncertainty in outputs	'[P]redicting the future <i>in detail</i> is inherently impossible beyond a short window' [6 p.4].
Dimensions and spread of uncertainty illustrated	A variety of dominant trends were used to illustrate 1 approach. Divergence of opinions on trends documented.
Scenario breadth	The first scenario construction approach generated 4 candidate / example worlds. The second approach (Field Anomaly relaxation – FAR) generated a tree containing dozens of intermediate worlds ending in 5.
Tests for self-consistency, coherence	The second scenario construction approach (FAR) involves tests for consistency across the parameters.
Discontinuities / wild cards	Yes.
Equivalent effort across scenarios	Yes (within each of the scenario construction approaches).
Scenario narratives	Yes- though FAR's transition sequences need interpreting.

Table D-1 (part 3) – rating of core studies against uncertainty management guidelines

Study	Madingley Scenarios [7]	The Future Strategic Context for Defence (MOD) [8]
Sources (textual and human)		
Explicit criteria for ID, selection, use	No.	Not stated.
Listing of sources	Yes. Selected bibliography given. Scenario building workshop participants listed.	Spot referencing only; no overarching list in [8].
Combination of research types	Yes.	Unclear from [8].
Review of previous work conducted	Yes.	Unclear from [8] though states it builds on previous MOD work.
Statement of uncertainty in inputs	Recognition of growing complexity leading to uncertainty. Recognition that the 4 key drivers have different degrees of (un)certainity and lists key uncertainties in each driver and 'surprises'.	Recognises that the paper contains 'judgements about the future with which many will disagree. Inevitably events will prove some of our judgements to have been wrong' [8]. Notes uncertainty in some inputs – e.g. rate of global warming and complexities of other issues (e.g. intra-China) that renders 'forecasting ... developments hazardous' [8].
Analysis		
Method documented	Yes.	Not stated in [8].
Statement of outputs purpose	Aim: to stimulate debate and basis for testing NHS strategies.	To 'provide a strategic context which will influence our internal planning for defence' [8].
Statement of uncertainty in outputs	Summary of 'relatively fixed points' and 'key uncertainties' [7].	Recognition that confidence decreases the further ahead in time one looks, and that near-terms trends analysis is more robust than long term ones. Paper's aim is not one of prediction [8].
Dimensions and spread of uncertainty illustrated	'The differences between the scenarios are created by considering differing outcomes of the relative uncertainties' [7].	Paper has 7 dimensions (drivers) and discusses developments and trends within these.
Scenario breadth	2 scenarios. Used creativity to describing 2 worlds - equally likely, attractive, and worrying.	N/A – scenarios not developed.
Tests for self-consistency, coherence	None listed in [7].	N/A.
Discontinuities / wild cards	No: surprises listed in inputs only.	Recognises that trend-driver analysis does not identify shocks [8].
Equivalent effort across scenarios	Yes.	N/A.
Scenario narratives	Yes: headlines, and per-dimensional summaries.	N/A.

Table D-1 (part 4) – rating of core studies against uncertainty management guidelines

Study	OUBS Millennium Project] [9, 35, 42, 43, 44]	PIU Strategic Future Project [10, 45, 46]
Sources (textual and human)		
Explicit criteria for ID, selection, use	Yes – multinational managers, Government Ministers, leaders of international bodies [42].	Criteria not explicitly stated though implied in [45] that work drew upon broad range of previous work. Criteria for human sources / experts not explicit.
Listing of sources	Individuals consulted listed only by broad type (see above). Bibliography of textual sources [43].	Spot referencing of sources throughout but no overarching list of textual sources used. Human sources described by broad type but no list.
Combination of research types	Yes, but appears dominated by human sources.	Yes: drew upon previous studies and talked to experts [45].
Review of previous work conducted	Yes [43].	Yes – see above.
Statement of uncertainty in inputs	Not explicit.	Key certainties and uncertainties identified [10].
Analysis		
Method documented	Series of methods documented in [35]. Includes need to focus upon important uncertainties.	In outline only in [45] and [10].
Statement of outputs purpose	'[M]ap the future across a wide range of topics' [9].	To 'gather ideas about what the world might look like over the next 10 – 20 years' [10].
Statement of uncertainty in outputs	In [9], boldly states 'These predictions are the most accurate ever made. They come from a four-year study involving more than a thousand of the world's largest organisations. Sponsored by the leaders in their various fields – ... this may be the most important, study of the future every undertaken. <i>It describes in graphic detail the future you will soon encounter.</i> ' In [42], states that views are based on those of the contributors – who 'are already <i>shaping</i> [the] future'. Summaries only contain own material, main text includes others'. Strong degree of convergence identified across inputs [42].	Recognised the 'drawback of looking at drivers of change separately is that it does not provide a complete picture.' Then 'tries to present a coherent picture both of what we think we know, and where the key dimensions of uncertainty lie.' 'The discussion ... concentrates on areas ... where significant future advances seem highly probable'. Recognised that it is hard to predict in some areas and that a spread exists from almost to not inevitable [10].
Dimensions and spread of uncertainty illustrated	Assessments given of scenarios' relative likelihoods.	7 dimensions of uncertainty explicitly described. See above for spread of uncertainty.
Scenario breadth	4: 3 optimistic, 1 pessimistic.	N/A - Scenarios not developed.
Tests for self-consistency, coherence	Methods described in [35] contain tests for consistency.	N/A.
Discontinuities / wild cards	'Disasters' discussed and indication that some scenarios 'may be subject to discontinuities' [42]. Some discontinuities within the scenarios [44].	Yes – some shocks listed in [10] and [46].
Equivalent effort across scenarios	Yes.	N/A.
Scenario narratives	Yes (limited direct narrative but supporting discursive material)	N/A.

Table D-1 (part 5) – rating of core studies against uncertainty management guidelines

Study	Shell Global Scenarios 1998-2020 [11]	UNU Millennium Project [47, 48, 49, 50]
Sources (textual and human)		
Explicit criteria for ID, selection, use	No.	Not explicit.
Listing of sources	No (though [11] is only 'a brief "public" overview of scenarios).	Yes for textual sources – bibliography at [48]; human sources not listed explicitly but described as combinations of futurists and scholars in 50 countries [49].
Combination of research types	Unknown.	Yes (see above).
Review of previous work conducted	Refers only to previous Shell work.	Scenario development built on previous work of the project from 1996. Whole 'project <i>is not</i> a one-time study of the future, but provides an on-going <i>capacity</i> as a geographically and institutionally dispersed think tank' [49].
Statement of uncertainty in inputs	Shaping forces (drivers) are postulated, and poses the question as to which will dominate, but no other statement.	{See 'uncertainty in outputs'.}
Analysis		
Method documented	Not explicitly. Can be partially deduced.	Yes [47].
Statement of outputs purpose	'[The] start for customised strategic development.'	A 'context for global thinking' [50].
Statement of uncertainty in outputs	'Scenarios are plausible and challenging stories, not forecasts. They do not ... predict'.	'Uncertainty, to the degree possible, was made explicit. While the model added quantification, it was not used to produce an illusion of "accuracy." but rather to help assure self-consistency' [47]. Recognition that the 'precision available should not mask the fact that the model's output is a direct result of the assumptions that went into establishing the values of the exogenous variables. Small changes in these assumptions might still be consistent with the narratives, but appreciably change the values of the output' [47].
Dimensions and spread of uncertainty illustrated	Only between the dominance of 2 sets of shaping forces (drivers). Certain forces are inevitable.	Only by taking four drivers in the scenario construction. No explicit confidence limits on outcomes.
Scenario breadth	2 scenarios.	4 exploratory scenarios (set in 2025; other exploratory ones set in later timeframes, and normative scenarios, both not under consideration here).
Tests for self-consistency, coherence	None listed in [11].	The model was used 'to help assure self-consistency' of the scenarios [47].
Discontinuities / wild cards	Only mentioned that scenarios help to prepare for these.	Not apparent (top 25 of 180 developments did not include wild cards; neither did the top 24 of 150 'promising developments' [47].
Equivalent effort across scenarios	Yes.	Yes.
Scenario narratives	Yes.	Yes (includes model's outputs and comments / revisions from group of writers and experts).

Table D-1 (part 6) – rating of core studies against uncertainty management guidelines

Study	USAF 2025 [13]	Which World? Scenarios for the 21st Century [14, 51, 52, 53]
Sources (textual and human)		
Explicit criteria for ID, selection, use	Not stated.	Not in [14].
Listing of sources	Yes - textual sources listed; human sources described in outline only (University staff, futurists, sci-fi authors...).	Not in [14].
Combination of research types	Yes.	Unclear from [14].
Review of previous work conducted	Yes.	Builds on some previous work.
Statement of uncertainty in inputs	Yes – comprehensive discussion of trends – including their uncertainties - in appendix B [13 pp.144-174].	Not in [14].
Analysis		
Method documented	Yes (asserted as the most robust method within US government. [13 p.114])	Not in [14].
Statement of outputs purpose	The ‘worlds form the framework for ... evaluation of ... systems and concepts’ [13 p.113] Aid to long-range planning.	‘This site ... is intended to raise questions in your mind about the future’ [51].
Statement of uncertainty in outputs	The scenarios ‘are not descriptions of how the world <i>will</i> be, but how it <i>could</i> be’ [13 p.5].	Some spread shown on e.g. global population. Recognition that some ‘trends cannot readily be projected into the future’ and that ‘Future political patterns are impossible to project’ [52].
Dimensions and spread of uncertainty illustrated	Major uncertainty examined was for the 3 leading drivers in the scenario analysis.	One scenario indicates that ‘the human capacity for change makes it impossible to rule out the possibility of rapid social transformation for the better’ [53].
Scenario breadth	8 worlds as corners of strategic planning space – selected 4, customer added 2.	3 (plus opportunity to create own scenario by changing two trends online).
Tests for self-consistency, coherence	Careful downselection of scenarios [13 p.13]. Testing for and removal of inconsistencies [13 p.139].	None listed in [14].
Discontinuities / wild cards	Possibilities considered and included in backcasted scenario histories.	Not in drivers in [14] but scenarios contain turning points.
Equivalent effort across scenarios	Yes.	Yes.
Scenario narratives	Yes (comprehensive, including backcasted view)	Yes.

Table D-1 (part 7) – rating of core studies against uncertainty management guidelines

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E Underlying driver matrices

Source	Canadian Military Assessment 2000	Chatham House Forum 2020 Drivers	CIA: Global Trends 2015	ECFSU: 2010 Drivers	Insight	Madingley Scenarios
Driver	Demography	Social and Demographic Change	Demographics		Demography	
	Environment		Natural Resources and the Environment		Environmental Change	The Living Environment
	Information Revolution	Knowledge and Technological Capabilities	Science and Technology	Technology and Work Organisation	Science and Technology	New Technologies and Information
		Connectivity and Interactions			Access to Knowledge	
	Globalisation	Economic Fundamentals	Global Economy and Globalisation	Globalisation	Globalisation of Economic Systems	
		Connectivity and Interactions		Other Economic Policies		
		Connectivity and Interactions	National and International Governance	Governance	Coherence of Politics (Decline of the State)	
	Governance under stress			Regional Security	Alliances and Alignments	New Power Structures
	Crisis of Identity			EU Institutions		
	The Emergence of Multiple Centres of Power			Labour Market and Social Policies		
	The RMA		Future Conflict			
	Nuclear Weapons					
		Natural Systems and Human Impacts				Social and Cultural Change
				Culture/Values	Public Perceptions	
				Central and Eastern Europe		
				Asia		
			Role of the US	USA		
				Mediterranean		
				Russia		

Source	MOD: Strategic Context	OUBS Millennium Project	PIU: The Future and How to Think About It	Shell Global Scenarios 1998-2020	USAF 2025 Project	UNU Millennium Project	Which World?
Driver	Physical		Demographics		Worldwide populations		Demographic Trends
	Physical	Resources	Environment		The Living Environment		Environmental Trends
					Energy, Space		
	Technological Dimension	Communications and IT Revolutions	Science and Technology	Technology	Computer Hardware, Software, Nano-technology	Communications	
	Technological Dimension				Communications and media		
	Economic dimension		Economic Globalisation	Globalisation	Economy	Globalisation	Economic Trends
				Wealth			
	Political Dimension	The Political Establishment	Political Institutions				Social and Political Trends
		Global Power		Liberalisation	International Relations	Leadership	
		Consumer Votes				Government Participation in Society	
	Military Dimension						
	Social Dimension	Education		Education	Education		Social and Political Trends
		New Role of the Community	Attitudes and Values	Ability to choose	Communications/Media		
	Legal Dimension						

Table E-1: Drivers matrix

F Summary of core studies that produced outcomes

Study	Chatham House Open Horizons 2020 Scenarios	CIA: Global Trends 2015
Purpose	Identify and analyse dynamics of political, economic and social complexity in world	Identify trends and drivers that interact to create integrated picture of world of 2015, and identify uncertainties of strategic importance to US.
Method(s) used	2D Boston matrices	2 workshops, (a) identifying major trends and events; (b) to develop four alternative plausible futures
Sources		Worked with NGOs, other experts and distilled diverse views from conferences/related workshops
Dominant drivers	Economic renewal	Demography
	Managing society	Natural resources
		Science and technology
		Global economy
		Governance
		Social/cultural identities
Scenario names and characteristics	<i>Wise counsels</i> – Knowledge economy; Individualistic differentiation or developing within self-defining communities	<i>Inclusive globalisation</i> – Technical development utilised to deal with problems of developing world; Robust global economic growth; Effective national and international governance; Public private partnerships shrink the role of the state; Minority of the world does not benefit
	<i>Atlantic storm</i> – Low economic growth; Defunct NATO; Global elite of nations; Distinctions between economic classes, ethnicity and nationalism	<i>Pernicious globalisation</i> – Elites thrive as result of globalisation, majority fail to do so; Migration becomes source of tension; Technologies fail to address the problems; National and international governance is weak; Increasing internal conflict; Growing gap between developed and developing
	<i>Market Quickstep</i> – ‘invisible hand’; Sub-regional areas differentiate, developing strengths and excluding weaknesses	<i>Regional Competition</i> – Sharp regional identities; Uneven distribution of technologies; Internal conflicts
		<i>Post-polar world</i> – Increased economic and political pressure in Europe; Domestic US view; Rise of Japan and China alerting fears of possible conflict between them

Table F-1 (part 1) – Summary of core studies that produced outcomes

Study	ECFSU 2010 Drivers	Insight	Madingley Scenarios
Purpose	To create series of coherent and thought-provoking images of future of Europe	Provide context for strategic planning for UK defence industry.	To mark 50 th anniversary of NHS. The aim was to explore the current values and agendas of NHS and consider these in the face of possible futures
Method(s) used	'Shaping Actors – Shaping Factors' method, 2 stages producing (a) partial (theme-specific) scenarios to be subsequently integrated into (b) global scenarios	2D and 3D Boston matrices. Field Anomaly Relaxation (FAR) method	
Sources	Expertise of Civil Servants in European Commission	Series of interviews with experts	Dept of Health's database, other more widely available resources
Dominant drivers	Institutions and governance	Globalisation of economic systems	Development of new technologies and even larger amounts of information
	Social cohesion	Coherence of politics	New power structures in politics, business and community life
	Economic adaptability	Alliances and Alignments	Social and cultural change
	Enlargement of EU Europe's external environment		Growing importance of new relationships with living environment
Scenario names and characteristics	<i>Triumphant Markets</i> – Growing world trade (free trade); Increasing social and regional inequalities	<i>Web of Nations</i> – High globalisation; High public involvement in politics; International institutions function; Marginalisation of undeveloped world.	
	<i>The Hundred Flowers</i> – Decline in administrations; Public dissatisfaction; Political fragmentation; Ominous international situation	<i>Subsidiarity with Interdependency</i> – Globalisation accelerated; Populations engaged in political process; Strong regional groupings	<i>Find my way</i> – Empowered individual; Global community; Institutions subject to mistrust; Unlimited information; Haves and have-nots
	<i>Shared Responsibilities</i> – Discontent among general public; Civil society on the rise	<i>Fragmented</i> – Side effects of globalisation; International institutions are weak; Cynical public	<i>Trust their guidance</i> – Re-vamped institutions; Limited individual choice; Strong national governments; Information cautious
	<i>Creative Societies</i> – Public pressure with regards to social questions	<i>Blocs</i> – Retarded globalisation due to isolationism and barriers; Public engaged in politics; Strong alliances	
	<i>Turbulent Neighbourhoods</i> – Globalisation fails to deliver; Tensions on EU's doorstep; China/Japan jockey for position in Asia		

Table F-1 (part 2) – Summary of core studies that produced outcomes

Study	OUBS Millennium Project	Shell Global Scenarios 1998-2020	UNU Millennium Project
Purpose		Identify business issues, especially external developments with direct bearing on strategic questions currently facing Multinational Corporations	To be an international utility to assist in organising futures research by continuously updating and improving humanity's thinking about future.
Method(s) used	Not explicit from web pages	Facilitated workshops discussing implications of scenarios for strategy development	Exploratory scenarios – 3D Boston matrices to create illustrative scenarios. Qualitative backbone added through computer modelling (“International Futures”)
Sources			
Dominant drivers	Abundant resources	Globalisation	Level of harmonisation in world
	Communications and Information Technology Revolutions	Liberalisation	Economic vitality in global sense
	Political establishment	Technology	Social focus
	Global power	Wealth	
	New role of the community	Choice Education	
Scenario names and characteristics	<i>Outer Space</i> – Technology developments	<i>The New Game</i> – New global institutions; Organisations adapt to globalisation, liberalisation etc; New rules of play for businesses	<i>Cybertopia</i> – Internet and technologies increase globalisation
	<i>Inner Space</i> – Contrast between technology and soft issues relating to individuals; Optimistic	<i>People Power</i> – Increased wealth, education, choice; Diversity and volatility; Fragmented political parties; Institutions challenged by speed of change;	<i>The Rich Get Richer</i> – Bigger divide between rich and poor
	<i>Shared Space</i> – How changes affect world as a whole		<i>A Passive Mean World</i> – Unemployment and underemployment rife due to population increases
	<i>Dark Space</i> – Fragmentation of political systems		<i>Trading places</i> – Asian governments politically and economically dominate over US/Europe

Table F-1 (part 3) – Summary of core studies that produced outcomes

Study	USAF 2025 Project	Which World?
Purpose	Identify systems, concepts of operation and technologies for US to possess in order to dominate air and space forces in future	
Method(s) used	3D Boston matrix	Not explicit from web pages
Sources	Air University participants; Interviews with respected futurists and scientists	
Dominant drivers	American World View	Demography
	ΔTeK	Environment
	World Power Grid	Economics
		Social and Political Trends
Scenario names and characteristics	<i>Zaibatsu</i> – Domestic US focus; Concentrated world power grid; Exponential technological growth	<i>Fortress World</i> – Economic boom, increasing gap between rich and poor; Upsurge in violence and organised crime; Collapse of Africa
	<i>Gulliver's Travails</i> – US heavily involved globally; Dispersed power grid; Constrained technological growth	<i>Market World</i> – Economic boom
	<i>Digital Cacophony</i> – Global US view; Dispersed power grid; Advanced technological growth; Individual independence but social isolation; Dangerous individual states;	<i>Transformed World</i> – Importance of public opinion, Internet giving the public increased voice
	<i>King Khan</i> – Dominance of Asian governments; Domestic US view; Concentrated power grid; Constrained technological growth	
	<i>Halfs and Half-Naughts</i> – Haves and have nots – mid-point of 3D matrix	

Table F-1 (part 4) – Summary of core studies that produced outcomes

Report documentation page

1. Originator's report number:		DERA/DSTL/CR00979/2.0	
2. Originator's Name and Location:		Simon Davies, Rm. 1016, A2 Building, DERA Farnborough	
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UNCLASSIFIED	June 2001	ix + 47	53
7a. Report Title:		Strategic Futures Thinking: meta-analysis of published material on Drivers and Trends	
7b. Translation / Conference details (if translation give foreign title / if part of conference then give conference particulars):			
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8. Authors:		Simon Davies, Ben Bolland, Kirsty Fisk, Mike Purvis	
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10a. Abstract. (An abstract should aim to give an informative and concise summary of the report in up to 300 words).			
<p>In April 2001 the PIU tasked the Centre for Defence Analysis to conduct a meta-analysis of the published body of strategic Futures thinking work in order to synthesise a view on the key drivers that might be expected to change the UK's policy baseline. The analysis was to give an assessment of the different approaches used in Futures thinking, their treatment of uncertainty and to indicate the degree to which their views on drivers agreed or diverged. The basic approach has been one of a sophisticated literature review. That is, to scan the published body of Futures work, select studies of sufficient relevance and stature, extract and assess the key elements, synthesise a description of the current state of the art and to present the results as a basis for further Futures thinking. The six key drivers selected were: demographics; environmental change; economics; science & technology; national & international governance; perceptions, beliefs, values and attitudes. A set of (largely convergent) trends was identified within each driver and this report notes their frequency of occurrence across the studies reviewed. In conclusion, there is an encouragingly large – indeed considerable - volume of previous work. There is reasonable – but not universal – agreement in the published work of the reviewed studies about how the input data pull through into trends and drivers (potential trajectories for change). However, there are significant differences in the degree to which uncertainty in the inputs and outcomes are handled. Some partial correlations are identified between drivers and methods used and outcomes. The one robust future identified across the reviewed studies from deductions that can be drawn from looking at the individual trends within each driver is that it appears that those in the developing world will continue to suffer.</p>			
10b. Abstract classification:		UNCLASSIFIED	
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