MINISTRY OF DEFENCE

Ministry of Defence

Strategic Trends Programme
Global Strategic Trends - Out to 2040

Fourth Edition

D·C·D·C

Background

Global Strategic Trends is a comprehensive view of the future produced by a research team at the Development, Concepts and Doctrine Centre (DCDC). This edition of Global Strategic Trends is benchmarked at 12 January 2010.

Conditions of Release

The findings contained in Global Strategic Trends are DCDC's and the document does not represent an official position of Her Majesty's Government or the Ministry of Defence (MOD). The information is, however, Crown Copyright.

Departmental Direction

Global Strategic Trends is an examination of the strategic context that faces defence and the challenges and opportunities it provides for the MOD. MOD direction on the DCDC Strategic Trends Programme stresses the requirement for a comprehensive approach.

DCDC's Strategic Trends Programme aims to provide a detailed analysis of the future strategic context for defence out to 2040. This will be an essential input into policy and concept development. Major outputs include:

- Trends based analysis of the future strategic context;

- Analysis of alternative futures, key risks and shocks, including an assessment of their probability, frequency and magnitude;

- Identification of how shocks might impact on the future strategic context;

- Identification of the broad defence and security implications of this analysis.

Building on previous editions of Global Strategic Trends, the analysis adopts a comprehensive approach to the key drivers and deduces the salient themes out to 2040. In compiling the analysis, the Strategic Trends Programme makes use of a broad and diverse evidence base.

Foreword by the Assistant Chief of the Defence Staff (Development, Concepts and Doctrine) – Major General Paul Newton CBE

The DCDC Strategic Trends Programme provides a comprehensive analysis of the future strategic context out to 2040. The work is based on research conducted at DCDC in conjunction with subject matter experts across a range of disciplines. These experts come from a multitude of backgrounds, including government and academia. It is a global view of future trends and DCDC has conducted workshops and consultations in Europe, the Middle East, Asia, Africa and North America to gain an international perspective.

Maj Gen P R Newton CBE

The document is a contribution to a growing body of knowledge and is aimed at the defence community. It seeks to build on previous editions of Global Strategic Trends with a more accessible format. It has a greater focus on defence and security issues and expands on other subjects, including resources, and the resurgence of ideology. From a comprehensive review of trends, it draws out 3 key themes: how we will adapt to the reality of a shifting climate and breakneck technological innovation (see the ***Human Environment***); the dominance of the West in international affairs will fade and global power will become more evenly distributed between the West and the rising powers in Asia (see the ***Dynamics of Global Power***); and finally, as society and the distribution of global power changes, the challenges to defence and security will increase (see ***Evolving Defence and Security Challenges***). It draws lessons from contemporary events to conclude that globalisation is a more volatile process than previously envisaged and that this volatility may leave globalised systems more vulnerable to strategic shock and systemic failure. It also draws out high level global defence and security implications.

Previous editions of Global Strategic Trends have been accused of taking a pessimistic view of the future. However, in this edition, we see the opportunities as well as challenges and believe that we provide a realistic assessment. The period out to 2040 will be a time of transition, which is likely to be characterised by instability, both in the relations between states, and in the relations between groups within states. This period of transition will not occur in a linear fashion; as climate change, global inequality, population growth, resource scarcity and the shift of power from west to east will transform the strategic context. These will be persistent, complex challenges.

However, it is the manner in which states, their leaders and their populations react to these challenges that will define the era. If they choose to implement collective responses then the challenges are likely to be overcome, and progress and development will follow. However, if they miscalculate under pressure, are constrained by misunderstanding, or fail to seize opportunities, the result is likely to be instability, tension and ultimately conflict.

Global Strategic Trends

Purpose

The need for defence to understand the future strategic context was articulated in the Strategic Defence Review (1998), which confirmed the long-term nature of defence planning and the need for a wide-ranging understanding of the future strategic environment. Global Strategic Trends provides a measure of context and coherence in an area characterised by transition, risk, ambiguity and change.

The DCDC approach goes beyond solely identifying potential future defence and security challenges to which our Armed Forces will have to respond, and looks at the developments in areas that will shape the wider strategic context within which defence will have to interact. For example, the document addresses subjects such as: the shifting global balance of power; emerging demographic and resource challenges; as well as climate change and societal changes.

One of the strengths of the Global Strategic Trends assessment is its relative independence from wider defence decision-making. Consequently, Global Strategic Trends is able to inform defence decisions, without being constrained by the latest good idea, fashionable trend or received wisdom. Some of the findings in Global Strategic Trends will, therefore, challenge views which derive from existing or transient circumstances, instead drawing on long-term trends and the enduring features of the strategic context.

This edition of Global Strategic Trends has contributed towards the Defence Green Paper.

Global Strategic Trends

Contents

Part 1: Analysis

Part 2: Dimensions

How to Read Global Strategic Trends

This is the fourth edition of Global Strategic Trends. It is a stand-alone document that seeks to explore the relevance of global trends to defence and security out to 2040, while building on previous editions. This document is split into 3 sections:

- **Executive Summary and Implications for Defence and Security.** This section highlights the major themes and their relevance to defence and security.

- **Part 1: Analysis.** This section brings together the important arguments, themes and analyses of the evidence. It is split into 3 sub-sections:

  - **Ring Road Issues.** The 4 key drivers for change that will affect the lives of everyone on the planet.

  - **Key Themes.** Three essays on ***The Human Environment***, ***Dynamics of Global Power*** and ***Evolving Defence and Security Challenges*** that develop and analyse trends and drivers as well as identifying the most likely outcomes.

  - **Strategic Shocks.** These are high impact events that have the potential to rapidly alter the strategic context.

- **Part 2: Dimensions.** This section considers underlying trends and drivers for the key themes. It summarises some of the evidence upon which they are based. This is intended as a reference section, and will also be of interest to some specialist readers.

Hot Topics are distributed through the document and identify issues of particular interest that are covered in greater depth.

Definitions

The definitions of some of the terms used within the document are:

Term	Definition
Trend	A trend is a discernable pattern of change.
Driver	A driver is a factor that directly influences or causes change.
Ring Road Issue	A driver that is so pervasive in nature and influence that it will affect the life of everyone on the planet over the next 30 years.
Dimension	In depth research and analysis on trends and drivers, organised into 5 key areas: Social; Resource and Environment; Economic; Geopolitical; and Science and Technology.
Outcomes	A description of salient features of the future strategic context, with an associated level of confidence. Alternative outcomes are judged less likely than probable outcomes.
Risks and Benefits	The consequences of the outcomes and how they could manifest themselves and affect defence business.
Strategic Shock	A shock is a high impact event that results in a discontinuity or an abrupt alteration in the strategic context. The strategic shock can either be expected or unexpected; the important point is that it dislocates the strategic context from the trends that have preceded it.

Outline Methodology

Global Strategic Trends is based on driver and trend analysis. The process identifies trends and drivers in the social, science and technology, economic, resource and environment, and geopolitical dimensions. Within each of these dimensions, key trends have been determined through detailed analysis with subject matter experts. A cross-dimensional analysis then considers how these trends are likely to develop and interact, in order to establish the key themes: **The Human Environment**; **The Dynamics of Global Power**; and **Evolving Defence and Security Challenges**. The assessments are made to varying degrees of probability to reflect multiple alternative outcomes. The future outlined in Global Strategic Trends is realistic, based on the most probable outcomes, although alternative futures are also explored.
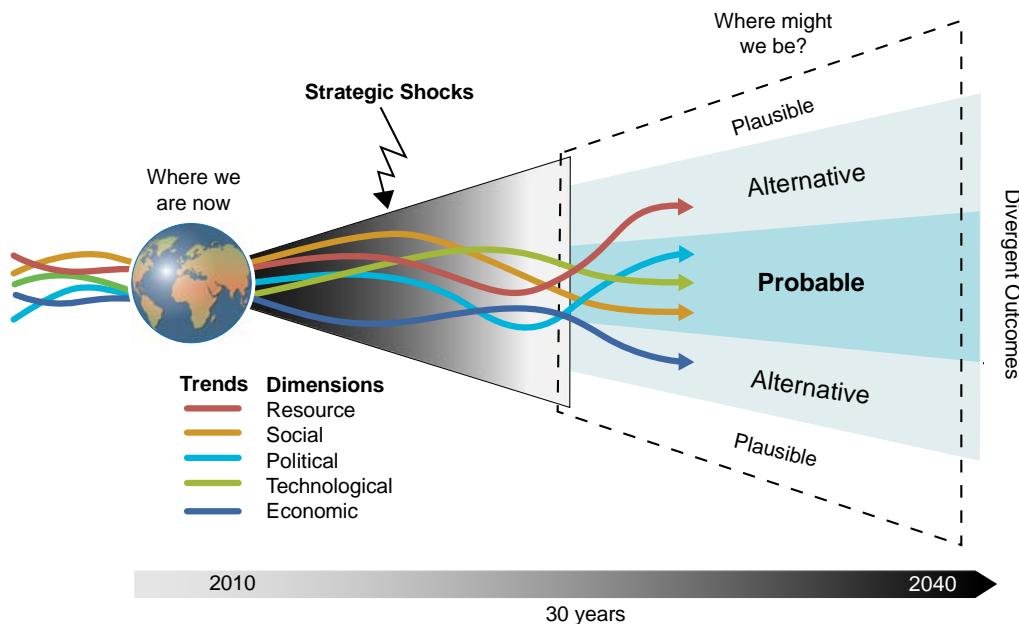
Figure 1 – Global Strategic Trends: Outcome Assessment

These outcomes are discussed in 3 key themes:

- The Human Environment.

- Dynamics of Global Power.

- Evolving Defence and Security Challenges.

These key themes identify outcomes from the trends and drivers. They are intended to help: understand interactions between the trends; distinguish between long-term significant changes and short-term turbulence; and identify major challenges and opportunities in the future strategic context.

As well as establishing trend-based outcomes, Global Strategic Trends seeks to identify and interpret the likely pattern of change over the next 30 years. In doing so, it assesses that during this period human activity will be dominated by 4 pervasive issues, which are described here as Ring Road Issues:

- Climate Change.

- Globalisation.

- Global Inequality.

- Innovation.

Expressing Probability

Each finding within Global Strategic Trends is presented with an assessment of likelihood assigned to it. This assessment represents the probability of the finding as viewed by the authors. Such probabilities are, of necessity, subjective. Their function within this document is to provide a measure that can be used as a guide for policy planners who need to make rapid, informed decisions regarding complex global issues using a readily comparable scale for judgements.[1]

Using the expressions listed below, these assessments are presented throughout the document *in italics.* Because of the high number of variables, trends-based analysis can never offer precise predictive analysis and the terms below provide a coarse indication of uncertainty, based on the available evidence.

Assessment of Probability	
Description	**Associated Probability Range**
Will	Greater than 90%
Likely/Probably	Between 60% and 90%
May/Possibly	Between 10% and 60%
Unlikely/Improbable	Less than 10%

---

[1] 'In order to acknowledge the uncertainty of an event the first task is to measure the intensity of your belief in the truth of that event; to attach to each event a number, which describes your attitude to the statement.' Lindley D.V, *Understanding Uncertainty*, 2006.

Executive Summary and Implications for Defence and Security

This section highlights the major themes and their relevance to defence and security.

Executive Summary and Implications for Defence and Security

The era out to 2040 *will* be a time of transition; this is *likely* to be characterised by instability, both in the relations between states, and in the relations between groups within states. During this timeframe the world is *likely* to face the reality of a changing climate, rapid population growth, resource scarcity, resurgence in ideology, and shifts in global power from West to East. No state, group or individual can meet these challenges in isolation, only collective responses *will* be sufficient. Hence, the struggle to establish an effective system of global governance, capable of responding to these challenges, *will* be a central theme of the era. Globalisation, global inequality, climate change and technological innovation *will* affect the lives of everyone on the planet. There *will* be constant tension between greater interdependence between states, groups and individuals and intensifying competition between them. Dependence on complex global systems, such as global supply chains for resources, is *likely* to increase the risk of systemic failures.[2]

The distribution of global power *will* change. Out to 2040, the locus of global power *will* move away from the United States (US) and Europe towards Asia, as the global system shifts from a uni-polar towards a multi-polar distribution of power.[3] This shift, coupled with the global challenges of climate change, resource scarcity and population growth, is *likely* to result in a period of instability in international relations, accompanied by the *possibility* of intense competition between major powers. The hegemonic dominance of the US *will* fade. She is *likely* to remain the pre-eminent military power, although, in political, economic and military terms, she is *likely* to be increasingly constrained as others grow in influence and confidence. However, the rise of individual states, such as China, should not be considered a certainty given the nature and magnitude of the challenges they face, nor should their eventual influence be over-estimated. Instead there *will* be several states and institutions competing for regional and global influence, cooperating and competing within the international community.

Globalisation is *likely* to continue, underpinned by the rapid development of global telecommunications, and resulting in a pervasive information environment in which much of the global population *will* be capable of being online all the time. Politically, globalisation is *likely* to raise the level of interdependence between states and individuals within the globalised economy. It is *likely* to be an engine for accelerating economic growth, but also a source of risk, as local markets become increasingly exposed to destabilising fluctuations in the wider global economy. Economically, globalisation is *likely* to generate winners and losers, especially in the labour market. As a result, everyday life is *likely* to be competitive, dynamic and fluid, leading to the possibility that political decisions *may* limit globalisation in order to protect reluctant populations from its negative effects. Looser forms of political, cultural and economic association *will* multiply as physical dispersion no longer acts as a barrier for those who share common interests.

---

[2] A systemic failure is the failure of a chain of markets or institutions. It is not limited to finance, and can occur in any complex system.
[3] A uni-polar world has a single dominant power. A multi-polar world has 3 or more states or alliances that dominate world politics.

The physical manifestations of globalisation are *likely* to be most apparent in the globalised core, which comprises the most interdependent and economically successful regions of the world. Instability within the globalised core is *likely* to adversely affect the national interests of major powers. Resources, trade, capital and intellectual property are *likely* to flow through this core, and rely on complex networks of physical and virtual infrastructure that are *likely* to be vulnerable to physical disruption or cyber attack by multiple actors. This infrastructure includes air and sea lanes and their associated ports, rail and road infrastructure, communications links, gas, oil, electricity pipelines and cables, food distribution centres, banking and finance hubs, universities and science parks, manufacturing and energy production facilities. Consequently, increasing dependency on this infrastructure, and the global supply chains that underpin globalisation, *will* leave the global economy vulnerable to disruption. Ensuring the security of this globally distributed infrastructure is *likely* to be of multilateral interest.

Climate change *will* amplify existing social, political and resource stresses, shifting the tipping point at which conflict ignites, rather than directly causing it. Extant greenhouse gas emissions *will* result in global temperature increases out to 2040, which are *likely* to be unevenly distributed, irrespective of any agreement to limit future emissions. These temperature increases are *likely* to lead to significant environmental change that *may*, for example, include desertification in the Saharan margins and changes to rainfall distribution patterns within the monsoon belt of the Arabian Sea and South Asia. The frequency and intensity of extreme weather events *will* change, *possibly* with severe impact on low-lying coastal regions. Rapid glacial melt, particularly in the Himalayas, *may* exacerbate water management problems in China, India, Pakistan and Bangladesh. Disease carriers, such as malarial mosquitoes, are *likely* to spread into previously temperate zones.

Sufficient energy, food and freshwater resources are *likely* to be available to sustain the growing global population and the global economy. However, distribution and access to resources *will* be uneven, and local and regional shortages *will* occur, increasing the likelihood of societal instability and of disagreement between states, and providing the triggers that *may* ignite conflict. Poorer states *will* often be unable to access the necessary resources to allow their economies to develop and their populations to prosper. The frequency, scale and duration of humanitarian crises are *likely* to increase. Many states, including China and India, are *likely* to become more dependent on food imports to feed their large and increasingly affluent populations. A shift in agricultural patterns and the distribution of grain growing areas, coupled with the rise in animal and plant diseases, is *likely* to disrupt food production, resulting in increased migration. However, improvements and efficiencies in agricultural production are *likely* to meet much of the increased demand, given *likely* scientific advances that develop high-yield, disease resistant crop strains, combined with better land usage and improved irrigation. Some regions, such as Siberia and parts of Canada, *may* open up to wider cultivation. The oceans *will* be further exploited for protein, raising the demand for fishing rights in previously inaccessible areas, such as the Polar Regions.

The proportion of the global population living in absolute poverty is *likely* to decline. However, inequality of opportunity *will* be more apparent due to globalisation and increased access to more readily and cheaply available telecommunications. Global

inequality is *likely* to be a significant source of grievance, *possibly* resulting in an increased incidence of conflict. This is despite growing numbers of people who are *likely* to be materially more prosperous than their parents. Demographic trends *may* also fuel instability, especially in the Middle East, Central Asia and sub-Saharan Africa. Youth bulges[4] are *likely* to provide a reservoir of disaffected young people. In particular, young males with limited economic prospects *may* be susceptible to radicalisation. However, states that experience lower birth rates and increased longevity are *likely* to benefit from a growing workforce and a falling dependency ratio. The result is a 'demographic dividend', which can produce a virtuous cycle of growth.

By 2040, around 65%, or 6 billion, of the world's population *will* live in urban areas, attracted by access to jobs, resources and security. The greatest increases in urbanisation *will* occur in Africa and Asia. Up to 2 billion people *may* live in slums. Many large urban areas, especially in regions of the world suffering from poor governance, are *likely* to become centres of criminality and disaffection and *may* also be focal points for extremist ideologies. Rapid urbanisation is *likely* to lead to an increased probability of urban, rather than rural, insurgency.[5] The worst affected cities *may* fail, with significant humanitarian and security implications. A greater understanding of the dynamics of urban societies *will* be required if instability within these regions is to be identified and managed.

New ideologies *will* emerge, driven by religion, ethnic differences, nationalism, inequality or a combination of these factors. Ideological conflicts are *likely* to occur and extremist groups *may* use violence to achieve political objectives. There *may* be a resurgence of anti-capitalist ideologies, such as Marxism. Diaspora communities are *likely* to increase in size and influence and many *will* bring economic benefits to their host states. However, those that fail to integrate are *likely* to remain reservoirs for resentment. Some of these groups are *likely* to become involved in ideologically driven conflicts, and *may* act as proxies for other states. Similarly, host states *may* be drawn into regions and conflicts that reflect the interests of their diaspora communities.

The proliferation of modern weapons' technologies, and *probably* Weapons of Mass Destruction (WMD),[6] *will* generate instability and shift the military balance of power in various regions. Counter-proliferation initiatives are *unlikely* to be wholly successful, and nuclear weapons are *likely* to proliferate. Terrorist groups are *likely* to acquire and use chemical, biological and radiological weapons *possibly* through organised crime groups. Many states are *likely* to develop ballistic and cruise missiles capable of delivering Chemical, Biological, Radiological or Nuclear (CBRN) weapons, as well as conventional payloads.[7] Ballistic Missile Defence (BMD) and other air defence technologies *may* mitigate some of the risk, but they are *unlikely* to remove the threat completely.

---

[4] A youth bulge is a peak on a demographic graph of median age in which the bulk of a population occurs between the ages of 15-21.
[5] Evans M, *War and the City in the New Urban Century*, 2009.
[6] North Atlantic Treaty Organization (NATO) doctrinal publications define Weapons of Mass Destruction (WMD) as weapons that are capable of a high order of destruction and of being used in such a manner as to destroy people, infrastructure or other resources on a large scale.
[7] Chemical, Biological and Radiological (CBRN) weapons are a specific type (and therefore a sub-set) of WMD.

Terrorists are *likely* to acquire and use chemical, biological and radiological weapons

Innovation and technology *will* continue to facilitate change. Energy efficient technologies *will* become available, although a breakthrough in alternative forms of energy that reduces dependency on hydrocarbons is *unlikely.* The most significant innovations are *likely* to involve sensors, electro-optics and materials. Application of nano-technologies, whether through materials or devices, *will* become pervasive and diverse, particularly in synthetic reproduction, novel power sources, and health care. Improvements in health care, for those who can afford it, are *likely* to significantly enhance longevity and quality of life.

States and non-state actors *will* exist in a condition of persistent competition. The fundamental nature of conflict *will* endure. It *will* remain an inherently human endeavour, with all the uncertainty that this implies. However, the character of conflict *will* continue to evolve, remaining innately volatile. State and non-state actors *will* seek to combine conventional, irregular and high-end asymmetric methods concurrently, often in the same time and space and across the combined domains of the air, land, sea, space and cyberspace.[8] Conflict is *likely* to involve a range of transnational, state, group and individual participants who *will* operate at global and local levels. In some conflicts, there is *likely* to be concurrent inter-communal violence, terrorism, insurgency, pervasive criminality and widespread disorder. Tactics, techniques and technologies *will* continue to converge as adversaries rapidly adapt to seek advantage and influence, including through economic, financial, legal and diplomatic means. These forms of conflict *will* transcend conventional understanding of what equates to irregular and regular military activity. Innovative communication techniques *will* create a network-enabled audience, providing

---

[8] 'Now and in the future we have no less than 5 interdependent geographies for warfare: land, sea, air, space, and cyberspace. It has been rare in history for a new geography to be added to the elite short list of environments for warfare. Now there are 2 such new geographies, space and cyberspace, and we are becoming ever more dependent upon them both.' Gray C.S, *The 21st Century Security Environment and the Future of War*, 2008.

both a challenge and an opportunity for military operations. Adaptive adversaries *will* seek to utilise the media and the opponent's political system to their advantage. States *will* increasingly sponsor proxies, seeking to exploit gaps in the international system while minimising state-on-state risks.

The strategic balance of military power is *likely* to change as Asian states close the technological gap with the West in some areas, develop and maintain strong military forces, and produce and export advanced military equipment to allied states and proxies. The majority of the technological breakthroughs are *likely* to be driven by the commercial sector, although technological adaptation in defence *will* continue at a rapid pace. Non-lethal, Directed Energy Weapons (DEW), space and cyber technologies *will* be available to a wide variety of actors, both state and non-state.

Out to 2040, there are few convincing reasons to suggest that the world *will* become more peaceful. Pressure on resources, climate change, population increases and the changing distribution of power are *likely* to result in increased instability and likelihood of armed conflict. Total war,[9] harnessing the full power of industrial states, war between major Western powers, and war between liberal democracies, are all *unlikely*.[10] However, disagreements between major powers over borders, influence and resources are *probable*. Such disagreements *may* lead to confrontation, including limited wars, where adversaries deliberately exercise restraint in the methods of warfare, their level of commitment or the objectives sought. Intra-state conflict *will* remain the most common type of conflict. The use of proxies is *likely* and conflict involving the proxies and partners of major powers is *possible*. Western militaries *may* become involved in coalition action against adversaries possessing significant military capabilities, with Western forces *possibly* fighting from a position of near-parity or even relative disadvantage. Apparently unsophisticated adversaries *will* have ready access to cheap, yet highly effective, technologies.

---

[9] For example, World War II.
[10] A discussion of drivers for inter-state conflict can be found in Roberts and Zaum. *Selective Security: War and the United Nations Security Council since 1945*, 2008.

Global Defence and Security Implications

- The incidence of armed conflict is *likely* to increase underpinned by: an unstable transition to a multi-polar world that allows old and new state rivalries to emerge; widespread global inequality that heightens associated grievances; population increases, resource scarcity and the adverse effects of climate change that combine to increase instability; and the increased importance of ideology.

- Future conflict *will* remain unpredictable and violent. Its character *will* continue to evolve and present new challenges. While technology *will* remain important, people are *likely* to provide the asymmetric edge when responding to both expected and unexpected challenges, if invested in and empowered through decentralisation.

- The differences between state, state-sponsored and non-state adversaries *will* blur. The range of threats *will* diversify, as technology and innovation opens up novel avenues of attack and adaptive adversaries exploit opportunities.

- Soft power *will* increasingly be utilised to facilitate the achievement of political goals. Moreover, all elements of power are *likely* to be wielded by a broader spectrum of actors and agencies, including organised criminal, terrorist and insurgent groups. The degree to which a state or group combines hard and soft power into an amalgam of effective statecraft[11] *will* determine their ability to achieve strategic objectives. Nonetheless, while traditional levers of power will continue to form the basis of statecraft, it is *unlikely* that the military instrument alone will be decisive.

- The CBRN threat from state and non-state actors is *likely* to increase, facilitated by lowering of some entry barriers, dual purpose industrial facilities and the proliferation of technical knowledge and expertise. Terrorist attacks using chemical, biological and radiological weapons are *likely*, as are mass-casualty attacks using novel methods. The likelihood of nuclear weapons usage *will* increase.

- The economic prosperity of many states *will* depend on functioning globalised markets and access to the global commons. Multilateral military activity to protect globalisation, including protection of global supply chains and space-based infrastructure from physical and virtual disruption, is *likely*. Such interdependence *will* give most conflicts, wherever they occur, a global dimension.

- The changing balance of power is *likely* to deter military intervention by major powers outside their spheres of influence, without widespread multilateral agreement, which is *likely* to reduce the latitude for discretion. When intervention becomes unavoidable, actors *will* seek to distance themselves by use of proxy forces, cyber attack, as well as covert and clandestine methods. Persistent,

---

[11] Statecraft is the skilful management of state affairs (Concise Oxford English Dictionary).

complex problems *will* require the integration of all levers of state power, both across government and among partners and allies.

- There *will* be an increasing range of political, legal, ethical and financial imperatives to build relationships with like-minded partners. New alliances and partnerships *will* form and established ones *will* be adapted to meet the breadth and depth of the challenges. For European powers, the North Atlantic Treaty Organization (NATO) is *likely* to remain the defence organisation of choice.

- Control and access to hydrocarbons *will* remain important and major powers are *likely* to use their defence forces to safeguard supplies. Conflicts over food and water resources are *possible*. For some protagonists, these *may* be viewed as wars of survival. Competition for resources *will* increase the geostrategic importance of certain regions such as; the Asian Meridian, the wider Middle East and the Polar Regions.

- Climate change *will* amplify existing social, political and resource stresses, shifting the tipping point at which conflict ignites, rather than directly causing it. Climate change is *likely* to increase the frequency, scale and duration of humanitarian crises. It is also *likely* to change patterns of migration, making border security an ongoing concern, especially in the developed world.

- Support to states suffering from instability *will* require interoperability between a wide range of joint and coalition military forces, other arms of state, and non-state actors, including international institutions, Non-governmental Organisations (NGOs) and contractors. Organisations *will* need to develop to ensure that they are able to effectively integrate their activities.

- Unlike some potential adversaries, Western defence forces *will* be subject to legislation that constrains their scope for action. This includes legislation concerning the conduct of operations, the emissions of greenhouse gases, and individual rights.

- Conflict *will* remain focused on influencing adversaries, neutrals and those at home, whose perceptions *will* be vital. Military operations are *likely* to continue to result in casualties and face the challenge of demonstrating legitimacy to sceptical public audiences. Influence activity, the battle of ideas, and perceptions of moral legitimacy *will* be important for success. Concepts of casualty acceptance and aversion are *likely* to remain linked to perceptions of the legitimacy of the conflict.

- Perceptions of inequality and associated grievances *will* result in increased instability and societal tension, *possibly* setting the conditions for conflict. Where instability affects national and multilateral interests, there is *likely* to be a requirement to provide support for legitimate governance structures and for stabilisation operations.

- Radicalisation, extremism and terrorism *will* continue to generate threats. Network technologies *will* provide new opportunities for group formation. Many threats *will* operate transnationally, requiring ongoing cooperation and multinational interoperability between security services to provide an effective response.

- The West is *likely* to lose its broad qualitative advantage in military equipment in some areas, challenging a Western paradigm of war; that technology can replace mass. The proliferation of advanced weaponry *will* continue. As technological parity between adversaries is approached, casualty rates are *likely* to escalate. Potential adversaries, both state and non-state, *will* leverage high-technology niche capabilities and employ innovative concepts of operation. Regional powers armed with precision-guided missiles and anti-access technologies, such as submarines and sophisticated surface-to-air missiles, *will* make traditional power projection strategies more costly.

- Advances in robotics, cognitive science coupled with powerful computing, sensors, energy efficiency and nano-technology *will* combine to produce rapid improvements in the capabilities of combat systems.

- Defence production is *likely* to become increasingly internationalised and most states *will* lack guaranteed access to industrial surge capacity during times of escalating tension. Weapons themselves are *likely* to become more portable, more widely available and easier to use.

- Increasing dependence on Information and Communications Technology (ICT),[12] and reliance on space-based assets to receive or transmit information across the electromagnetic spectrum, *will* maintain the importance of cyber-security. Cyberspace *will* be widely exploited by all types of actors, but the effects of their actions are *likely* to vary. Attribution, intent and legitimacy of cyber-attacks *will* all be disputed.

- Strategic shocks *will* occur, although their character and detail remain unpredictable. Complex interconnected and interdependent systems *will* be subject to systemic risk and the potential of cascading failures. Organisations that are built around agility and versatility are the most *likely* to be successful at adapting to events.

- Success in future conflict, especially against adaptive and agile adversaries, *will* require a shift away from kinetic to influence activity, underpinned by a greater understanding of the enemy. This understanding *will* require more emphasis on intelligence gathering, cultural awareness, individual and collective training, and focused comprehensive approaches.

---

[12] Information, Communications and Technology (ICT) is the entire infrastructure, organisation, personnel, and components that collect, process, store, transmit, display, disseminate and act on information.

- Resource security *will* become an increasingly important issue for governments and defence forces. While the United Nations (UN) Charter framework *will* remain in place, the legal prohibition on the use of force is likely to come under increasing pressure when resource security adversely affects national survival. In such circumstances, a state *may* interpret the legal framework in a manner that seeks to legitimise their use of force.

Part 1

Analysis

This section brings together the important arguments, themes and analysis of the evidence. It is split into 3 sub-sections:

- Ring Road Issues. The Ring Road issues are the 4 key drivers of change that will affect the lives of everyone on the planet.

- Key Themes. Three essays on *The Human Environment*, *Dynamics of Global Power* and *Evolving Defence and Security Challenges* that develop and analyse trends and drivers and identify the most likely outcomes.

- Strategic Shocks. High impact events that have the potential to rapidly alter the strategic context.

Ring Road Issues

The Ring Road issues are key drivers of change that will affect the lives of everyone on the planet over the next 30 years.

Globalisation

During the next 30 years, the number of transactions, conducted irrespective of physical distance, is *likely* to increase. Such an expansion is *likely* to shape and, in general, improve everyday life for millions of people. A key feature of globalisation is *likely* to be the continuing internationalisation of markets for goods, capital, services and labour, which integrates geographically dispersed consumers and suppliers. This is *likely* to be an engine for accelerating economic growth, but also a source of risk, as local markets become increasingly exposed to destabilising fluctuations in the wider global economy. These developments are *likely* to be driven by advances in global telecommunications, resulting in a pervasive information environment in which much of the global population *will* be able to be 'online all the time'. There are *likely* to be winners and losers in a global economy led by market forces, especially in the field of labour, which *will* be subject to the laws of supply and demand. As a result, everyday life for people is *likely* to lack stability and certainty, leading to the possibility that political decisions, made to protect reluctant populations from the negative effects, *may* limit the extent of globalisation. This interconnectivity *will* significantly reduce the time available to plan for and respond to global events, which *may* lead to political or economic miscalculation. Socially, looser forms of political, cultural and economic associations are *likely* to multiply. Virtual and disassociated groups are *likely* to form, linking members who are physically dispersed, but who share common interests and seek competitive advantage by association. Politically, globalisation is *likely* to raise levels of interdependence between states that are increasingly integrated within the globalised economy.

A feature of globalisation is *likely* to be the continuing internationalisation of markets

Climate Change

Overwhelming evidence indicates that the atmosphere *will* continue to warm at an unprecedented rate throughout the 21st century. A scientific consensus holds that a large part of this warming is attributable to human activities, primarily through increased concentrations of carbon dioxide and other greenhouse gases. However, there is uncertainty about the rate and magnitude of change over the next century. For example, feedback mechanisms, such as melting ice-caps that accelerate global warming as less light is reflected back to space, *may* play a significant role. Despite this uncertainty, by 2040, the global temperature is *likely* to have risen by around $2^{o}C$ above pre-industrial levels. This rise is independent of future emissions agreements which *will* be vital only in limiting the magnitude of change beyond 2040. These agreements *will* be highly politicised, especially given their effect on relationships between the developed and developing economies.

Overwhelming evidence indicates that the atmosphere *will* continue to warm

Climate change *will* affect the land, the atmosphere and the oceans, and *may* be an unstable and unpredictable process, involving both progressive evolution and sudden instabilities. Major changes are *likely* to include melting ice-caps, progressive thermal expansion of the oceans, and increasing acidity of seawater as carbon dioxide transfers from the atmosphere. These changes *will* have consequences that vary over time and geographical extent. For example, some regions *will* experience desertification, others *will* experience permanent inundation, and tundra and permafrost are *likely* to melt, releasing methane, *possibly* in large amounts.[13] Land available for habitation is *likely* to reduce, and patterns of agriculture are *likely* to change. Tropical diseases, such as malaria, are *likely* to move north and into previously temperate zones. Extreme weather events *will* change in frequency and intensity, threatening densely populated littoral, urban and farming regions with changing growing seasons, flooding and storm damage, and resulting in increased migration.

---

[13] Methane is 8 times more powerful as a greenhouse gas than carbon dioxide.

Global Inequality

Economic, social and political inequality of opportunity, occurring between both individuals and groups *will* continue to fuel perceptions of injustice among those whose expectations are not met. This *will* increase tension and instability, both within and between societies and result in expressions of unrest such as disorder, violence, criminality, terrorism and insurgency. While material conditions for most people are *likely* to improve over the next 30 years, the gap between rich and poor is *likely* to increase. Absolute poverty *will* remain a global challenge. Significant *per capita* disparities *will* exist within most countries and across some regions. In some areas of sub-Saharan Africa, previous falls in poverty *may* be reversed. Differentials in material well-being *will* be more explicit, highlighted by increased access to more readily and cheaply available telecommunications. Associated grievances and resentments are *likely* to increase despite growing numbers of people being materially more prosperous than their parents and grandparents. Inequality *may* also lead to the resurgence of not only anti-capitalist ideologies, *possibly* linked to religious, anarchist or nihilist movements, but also to populism and even Marxism. Conversely, it *may* also lead to demand for greater access to the benefits of globalisation and greater connectivity for the least developed states.

Significant per capita disparities *will* exist within most countries

Innovation

Innovation *will* create new opportunities and generate value, by successfully exploiting new and improved technologies, techniques and services, overcoming cultural and process barriers. It *will* occur when invention reduces costs to a point where an explosive growth cycle is realised or where a new market is created. For example, over the past 20 years the reducing cost of mobile telecommunications has made them readily available. Scientific advancement or invention is *likely* to produce breakthroughs in several disciplines primarily in Information and Communications Technology (ICT), though developments *will* also be observed in biotechnology, and energy management. Examples of such advances include: growth in biotechnology pharmaceuticals, stimulated by an ageing population; and energy management advances driven by the need to reduce carbon usage and reliance on fossil fuels. The complexity and interdependence of physical, social, and virtual environments *will* increase, and successful innovation is *likely* to require a collaborative, networked approach to development. The overall pace and direction of this development is *likely* to be driven by commercial logic, although initial research activity is *likely* to remain primarily government funded. There is *likely* to be significant lags between invention and the development of ethical norms governing their application. Also, the fact that innovation is a creative process that is difficult to control or regulate *may* make it easier for immoral actors to evade controls, leading to perverse applications.

Scientific advancement is *likely* to produce breakthroughs in several disciplines, such as transport

Key Theme – The Human Environment

People are, and *will* remain, the most important driver of change, underpinning societal, geopolitical and security developments. This section seeks to investigate trends in society by considering how challenges in the physical domain, combined with societal change and technological advances, will shape the human environment. Robust demographic growth, resource scarcity and the need to address climate change *will* require innovative technological and organisational solutions that have a profound effect on society. These demographic, physical and economic drivers will be interlinked and intense, shaping behaviour, development and the need for adaptation out to 2040.

The *Human Environment Key Theme* considers:

- The Physical Environment.

- Changes in Society.

- The Technological Challenge.

The hot topics are *Radicalisation* and *Global Health*.

The Physical Environment

The global population is *likely* to grow from 6.9 billion in 2010 to 8.8 billion by 2040 with many enjoying increasing prosperity accompanied by burgeoning material expectations.[14,15] Rapid population growth is a continuation of a trend stretching back to the last century that is *likely* to continue, before *possibly* moderating late in the 21st century as economic development leads to a progressive decline in global fertility rates.[16] Population driven resource demand is therefore *likely* to increase in intensity out to 2040 before gradually subsiding in the late 21st century as technological and organisational innovations take effect, and the rate of population growth declines. The most acute stresses are *likely* to arise from competition for energy, food and freshwater, as well as access to the 'global commons'.[17]

---

[14] For instance in India the middle class has tripled in size to 250 million people and may reach 50% of the population by 2040. *Time Asia*, November 2004.

[15] In 1998, the United Nation (UN)'s best estimate for 2050 was that there would be 8.9 billion humans on the planet. Two years later, the figure was revised to 9.3 billion. The number subsequently fell and rose again. Modest changes in birth rates can have significant consequences over a couple of generations. For example, rises in US and European birth rates are among the developments factored into the UN's latest 'middle' projection that world population in 2050 will be just over 9.1 billion. *UN Population Division of the Department of Economics and Social Affairs*.

[16] Processes such as globalisation and urbanisation are likely to contribute to the trend towards smaller family size seen in developed countries over the past 50 years. This trend is likely to continue in developing countries. For example, a recent UN projection assumes a decline of the global fertility rate to 2.02 by 2050, and eventually to 1.85, with total world population starting to decrease by the end of this century. Department of Economic and Social Affairs, Population Division, *World Population in 2300*, 2004.

[17] The 'global commons' are those regions used jointly by the members of a community. They include, but are not limited to, those parts of the earth's surface beyond national jurisdictions such as the open ocean and the living resources found there, the atmosphere and orbital Space. The only landmass that may be regarded as part of the 'global commons' is Antarctica.
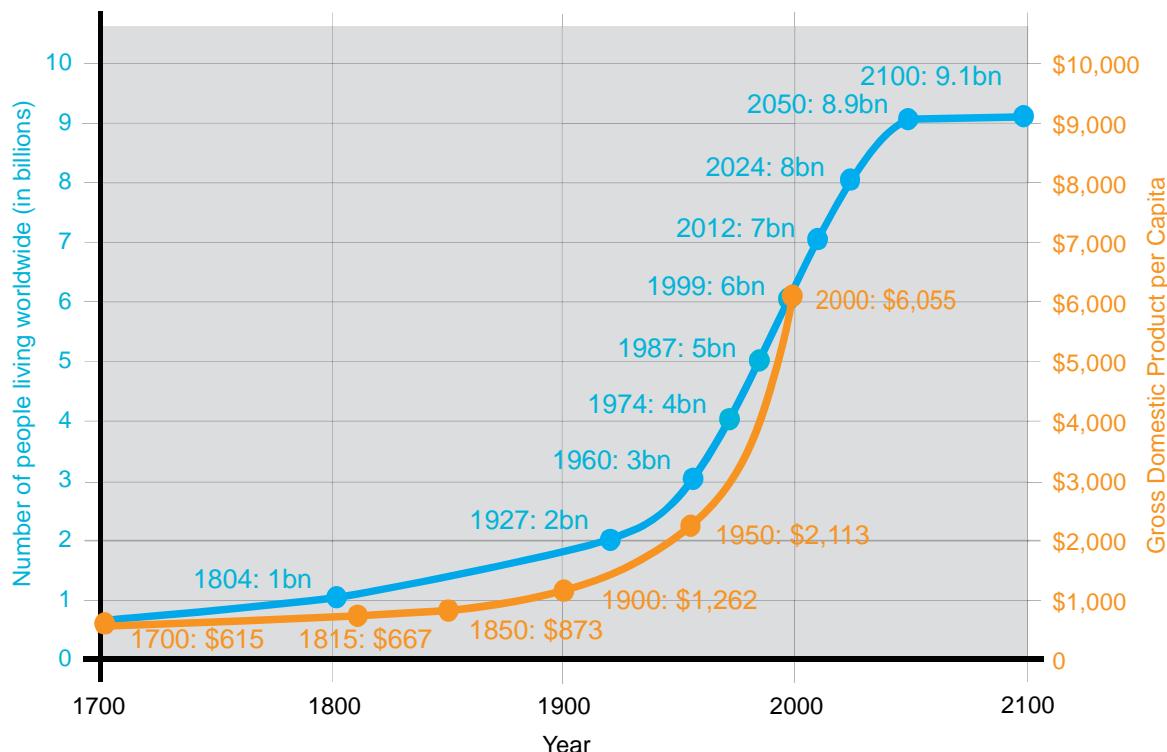
Figure 2 – Projection of Global Population from 1700 to 2048

Global energy, food and water supplies are *likely* to be sufficient for the increased global population. However, geographic distribution, access, cost and transportation *will* be critical issues. The inability of some regions and segments of society to meet the costs involved in accessing resources makes local and regional scarcity *likely*, stunting economic and societal development and leading to poverty, instability and conflict. For example Mexico city has already experienced conflict over access to water supplies.[18] Despite this, growing numbers of people are *likely* to enjoy increasing affluence as consumption and global Gross Domestic Product (GDP) *per capita* rise. Such economic growth is *likely* to lead to a continued reduction in absolute poverty; however, rapid population growth *may* contribute to increased levels in the least developed regions.[19] Economic development is *likely* to be directly linked to greater resource consumption. However, an increased number of cars, the change to protein-rich diets, and increasing personal water usage *will* be partially offset by the emergence of renewable and unconventional energy sources, increasing crop yields and innovative solutions, such as conservation measures.[20] Producer and consumer economies *will* seek political and economic partnerships to guarantee supply, some of which *will* require moral compromises to be made. Scrambles for energy, minerals and fertile land are *likely* to occur with increasing intensity. These scrambles *may* not always be motivated by immediate shortage, as many states compete for access to long-term supplies and

---

[18] Barkin D, *Mexico City's Water Crisis*, NACAL Report on the Americas 2009 and Dry Taps in Mexico City: *A Water Crisis Gets Worse* at http://www.time.com/time/world/article/0,8599,1890623,00.html
[19] Absolute poverty is defined here as those living on the equivalent of $1 per day or less.
[20] These sources include photovoltaic cells within solar panels that are used to convert solar energy into electricity and exploitation of tar sands. These are oil-rich rocks that contain a form of hydrocarbon that currently requires considerable effort to extract and process.

develop extensive strategic reserves. The combined effects of climate change and increased demand for food production are *likely* to alter the productivity and distribution of the world's 'bread-basket' regions and accelerate soil degradation in previously fertile areas. The inequality between areas that either possess an abundance of natural resources, or can afford access to them, and those that cannot is *likely* to be a source of grievance, providing an ethical challenge to the global market-based economic system.

By 2040 climate change, and associated measures designed to limit greenhouse gas emissions, *will* have a significant effect on the development of societal norms, the cost and usage of energy, land use, and economic development strategies. A new, higher temperature global climate *will* be a reality and many measures to limit further long-term temperature increases are *likely* to have been implemented. The measures are *likely* to be agreed multilaterally after a period of discord regarding the associated economic and financial burden of how individual states and regions bear the costs. These disagreements, based on differing narratives for apportioning responsibility for climate change, are *likely* to be particularly intense between developed and developing economies.[21] This is *likely* to place greater emphasis on sustaining rather than maximising economic growth, particularly in the West. Options for enhancing sustainability include technological solutions, such as carbon capture and storage[22] that are *likely* to allow widespread usage of fossil fuels to continue. Material expectations *will* be tempered by greater environmental awareness. These developments *will* mitigate, and *may* counteract, a number of the long-term de-stabilising impacts of climate change, but considerable uncertainty surrounds the rapidity with which such solutions can emerge, and adaptation is *unlikely* to be smooth or wholly successful.

Climate change, and the progressive impact of gradual temperature increases, *will* exacerbate resource scarcity by altering regional precipitation patterns, affecting agricultural production capacity, and worsening existing problems of resource distribution and access. Climate change *will* also cause some previously infertile land regions to become fertile. However, such regions are *likely* to lack the necessary farming infrastructures and it *will* take considerable time and effort to establish them. These changes in the pattern of agriculture are *likely* to impact on food security. Environmental changes are also *likely* to lead to significant increases in environmentally-induced migration. Such migrants are *likely* to move locally, and then regionally, with a relatively small proportion of them moving internationally. However, much of the migration *will* be uncontrolled and generate significant social and economic impacts wherever it occurs. States and cities that are unable to cope are *likely* to seek international humanitarian assistance of unprecedented scale and duration.

---

[21] Such difficulties were exemplified during the Copenhagen summit in December 2009.
[22] The first prototype carbon capture unit in the UK, run by Scottish Power, is working at a coal-fired power station in Longannet. During tests it has captured around 90% of the carbon content emitted from exhaust gas. *Carbon Capture Journal*, 30 November 2009.

Changes in Society

Out to 2040, the demographic profiles of societies *will* change. The developing world *will* account for the majority of population growth and represent 7.6 billion people, or around 85% of the global total.[23] Many of these people *will* enjoy improved economic status and heightened material expectations. This economic development, along with widespread availability of birth-control measures, increasing life expectancy and continued urbanisation, is *likely* to temper birth rates in some regions. However, limited economic development and cultural norms *will* persist, sustaining high fertility rates in other regions such as sub-Saharan Africa, parts of the Middle East and Asia, and specifically in countries such as Afghanistan, Syria, Yemen and Pakistan.[24] In contrast, Europe, Japan and eventually China and Latin America are *likely* to face the problems of an ageing and declining population. Russia, in particular, is *likely* to experience a population collapse from over 140 million in 2009 down to 122 million by 2040, posing significant social, security and economic problems, particularly as the decline is most acute amongst ethnic Russians rather than minority groups.[25] However, the long-term decline in fertility rates experienced by the most developed states is eventually *likely* to be halted, or even reversed, as societal norms change.[26]

Climate change *will* amplify existing social, political and resource stresses. It is *likely* to be an indirect factor that sets the conditions for conflict, rather than directly causing it. The effects of climate change are *likely* to dominate the global political agenda, especially in the developed world where it *will* represent an increasingly important single issue. The developed world is *likely* to experience a degree of transformation as it moves from a consumerist society based on freedom of choice to a more constrained, sustainable societal model that provides financial and social rewards to encourage greener practices and discourage waste. This *will* represent a shift in international norms as the developed world looks to achieve sustainability, while the developing world continues to concentrate on building the infrastructure required to maximise economic growth. Despite this, the developing world is *likely* to represent an important engine of innovation where new, cheap, environmentally sustainable technologies are trialled without opposition from industrial interests that defend inefficient, legacy systems. The developing world is *unlikely* to be constrained by the stringent legal controls applied to the developed world. In certain research areas, such as cloning and clinical trials, this *may* lead to technological advances that *may* be deemed unethical in the West.

---

[23] UN Population Division definition 2008. All regions of the world except Europe, Northern America, Australia/New Zealand and Japan.

[24] By 2040, Afghanistan is likely to see its population increase from 29.1 million in 2010 to 62.3 million in 2040; Syria from 22.5 million to 34.1 million; Yemen from 24.3 million to 46.9 million; and Pakistan from 184.8 million to 302.8 million. *UN World Population Prospects*, 2008 Revision, Medium Variant.

[25] The population of the Russian Federation is projected to be 140 million in 2010 declining to 122 million by 2040. A decline of 18 million over 30 years (10950 days) equates to a loss of 1700 people a day. *UN Population Division*, 2008 Revision, Medium Variant.

[26] Fertility has tended to decrease with increases in prosperity and living standards (as measured by the Human Development Index (HDI)). However, this may only be true for earlier stages of development. At higher levels of development (above a HDI of 0.86 a level only found in the most developed economies) fertility in many countries increases with HDI. Thus, falls occur as HDI approaches 0.86, but above that level HDI begins to increase again in many countries. It is likely that countries with an HDI above 0.86, such as Italy, Spain, Netherlands, Germany, and Sweden, have implemented policies that persuade women to have children. However, other countries, such as Canada, South Korea and Japan, have not yet followed this path. Shripad Turjapurkar, 2009, *Babies make a comeback*, Nature, Volume 460, page 693. Myrskyla et al (2009), *Advances in development reverse fertility declines*, 2009.

Russian Federation

Population in millions: 140.4 (2010), 122.1 (2040)
Average age: 38.1 (2010), 45.5 (2040)

China

Population in millions: 1354.1 (2010), 1455.1 (2040)
Average age: 34.2 (2010), 44.1 (2040)

South-Eastern Asia

Population in millions: 589.6 (2010), 744.7 (2040)
Average age: 27.8 (2010), 37.3 (2040)

Europe

Population in millions: 732.8 (2010), 708.5 (2040)
Average age: 40.2 (2010), 46.9 (2040)

India

Population in millions: 1214.5 (2010), 1564.8 (2040)
Average age: 25.0 (2010), 35.3 (2040)

Oceania

Population in millions: 35.8 (2010), 48.2 (2040)
Average age: 33.0 (2010), 37.9 (2040)

UK

Population in millions: 61.9 (2010), 70.2 (2040)
Average age: 39.9 (2010), 42.3 (2040)

Africa

Population in millions: 1033.0 (2010), 1769.6 (2040)
Average age: 19.7 (2010), 25.9 (2040)

Global

Population in billions: 6.9 (2010), 8.8 (2040)
Average age: 29.1 (2010), 36.6 (2040)

USA

Population in millions: 317.5 (2010), 388.9 (2040)
Average age: 36.6 (2010), 40.8 (2040)

Latin America and the Carribean

Population in millions: 588.6 (2010), 718.0 (2040)
Average age: 27.7 (2010), 38.6 (2040)

Figure 3 – Global Population Growth and Age Demographic by Region 2010 - 2040

Broader and deeper social interaction, facilitated by globalisation, sustained international migration, and ubiquitous global ICT connections *may* drive the development of a global culture, although the characteristics this culture takes are difficult to anticipate. Social trends are *likely* to reinforce this, with some religious movements, such as Pentecostalism, becoming increasingly globalised in outlook and character. Furthermore, individuals and small businesses are *likely* to become increasingly connected to world-wide markets. The complex international relationships that result are *likely* to lead to an increased familiarity with other cultures. Knowledge of overseas events is *likely* to become constant and real-time, providing the opportunity for violent responses to be orchestrated through communications networks that *may* be untraceable and poorly understood by the traditional security apparatus. The social tensions caused by intrusive global culture are *likely* to be most acute amongst those who seek to maintain their indigenous and traditional customs and beliefs, and feel threatened by changes. This is *likely* to lead to an increasing number of individuals and groups, many of whom form around single issues that differentiate them from wider society, becoming marginalised and *possibly* radicalised.

Protest on global issues *may* be conducted on rapidly expanding scales

The presence of transnational diaspora, with close ties to their home countries, *will* often cause events in the migrants' state of origin to become political issues in the host state. Protest action in response to global or transnational issues *may* be conducted on an expanding scale with, for example, local events in Bangladesh leading to protests by ethnic Bangladeshis in London. These protests *may* include demands for intervention to address problems in the state of origin or, alternatively, lead to transnational inter-communal violence conducted between different ethnic communities in the host country. Often, the host state government *may* be perceived as a source of grievance due to

ideological or cultural differences. When such conditions exist, particularly when exacerbated by high levels of marginalisation and social exclusion, sections of the populace *will* develop grievances that *may* lead to extremism. Examples include the 7/7 attacks in 2005 on the London transport network where terrorism was justified through reference to historical injustices, repression, and violence against Islam.[27] Technology *will* facilitate the organisation of protests and high impact terrorist attacks that occur rapidly, and without fore-warning, and seek to achieve symbolic effects that create the greatest media impact. The 2004 Madrid train bombings in the run-up to the Spanish national elections demonstrate the ability of trans-national terrorism to achieve political effect.

Regions of alternatively governed space *will* continue to exist in both rural and urban environments where instruments of legitimate national governance do not operate effectively and power resides locally with tribal groups, warlords or criminal gangs. Diaspora communities in developed states *may* form similar enclaves.[28] Instability, crime and terrorism are *likely* to radiate from such centres making their containment or stabilisation an ongoing international problem. Regions that suffer the highest levels of inequality and poverty are also *likely* to experience increased risk of humanitarian catastrophes caused by an amalgam of climate change, resource pressures, the effect of disease, and population growth. Clear moral cases that invite humanitarian intervention *will* persist.

Within the global system an innate cultural divide is *likely* to remain between societies that are principally individualistic in outlook and those that foster strong collective identities. Both types of society *will* be challenged and undergo change. For example, collectivist societies are *likely* to face calls for more democracy, freer markets, freedom of speech and belief, and individual legal rights. However, individualistic societies are *likely* to experience tensions as their constituents increasingly question the role and authority of the state and wrestle with the balance between the needs of the many and the rights of the individual. For example, China is *likely* to continue to foster a strong collective identity based on nationalism. However, the manner in which the Chinese state resolves the inevitable tensions associated with the rise of individualism, along with divided allegiances as open religious affiliation becomes more widespread, *may* come to define its future path.

Religious affiliation *will* remain a collective identity that transcends national boundaries. Many religions *will* have transnational presence and institutions such as the Roman Catholic Church *will* remain influential and Islam as a faith *will* continue through the 'umma'[29] to unify individuals across borders. In a number of religious contexts, including Judaism, Sikhism and Islam, religious identity is *likely* to remain more significant than national identity. Because of increasing global connectivity diaspora communities are more *likely* to react to events impacting on their religious or cultural identity. Single issues, such as women's rights, or the desire to practise different languages or cultures, *will* form barriers to integration, generating further tensions and *possibly* conflict. However, although these differences *may* result in tension between different societies,

---

[27] J Githens Mazer, *Islamic Radicalisation among North Africans in Britain*, British Journal of Politics and International Relations PJPIR: Volume 10, pages 550-570, 2008.
[28] For example, Albanian, Jamaican or Somali criminal gangs operating in cities such as London.
[29] 'Umma' is the Arabic term for the whole community of Muslims bound together by the ties of religion.

they are *unlikely* to result in a 'Clash of Civilisations'.[30] Moreover, external influences and extended exposure to liberal cultures is *likely* to soften support for violent extremism and gradually decrease the impact of ideologically-driven terrorism.

As the globalised economy becomes increasingly dependent on knowledge-based industries, creativity and innovation, the importance of advanced education *will* increase. However, global access to education *will* remain variable, although ICT based initiatives are *likely* to improve basic skills in numeracy and literacy. Those who do become better educated *may* suffer frustration if they continue to experience inequality of opportunity based on their physical location, culture or language. The increasing role that ICT will play in future society is *likely* to lead to the vast majority of individuals developing the skills required to use and operate such technology. However the proportion of the population with the harder skills required to understand the fundamental principles of how such technology works is *likely* to decline.[31]

The state *will* remain the pre-eminent actor in international relations and many individual states *will* be dominated by elite groups that emerge from distinct socio-economic, educational, tribal and ethnic groups. However, the emergence of a global elite, a powerful network of individuals and institutions that sits above the level of individual states and influences the global agenda, is also *possible*. Elites provide an indication as to how different regions *may* see the world and to what strategies they afford the greatest priority. The Western world is *likely* to remain dominated by personality politics with charismatic leaders engaging their publics on emotional and personal issues based on morality and values. In East Asia, a more technologically focused leadership *will* seek stability, economic growth and the collective good, affording less significance to social issues and individual rights. In the developing world, traditional forms of organisation are *likely* to remain significant even if states transform their governance structures according to democratic principles. Transformation, especially if it is driven by globalisation, is *likely* to generate tensions within traditional systems and *may* spill over into conflict between groups, as was illustrated by violence following the 2007 Kenyan elections.[32] Countries that sustain both caste and class systems *may* also experience internal tensions or instability as hierarchical systems become subject to stress.

---

[30] Huntingdon S, *The Clash of Civilisation and Remaking of World Order*, 1993.
[31] Hard skills describe technical disciplines such as maths, engineering and physics.
[32] The Economist, *Kenya's Dysfunctional Coalition Government,* 23 April 2009.

Hot Topic – Radicalisation

Radicalisation is defined as the process of advocating political, ideological or societal reform that can, in some instances, lead to the generation of extremist beliefs and terrorist activity.[33] Extremists, either violent or non-violent, are those radicalised groups and individuals who are willing to cross ethical and legal boundaries. Terrorists are the most fanatical examples of extremists, willing to use 'armed propaganda'[34] to achieve their goals and are *likely* to develop compelling messages to gain support. Through considered narratives, which explain their aims and actions to a target audience, such groups are *likely* to encourage local responses in support of their objectives.

Out to 2040, radicalisation *will* continue, driven by a range of complex factors, such as the gradual shift in political beliefs, individual and group grievances,[35] and economic and social inequalities.[36] Although the precise links between poverty and radicalisation remain unclear, poverty is *likely* to encourage radicalisation due to the grievances it generates and the long-term stresses it causes. Traits exhibited by fragile states, including high levels of inequality, poor human rights, and minimal social support, healthcare and welfare systems, are *likely* to allow radicalisation to develop.[37] States in the liberal, developed world are also *likely* to experience radicalisation, partly as a consequence of globalisation, migration and sustained societal inequality. State actions are *likely* to have a significant impact on the process of radicalisation. For example, during stabilisation operations, the over-vigorous application of military power to crush radical groups *may* result in increased public support for them, or drive them to ally with other extremists. Moreover, it *may* force radical groups to become more extreme, *possibly* condensing into terrorist cells.

Many of the conflicts and disputes exploited by international terrorist organisations show no signs of early resolution and, out to 2040, international terrorism *will* persist. Terrorist organisations, such as al-Qaeda, are *likely* to evolve, while maintaining their overall strategic aims.[38] Al-Qaeda's pursuit of global objectives *will* rely upon radicalisation to provide support and to generate the conditions in which they can operate.

However, there *may* be a number of factors that reduce the spread of international terrorism. For example, ideologies based upon a selective interpretation of Islam, contemporary politics and history, are *likely* to be rejected by many Muslims across the Islamic world. The use of terrorist violence is *unlikely* to succeed in the long-term and indiscriminate killing is *likely* to further erode terrorist support and credibility.[39]

---

[33] Moskalenko S and McCauley C, *Measuring Political Mobilisation: The Distinction between Activism and Radicalisation*, Terrorism and Political Violence 21:2, April 2009, pages 239-260.
[34] Armed propaganda is classically viewed as the mechanism through which a terrorist group tries to advance its goals by violent action, based on how a given attack will influence external audiences and constituencies.
[35] The desire to respond to grievances (either long established or recently generated) can be due to the impact of a single event, such as the killing of a family member or a perceived ethnic, tribal or religious affront by another group.
[36] Relative deprivation itself is the discrepancy between what an individual or group has, and what they believe they are entitled to. Gurr suggests that relative deprivation leads to discontent, which tends to lead to politicisation of discontent, which can lead to political violence. Ted Robert Gurr, *Why Men Rebel*, 1970.
[37] Department for International Development (DFID), *Eliminating World Poverty: Building Our Common Future*, July 2009.
[38] Assuming continued international pressure, the al-Qaeda 'core' organisation is likely to fragment and may not survive in its current form. The core group will not be able to achieve its strategic goal (popular unrest and uprising leading to the overthrow of governments and the establishment of a caliphate), but it will still have the capability to conduct significant terrorist attacks. *The United Kingdom's Strategy for Countering International Terrorism*, March 2009.
[39] *Ibid.*

New forms of extremism and terrorist violence are *likely* to emerge, both locally and internationally. For example, in China the polarisation of societal structures and inequality between the elite, the urbanised workers and rural peasants are *likely* to become a source of grievance. Consequently, China *may* experience the radicalisation of a new generation of urban workers, who already number around 120 million, and have been drawn from the countryside by the prospect of better paid employment but do not receive the same rights as those originating from the city.[40]

The Technological Challenge

Technology *will* provide partial solutions for both adapting to, and mitigating the effects of, climate change. However, it is *unlikely* that, by 2040, technology will have produced low emission energy sources capable of providing the majority of the energy demanded. Nevertheless, advances in carbon capture technology are *likely* to be significant, allowing fossil fuel usage to continue in a limited emission regime, with particular expansion in the use of coal. Despite this, resource competition, carbon pricing, increased energy demand and the limitations imposed by climate change are *likely* to increase the cost of fossil fuels, stimulating the development of cleaner, renewable energy solutions and nuclear power.[41] Supply and

Developments in social networking technology *will* continue

demand for energy are *likely* to be closely matched. However, an inability to alter supply rapidly, in response to sharp changes in demand (and vice versa), is *likely* to result in market volatility and price spikes. Supply problems are *likely* to be exacerbated by under-investment, instability and the deliberate actions of states seeking wider political objectives, making energy security an ongoing concern. These spikes are *likely* to be of greater magnitude than in previous energy crises, severely affecting global economic growth and making the development of novel energy sources, previously deemed economically unviable, both economically and politically necessary.[42] These economic imperatives *will* transform energy production and usage, but breakthrough events, such as commercially viable nuclear fusion, are *unlikely* to come to fruition by 2040, and regions rich in natural resources *will* therefore retain strategic importance. Emerging research into fledgling disciplines such as geo-engineering *may* provide methods to ameliorate climate
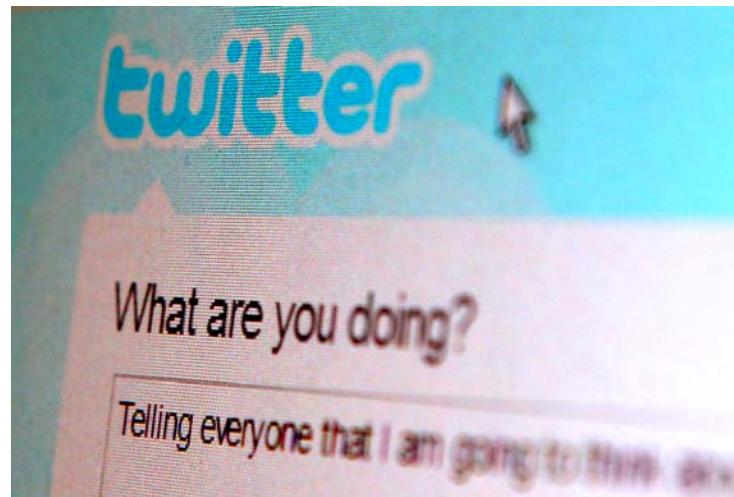
---

[40] *The Radicalisation of a New Chinese Working Class: A Case Study of Collective Action in the Gemstone Industry* , Third World Quarterly, Volume 30, No.3, 2009, pages 551-565.
[41] Carbon pricing provides economic incentives to reduce carbon emissions.
[42] As mineral processing and extraction technologies become increasingly efficient, previously exhausted reserves may become economically viable again. This could also include the mining of refuge and waste sites.

change. However, attempts to conduct geo-engineering projects in the Earth's complex biosphere are *likely* to be a source of tension and considerable anxiety regarding unintended outcomes.

The future global environment *will* be defined by physical, social and virtual networks. The physical system *will* consist of complex interconnections, including extensive resource pipelines, communication cables, satellites and travel routes. The virtual networks *will* consist of communications servers linking individuals and objects, many of which *will* be networked through individual Internet Protocol (IP) addresses. The majority of individuals are *likely* to have access to network connections leading to large-scale changes in identity through the use of multiple online profiles. Remote working is *likely* to become the norm with controlled network spaces representing the new work environments. Virtual reality technologies are *likely* to blur the distinction between real and virtual life, facilitating the formation of ubiquitous groups that *will* form and disband with considerable rapidity. New ideas, beliefs and fads *will* be transmitted near-instantaneously around the globe. Avenues for protest, and opportunities for new and old forms of crime, *will* emerge and *may* allow hostile groups to form and rapidly create effect. At the same time, however, greater access to information resources *will* expand the opportunities for research and knowledge development through virtual interfaces, diminishing the effect of geographic separation between those who seek to collaborate. The increasing ease of use and importance of computers and networks in many aspects of life is *likely* to lead to dependence on them and create critical vulnerabilities for potential adversaries to attack. These vulnerabilities *will* be reduced by reversionary options and in the longer term resilience *may* be increased by the development of intelligent, self-repairing networks. However, institutions based upon hierarchical, ordered structures, *will* find themselves challenged by competitors and potential adversaries who are able to capitalise on the rapidity of communication and group formation enabled by social networking technology. There *may* be need for bureaucracies to decentralise to address these challenges.

Developments in social networking technology *will* continue to facilitate the rise of 'citizen journalism' and make it increasingly difficult for even the most autocratic states to control access to information, especially as globalised connectivity allows local news stories to be broadcast instantaneously across the globe. In such circumstances tension and instability are *likely* to occur as autocratic states attempt to address rapid changes in popular opinion through force. The public response to the 2009 Iranian elections, with information spread and protests coordinated through transnational social networks, provides an example of the potential impact. Similarly, in response to the 2008 earthquake in the Sichuan Province, the Chinese government relaxed its policies on the control of social network services leading to an increased coordination of aid, but simultaneously creating a virtual environment in which the official response to the disaster could be openly criticised by the general public, leading to wide-scale protest and unrest.

Hot Topic – Global Health

By 2040, health *will* be recognised as a fundamental global issue. Acknowledgement that healthcare provision contributes to stability at local, national and global levels *may* lead to increased international investment in global health in order to reduce inequality and also provide positive opportunities for education and training. Such developments are *unlikely* to be rapid, but *will* be accelerated by high impact events, such as pandemics and episodes of mass migration.

Average global life expectancy is *likely* to increase, driven by continued advances in the quality and coverage of healthcare. However, access to healthcare is *likely* to remain unequal between the developed and developing worlds and, at the national level, between different socio-economic groups. Hence, although health inequality *will* be affected by genetic, cultural and behavioural drivers, the most significant inequality drivers are *likely* to be material deprivation and an individual's local socio-economic environment. The costs associated with healthcare in the ageing societies of the developed world *will* be considerable, especially in Europe, but also in Japan, Korea and China. Individuals in the developed world and in the expanding middle-classes of India, China and Latin America are *likely* to demand increasing levels of healthcare. Geriatric and palliative medicine *will* become increasingly important with a significant proportion of the global healthcare industry existing to prolong life.[43] This *will* create an increased burden on states in addressing long-term health requirements and also increasing pension commitments and welfare support. These costs, and continual pressure to improve healthcare standards, *will* be an important ongoing political issue that exerts pressure on government budgets.

The geographic extent of certain diseases, such as Dengue Fever, *will* spread

---

[43] Palliative medicine treats the symptoms not the cause of disease.

Dependence on international trade, relatively unconstrained movement of people, and high levels of legal and clandestine migration *will* minimise the opportunities to isolate outbreaks and provide channels that can propagate a viral pandemic. Other diseases such as cholera, malaria, water-borne infectious diseases, tuberculosis and hepatitis *will* remain significant. The geographic extent of certain diseases *will* be modified by variations in climate, with regions not previously susceptible to diseases, such as Dengue fever and Lyme disease, becoming progressively affected. In the developing world, global inequality in healthcare provision *will* result in medical care being poorly coordinated and often reactive. Many states *will* lack access to a legal pharmaceutical industry, depending instead on unregulated and often counterfeit sources of drug and vaccine production. The level of HIV/AIDs *will* remain significant in the developing world and within Russia, although increased awareness, better availability of anti-retroviral medications, and the *likely* development of a successful vaccine, are *likely* to make the disease less of an international concern. Variability in healthcare provision and treatment regimes make it *likely* that previously manageable diseases, such as tuberculosis, MRSA and other bacterial or viral infections, *will* continue to be prevalent.

Global recognition of the importance of a healthy lifestyle is *likely* to increase. Diagnosis and treatment of genetic diseases *will* improve, and lifestyle choice is *likely* to become the main driver of poor health in the developed world. The treatment of chronic lifestyle diseases *will* grow in importance, placing increased emphasis on primary care. Individuals within the developing world are increasingly *likely* to be exposed to Western, mass-consumer dietary options and lifestyle vices and *will*, consequently, fall prey to similar lifestyle diseases.

Significant healthcare developments are *likely* in the global pharmaceutical industry with novel and targeted drug design solutions arising from the application of advanced genetics and nano-technology. Stem-cell technology is *likely* to lead to the growth of tissue specific cells and organs. Research *will* remain ethically controversial, but its application is *likely* to prove its utility, especially as mature cell re-programming develops. Screening and real-time health monitoring *will* be available and systems able to regulate health down to the cellular or even nuclear level are *likely* to be developed. Genetic testing and modification of foetuses *will* be achievable, although strict regulation in many societies *may* result in offshore or illicit treatment centres emerging. Human augmentation, especially with mobile communications and computing devices, *will* become practicable and *may* have significant military application, despite ethical and legal concerns.

Key Theme – The Dynamics of Global Power

This key theme examines shifts in geopolitical power out to 2040. The locus of global power *will* move away from the Atlantic towards Asia and the Pacific, as the global system shifts from a uni-polar to a multi-polar distribution of power and the hegemonic dominance of the US diminishes. This is *likely* to place increasing stress on the international rules-based system and generate opportunities for both cooperation and confrontation between major powers.

The Dynamics of Global Power analyses trends in:

- The Changing Distribution of Global Power.

- Globalisation and Instability.

- Interdependence and Competition.

- Geopolitical Influence.

- The International System – subdivided into the following groups:
  ° Contemporary Powers;
  ° Rising Powers;
  ° Emerging Powers;
  ° Pivotal Regions.

The Hot Topics within this section are ***Frontier Disputes*** and ***The Asian Meridian***.

The locus of global power *will* move away from the Atlantic towards Asia and the Pacific

The Changing Distribution of Global Power

The distribution of the elements of global power is complex.[44] For long periods of the late 20th century power was concentrated either in the 2 superpowers, or, with the fall of the Soviet Union, in the United States as the global hegemon. While military power is currently concentrated in a few, great or major powers,[45] economic power is more widely spread across a range of state actors and global institutions, and in this realm, power is already multi-polar. The shift in power from the US and Europe to Asia, coupled with the global challenges of climate change, global resource scarcity and population growth, is *likely* to result in a period of instability in international relations, accompanied by the *possibility* of intense competition between major powers.

The US is *likely* to remain the pre-eminent military power. However, in political, economic and military terms she is *likely* to become increasingly constrained and consequently her global leadership is *likely* to diminish. Moreover, the US and her allies *may* find it increasingly difficult to capitalise on softer elements of their power, as rising and emerging powers grow in influence and confidence. However, Western economic models, coupled with their relatively open societies, are *likely* to remain attractive influences to many individuals, especially entrepreneurs, and to some states. However, the rise of individual states, such as China, should not be considered a certainty given the nature and magnitude of the challenges they face, nor should their eventual influence be over-estimated. For example, the US, the European Union (EU) and Japan represent around 60% of world GDP and share many common values, such as a commitment to market economies and democracy. Out to 2040, this dominant position *will* fade, but together with like-minded allies they are *likely* to represent up to 50% of world output, have powerful military forces available, and exert significant influence over the international system, irrespective of the increased influence of China, India, Brazil and other actors. Moreover, the changing distribution of power is *unlikely* to be simple, linear or apply to all levers of power simultaneously. Most actors are *likely* to find adaptation challenging. The realignment process is *likely* to encompass a period of non-polarity, as states strive to realign their power to the changing strategic environment, and struggle to achieve objectives through traditional mechanisms.[46]

The processes of global governance capable of bringing interested parties together to tackle global issues are *likely* to continue to evolve, in particular to deal with collective challenges, such as climate change. The strength of the collective responses agreed *will* depend on perceptions of national interest, and be linked to the scope, breadth, cost of enforcement, and marginal costs involved. Perceptions of equity are also *likely* to be important. The global governance process is *likely* to help moderate the effects of instability by facilitating political cooperation rather than confrontation. However, the

---

[44] DCDC research identifies several complimentary definitions of power, including those of Nye, Waltz, Mearsheimer, Buzan and Waever. In summary, power status can be defined by the amalgam of military strength, access to resources, size of economies, educational opportunity, demographics, geo-political position and political stability amongst others.
[45] The US is currently the only great power; the major powers are China, Russia, France and the United Kingdom. Japan and Germany are major economic powers. Their status is *unlikely* to change out to 2040. However, powers, such as India and Brazil are *likely* to have achieved major power status by 2040 and China *may* reach great power status by 2040.
[46] Hass R N, *The Age of Non-polarity,* Foreign Affairs, Washington, May/June 2008 in this he stated 'the US uni-polar moment is over. International relations in the 21st century will be defined by non-polarity. Power will be diffuse rather than concentrated, and the influence of nation-states will decline as that of non-state actors increases'.

development of a truly effective global governance process capable of agreeing strong collective deals is *likely* to involve considerable discord and require the stimuli of significant international crises to drive change. Such crisis-induced change is *likely* to be the norm, rather than proactive and pre-emptive change and is *likely* to give the impression of an enduring crisis of global governance. Moreover, even when global agreements are reached on issues ranging from climate change to nuclear non-proliferation, many are *likely* to be ineffectually implemented and resistance to intrusive policing and regulatory frameworks *will* persist.

Global institutions such as the UN, the World Trade Organisation (WTO), G8 and G20, World Bank and the International Monetary Fund (IMF) *will* remain influential, especially in addressing the problems of a highly globalised and interdependent world. A global government is *improbable*. The contemporary powers *will* remain reluctant to share power and the rising and emerging powers *will* seek appropriate levels of recognition, especially in the UN Security Council (UNSC). Despite concessions, without significant reform the least developed states *may* continue to see global institutions as being unrepresentative of their interests and place most value on the services they provide.

The evolution of global governance institutions is *likely* to involve considerable discord

Globalisation and Instability

Globalisation is *likely* to continue.[47] It is both an idea and a process linked to transactions of capital, goods, services, people, intellectual property, information and resources that are conducted via physical and virtual networks. Its influence is *likely* to be pervasive, with the economic success of states dependent on access to, and exploitation of, opportunities within the globalised economy. However, many individuals and some political elites *will* regard globalisation as threatening to their interests and to social stability, resulting in periodic local arrangements that protect sensitive industries and sectors of societies. While globalisation is inevitable over very long time periods, it can be temporarily slowed, halted or even reversed as demonstrated by the events of the Great Depression (see the Economic Dimension). Out to 2040, widespread economic protectionist measures are *possible* in response to geopolitical insecurity or macro-economic instability. If implemented they would lead to a decrease in interdependence, an increase in inter-state and inter-bloc rivalries, and the fostering of confrontational rather than cooperative approaches, with significant defence and security implications.

Despite strong transnational trends, the state *will* remain the building block of the international system, providing security and economic opportunity for citizens. However, globalisation is *likely* to have a Darwinian 'survival of the fittest' effect on poor governance by dissuading international investment and providing incentives for governments to improve practice in order to meet accepted norms. Contemporary, rising, and emerging powers are *likely* to use their influence to promote and protect the globalised system on which their prosperity depends. In extremis, this *may* include using military force.

Security of global supply chains, and access to the 'global commons' and global markets *will* be a priority for virtually all states. Effective governance, regulation, operation and control of the networks that underpin economic activity *will* be an ever-present concern. These networks, in the maritime, land, air, cyberspace or space domains, traverse vulnerable chokepoints and are dependent on functioning nodes to link major centres of trade, finance, intellectual endeavour, energy production, and industrial production and consumption. The infrastructure underpinning these networks is *likely* to evolve as the global economy develops and new technologies are introduced. Inherent network resilience and redundancy is *likely* to be difficult to assess. However, they are *likely* to be vulnerable to infrequent external shocks that cause systemic disruption, although the form and severity this disruption takes is difficult to anticipate. Examples could include the following vulnerabilities: the impact of geopolitical instability on maritime choke-points; the disruption of energy production; distribution and refining capabilities due to regional conflicts and natural hazards; and the intensifying dependence of developed economies on cyberspace.

Regions that exhibit the most intense economic and financial global linkages, underpinned by the necessary network infrastructure, represent a globalised core, the geographical boundaries of which are illustrated in Figure 4. This graphic also illustrates important suppliers of energy and strategic minerals, and states at risk of instability. Given that

---

[47] For detailed explanation see Baylis, John and Smith, *The Globalisation of World Politics*, 3rd edition, Oxford University Press, page 773, 2005.

prosperity in the developed world is associated with globalisation, instability within the globalised core is *likely* to directly affect the interests of the developed world. Moreover, the Middle East and the Asian Meridian (see Hot Topic - The Asian Meridian) are regions where the globalised core, resource exporters and states at risk of instability are juxtaposed. Greater instability, with severe consequences to the international system is *likely*, making these regions particularly relevant out to 2040. In addition, the borders of the globalised core do not follow state borders. For example, the centres of industrial production and commerce in China's littoral regions are intimately linked into globalised networks, but the relationship of China's rural hinterland is different. Here, the predominant connection is the flow of remittances from migrant workers attracted to the rapidly-expanding conurbations by economic opportunity. Splits, such as these within a state, have always been present, but are *likely* to be remain a source of domestic social tension made more acute by the inequality generated between the economic 'haves' and 'have-nots'. The effects of such inequalities are context specific, but they *will* often be a cause of instability, threatening the cohesion of some states.

The number of internationally recognised states, as defined by membership of the UN, has grown rapidly. In 1950, the UN had 60 members but this had risen to 192 by 2009, an addition of around 2 states per year. Many new states were recognised following the independence of former European colonies and the collapse of the Soviet Union. However, others were created by violent, enduring separatist movements that fragmented previously viable states, for example in Yugoslavia. Out to 2040, state fragmentation is *likely* to continue, although the rate at which new states are recognised *will* slow. Some cities *may* also seek to secede from states and look for greater recognition as independent entities. Most new states are *likely* to be small both geographically and demographically and *will* seek alliances and protection to safeguard their independence and territorial integrity. For example, Slovenia gained independence in 1991, UN membership in 1992 and EU and NATO membership in 2004. *De facto* states that lack full international recognition, such as Kosovo, highlight some of the problems facing would-be states.[48] Not only does she have a history of conflict, but she is land-locked, has a large ethnic minority with close ties to Serbia, problems with governance and competing interests between the EU, the US and Russia who are all engaged in the region.

[48] Other *de facto* states include Transnistria and North Cyprus.
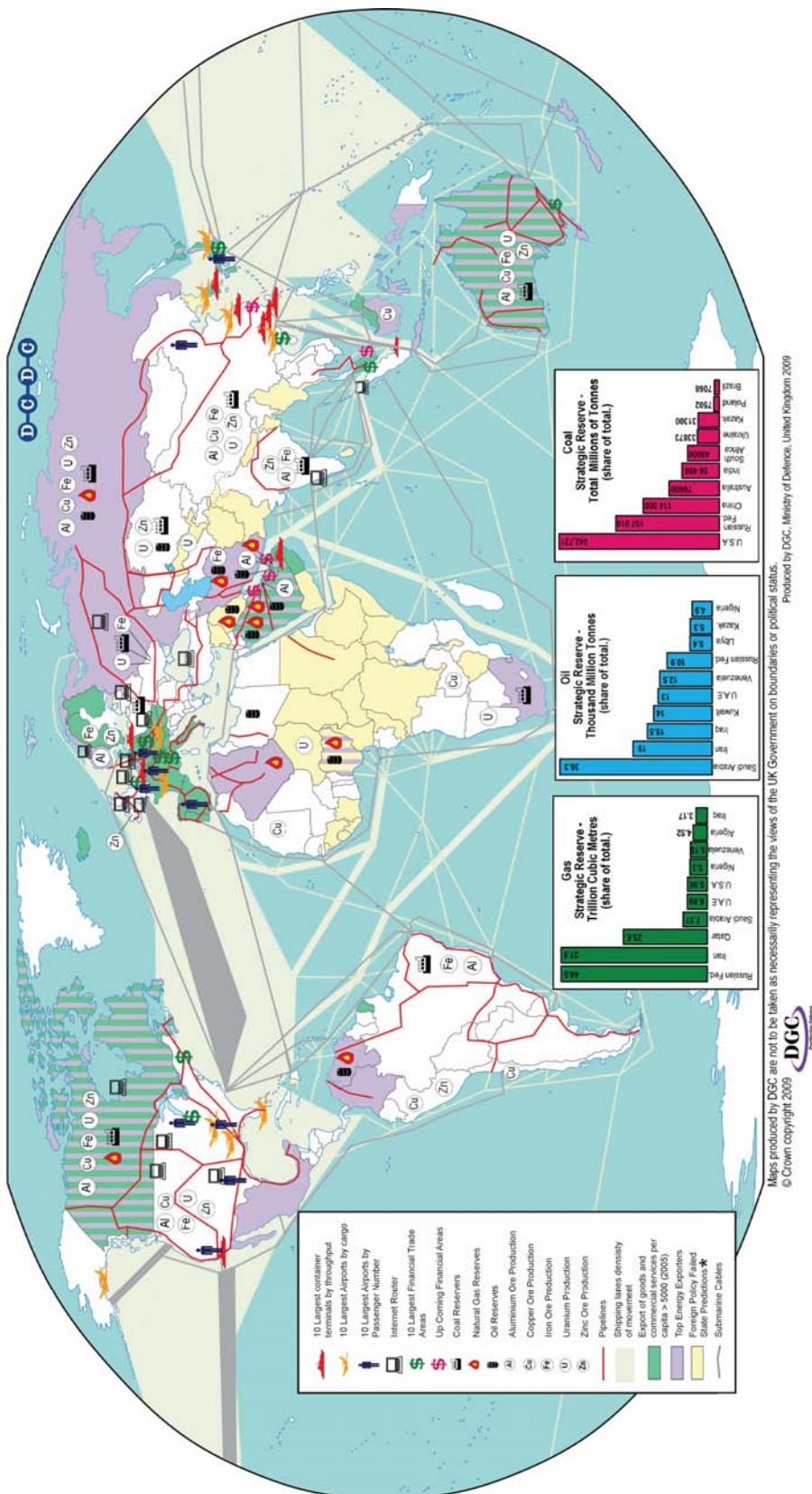
Figure 4 – Global Infrastructure and Resources Map

*Data on Failed and Failing states taken from Failed State database 2008, from www.foreignpolicy.com

Interdependence and Competition

A defining feature of the next 30 years *will* be the constant tension between greater interdependence and intensifying competition between individuals, communities and states. This feature *will* stimulate competing strategies based around the extent to which these groupings will wish to exploit, or resist, change. Difficulty in meeting global resource demand is *likely* to become an enduring feature, resulting in states gradually drifting towards seeking individual rather than multilateral solutions. For example, despite the benefits of globalisation, bilateral agreements between resource suppliers and major consumers are *likely* to become increasingly common, threatening to fragment global markets. Similarly, despite economic interdependence and global challenges, such as climate change, that require cooperative solutions; the use of power is increasingly *likely* to focus on self-interest rather than the common good.

Global consumer demand, especially in China and India, heightened by increasing material expectations, *will* continue to feed through to economic activity and the demand for resources. States, rather than Multinational Corporations (MNCs) and markets, are *likely* to become a stronger force in shaping responses to resource scarcity and the energy market is *likely* to be increasingly dominated by state-controlled corporations. This increase in state influence *may* cause uncertainty as to intent and result in volatility, especially in energy markets. Offshore production of food and other agricultural produce, highlighted by state-sponsored land purchases in fertile agricultural regions, is *likely* to continue. This utilisation of developing states by wealthier states for resource extraction is *likely* to have a degree of mutual benefit. However, in regions that are prone to instability, it is *likely* to become a source of grievance and *possibly* conflict, especially where it is perceived to be detrimental to the indigenous population.[49]
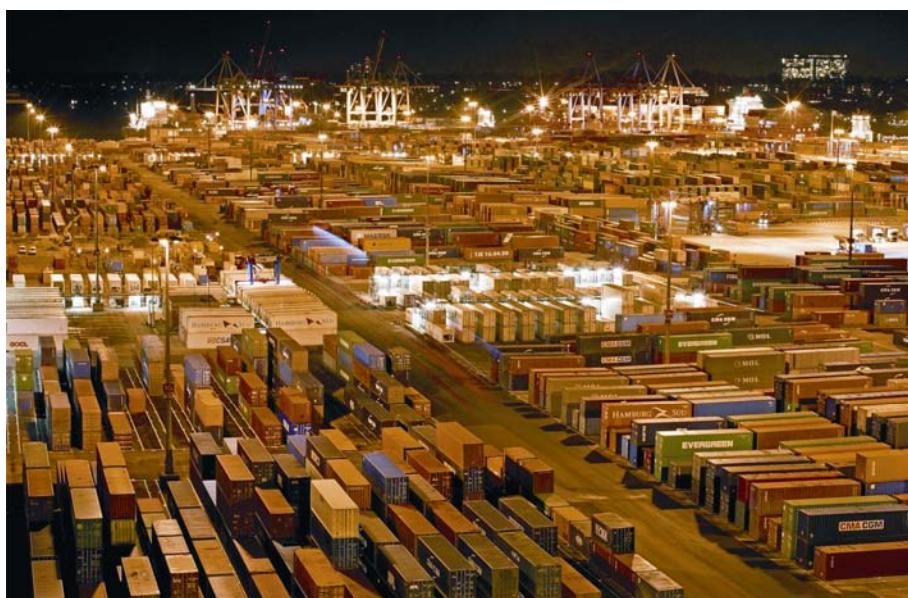
Global consumer demand, heightened by increasing material expectations, *will* increase the demand for resources

---

[49] For example, the investment by Daewoo of South Korea in 1.3 million hectares of agricultural land in Madagascar was linked to the ousting of the Malagasy President Marc Ravalomanana. RAND (Europe).

Geopolitical Influence

The maintenance and expansion of geopolitical influence *will* be an important consideration for all powers, especially those with global or regional leadership aspirations. Informal spheres of influence are *likely* to coalesce around the leadership of China, India, the US, Russia and others.[50] Similarly, middle and lower-rank powers are *likely* to band together into regional blocs, often based on trade and economic links, in an effort to maximise their collective prosperity and influence. These trends towards regionalisation are *likely* to be compatible with globalisation in the same way that the EU is both a regional bloc and a cog in the globalised economy. The spheres and blocs are *likely* to be based around geographical proximity, common security challenges, cultural linkages, language, economic ties, political or religious ideology and *possibly* coercion. However, given the pervasive character of globalisation and mass communication, influence within the spheres is *unlikely* to be static or exclusively limited to a single major power. Moreover, the boundary of the spheres is *likely* to be ill-defined and fluid, reflecting the ongoing competition for influence. Intervention by a great or major power into the sphere of interest of another major power is *unlikely* given the risk of conflict, especially as these powers are *likely* to be able to deploy WMD or significant amounts of conventional military force. Hence, the greatest likelihood of confrontation between major powers lies in contested regions, especially those in geo-strategic locations, those with significant resource potential or in areas where the spheres overlap or touch. Such areas include parts of Africa, the Indian Ocean Region, the Asian Meridian, and the Arctic.

Changes in the distribution of power, the need for influence in a globalised world and balance of power considerations are *likely* to drive the formation of formal alliances and informal partnerships. Traditional alliances, such as NATO, are *likely* to continue, but states *will* also seek partnerships of common interest with non-traditional partners. However, the effectiveness of partnerships, especially in times of crisis, is *likely* to be less certain than that of an enduring alliance. Within Europe, the EU is *likely* to increase its influence and expand its economic, foreign policy and security role. However, a more extensive defence relationship that would extend EU power into and beyond Europe's near abroad is *unlikely.* For European powers, NATO is *likely* to remain the defence organisation of choice. In the international security environment, consensus on collective military action is *unlikely*, and the proliferation of anti-access technologies is *likely* to inhibit individual state actors and groups from regularly exercising military power on a global scale.[51] The strengthening influence of rising powers *may* result in a re-interpretation of international legal norms resulting in a less western-influenced international legal system. For example, human rights legislation *may* come to place more emphasis on collective rather individual rights.[52]

New ideologies and macro-economic frameworks that re-shape the geopolitical landscape are *likely* to develop in response to the changing political, economic and social context.

---

[50] For example, Russia already claims such a sphere of influence in her near-abroad – however many of its neighbours refute these claims.

[51] For example, sub-surface warfare capabilities, integrated air defence systems and short-range ballistic missiles.

[52] For example, in March 2009, a UN forum passed a resolution condemning 'defamation of religion' as a human rights violation, despite wide concerns that it could be used to justify curbs on free speech. Reported by Reuters, 26 Mar 2009. Available online at http://www.reuters.com/article/worldNews/idUSTRE52P60220090326 (accessed 11 May 09).

Their nature is difficult to anticipate but grievance, in the face of continued inequality and highlighted by pervasive global communications, *may* result in a revival of Communism, especially if it evolves and dissociates itself from the failures of the Soviet Union. Similarly, nationalism *will* remain a powerful force, especially as the international environment becomes increasingly competitive, and far-right ideologies *may* see a revival. Influential religiously and philosophically inspired ideologies, linked to Islam and Confucianism, *may* also emerge. The US-led liberal model, known as the 'Washington Consensus', constructed around the institutions and policies of the western powers, has been the dominant global model, especially since the end of the Cold War. However, this model is *likely* to be unattractive to governments struggling with the adverse impact of poverty, climate change, and global inequality, especially where ruling elites fear loss of political power. These states, especially in developing economies, are *likely* to adopt alternative models. For example, the 'Beijing Model' of a less *laissez-faire*, more planned, regulated and controlled political and economic market system.[53]

The International System

This section examines the international system dividing it into key powers and regions; for ease of explanation these are grouped under Contemporary, Rising and Emerging powers and Pivotal regions. These states and regions have been examined because they *will* impact on global defence and security. The groupings are designed for ease of reference and in the limited space available are not fully inclusive of all state and non-state actors.

The Contemporary Powers

The contemporary powers are those that have wielded global power and influence post-World War II, and continue to do so today. These powers include the US, Japan, Russia, the European powers, and institutions of global governance, such as the UN. Out to 2040, they *will* face challenges to their power, such as changes in demography and economic prosperity, although the impact of these challenges *will* differ in scale for each actor.

The United States

By 2040, the US is *likely* to lose her hegemonic status as rising powers enjoy more rapid economic growth and close the technology gap in military capability. The US share of global GDP has already decreased from around 50% in 1950 to 22% in 2007, and although it remains 3 times the size of her nearest national competitor,[54] this shrinkage *will* continue, resulting in a diminution of US economic power. Despite this relative decline, the US economy and military *will* remain amongst the world's strongest and, with her well-established educational system, *may* be particularly adept in exploiting emergent technologies that could drive an economic resurgence. The US is *likely* to remain a

---

[53] The Beijing Consensus is a planned approach to economic growth that uses the power of the state to gradually de-regulate and open up the economy to growth, while minimising instability. In practical terms, this means that individual freedoms are curtailed for what the state views as its collective good. It is based on the model adopted by the Chinese Communist Party. Cooper J.R, *The Beijing Consensus*, 5 November 2004. Cited at http://fpc.org.uk/fsblob/244.pdf
[54] In terms of its share of Global GDP Japan is the world's second largest economy. In terms of purchasing power parity China is the second largest economy. *International Monetary Fund World Economic Outlook Database 2008.*

centre of innovation, economic opportunity and populist culture, which *will* remain attractive to both states and individuals seeking her support and partnership.

When compared to other contemporary powers, robust population growth and less significant demographic ageing *will* help underpin US economic performance, in contrast to the demographic stagnation that is *likely* to occur in continental Europe, Russia and Japan. This contrast *will* maintain US influence and leadership in the context of the contemporary powers.[55] For example, the US population as a percentage of the developed world population was around 25% in 2008, and is *likely* to approach 33% by 2040. Latin America is *likely* to be a particular area of interest for the US given the growth of her hispanic minority from only 6% in 1980, to around 22% by 2040.[56]

The US *will* remain a politically stable major power; however, her response to the decline of her hegemony *will* be a critical factor for global stability. She is *likely* to respond positively to impending challenges by renewing alliances and partnerships as well as forming collaborative relationships with emerging and rising powers, carefully calibrating her military responses, and concentrating on soft power to achieve her objectives. However, on occasion she is also *likely* to seek opportunities to bolster her power and prestige as her position comes under threat. There *will* also remain, at least out to 2020, a global expectation that she will provide international leadership in times of crisis. However, the US is, on occasion, *likely* to operate in its self-interest rather than that of the global system, and this is *likely* to result in tension between her and the emerging and rising powers. Some states and non-state actors are *likely* to resist any US attempt to protect her global standing, especially where she is perceived as being overextended and vulnerable. Increased competition and confrontation *may* range from opposing US diplomatic and trade initiatives, to undermining US attempts to secure favourable access to resources and the global commons, coupled with attempts to drive wedges between the US and her allies. While it is *unlikely* that any state would directly challenge the US militarily, asymmetric attacks, from ideologically opposed state and non-state actors are *likely*.

---

[55] Calculations of population are based on sum of US, Europe, Japan, Australia, New Zealand and Canada population using UN Population Division 2008 figures, medium variant.
[56] US Census Bureau. Available online at:
http://www.census.gov/population/www/socdemo/hispanic/hispanic_pop_presentation.html (accessed 12 October 2009).

The European Powers

Individual European states are *likely* to continue to exercise economic power under the auspices of the EU, which is *likely* to retain significant global economic influence. It is the world's largest economic bloc; in 2008 it had a combined output of $16 trillion, 20% greater than the US, and comprised 31% of the global economy in terms of its share of global GDP.[57] However, the EU economy is *likely* to grow less rapidly than the US, China and India, such that by 2040, they will all share similar magnitudes of economic output. This relative under-performance *will* be the result of demographic challenges that are *likely* to decrease Europe's share of the global population from 22% in 1950 to about 6% by 2040. Moreover, ageing *will* cause disproportionate decreases in the traditional workforce that *will* challenge norms for retirement and is *likely* to increase demand for migrant workers. The demographic profile, along with the

The EU economy is *likely* to grow less rapidly than the US, China and India

diversity of national interests between member states, *will* diminish the ability of the EU to exert economic power. Difficult economic conditions *may* cause political tensions, particularly over monetary policy that threaten Euro Zone cohesion and cause significant economic dislocation. However, the Euro is *likely* to survive as a viable currency with an increased membership.

The EU is *likely* to remain the focus for most national economic and some foreign policy matters, but political integration is *likely* to be slow at best. Internally, and on its peripheries, poor economic performance and inequality *may* contribute to creating pockets of extremism; this has the potential to lead to instability and violence. Nationalist, ethnic and ideological movements *may* gain in prominence. Violent extremism, concentrated in areas of social deprivation within large disaffected migrant communities, or in areas with underlying ethnic tensions, such as in the Balkans or the Basque Region, *may* increase in intensity. Externally, Europe *will* find itself faced in the east and in the Arctic by an assertive Russia upon whom it is dependent for gas supplies. To the south, it *will* face the combined impacts of a rising population in North Africa and illegal migration.

---

[57] In 2008 the EU's share of global GDP was 31%, in terms of Purchasing Power Parity (PPP) it was 23%. *International Monetary Fund (IMF) World Economic Outlook Database 2008.*

European states are *likely* to focus on integrating border security arrangements, especially on the southern flank of Europe, considering instability in North Africa and the Levant to be a direct threat to European security, and engaging with North African states to promote stability, access energy resources and pre-empt *possible* large-scale migration. Further coordination of military forces is *likely*. In particular, financial restraints are *likely* to result in a requirement to pool and share capabilities, for example, capabilities such as strategic airlift. NATO is *likely* to remain the guarantor of European security, despite the fact that the US *will* be less focused on Europe. The EU is *likely* to remain reluctant to project military power beyond the Petersberg tasks[58] even in cases of clear multilateral interest such as in the Balkans, or where the humanitarian imperative is clear. By being drawn closer into a Mediterranean dialogue with Europe, the Maghreb region is *likely* to follow a different political model of development from the wider Middle East. Political Islamic influences *will* remain important, but diaspora communities in southern Europe *may* drive increasing political, economic and energy cooperation. Of those states in North Africa drawing economically and politically closer to the EU, Egypt, is perhaps of the greatest geostrategic significance and *may* remain a moderating influence, despite challenges from violent extremism, demographic expansion and climate change.

By 2040, the UK population is *likely* to expand to around 70 million, rivalling Germany as the most populous EU state. The UK economy is *likely* to benefit from relatively high birth rates and inward migration that sustains workforce levels when compared to other EU states.[59] The median age of the population is also *likely* to be significantly below the EU average. The UK economy is *likely* to remain within the top 10 global economies, measured by GDP. Socially, the UK *will* be a diverse society with significant increases in minority populations.

The UK and France are *likely* to continue to be medium-rank global powers in their own right. Their economies *will* remain integrated into the globalised system and dependent on international links and they *will* continue to engage diplomatically and militarily in pursuit of national strategic objectives. They *will* maintain close links with the US, but also develop new partnerships with rising and emerging powers. Both the UK and France are *likely* to continue as nuclear weapon states with independent seats on the UNSC.

Russia

Russia's ambition to recapture her standing as a global and regional power in the face of domestic political, social, and demographic challenges *will* continue, making her a security challenge for Europe and, by implication, for the US. Her external relations are *likely* to be driven by a sense of insecurity, a belief in her right to be a global power and economic factors. She is *likely* to form strong links with some EU states, when it is in her national interest to do so, periodically seeking to disrupt EU and NATO coherence. The near-

---

[58] The Petersberg tasks are an integral part of the European Security and Defence Policy (ESDP). They were explicitly included in the Treaty on European Union (Article 17) and cover: humanitarian and rescue tasks; peace-keeping tasks; tasks of combat forces in crisis management, including peacemaking. These tasks were set out in the Petersberg Declaration adopted at the Ministerial Council of the Western European Union (WEU) in June 1992.
[59] The UK population is likely to grow to around 70 million and the median age is likely to be around 42 years. Germany's population is likely to have contracted from 82 million to around 74 million. The median age is likely to rise from 44 to around 51 years. *UN Population Division*, 2008 Revision, Medium Variant.

abroad of former Soviet satellites *will* continue to be heavily influenced by Russian hard and soft power and is *likely* to remain part of a *de facto*, although largely unwelcome, Russian sphere of influence. Interference in the internal affairs in the Ukraine, and the states of the Caucasus and Central Asia, is *probable* and Russia *will* strongly oppose NATO expansion. Russia *will* seek to dominate the Arctic, considering the region as central to her future prosperity and security. She *will* continue to view China and Japan suspiciously and, despite her membership of the Shanghai Cooperation Organisation, *will* seek to deter foreign infiltration and influence, most notably from China in eastern Siberia.

Russia *will* continue to face pressing social challenges. High mortality rates, particularly among males, combined with low fertility rates, are *likely* to result in falls concentrated within the ethnic Russian section of the population (see The Human Environment Key Theme). In contrast, the proportion of Russia's large non-ethnic groupings, especially Islamic groups in the southern regions, is rising and is *likely* to exacerbate separatist tensions. Failure to reverse this demographic trend, particularly in economically vital regions of Siberia and Russian Central Asia, *may* result in national decline and an inability to control her energy rich hinterland. These adverse trends *may* be a precursor to a period of instability within Russia, which *may* result in success for separatist movements and the *possibility* of a resurgence of radical ideology.

Europe *will* remain Russia's primary economic focus with access to the EU's markets for hydrocarbon exports being an economic imperative. Russia suffered a decade of economic and political turbulence following the collapse of the Soviet Union, but since the turn of the century her economy has performed strongly based on her resource wealth and rising commodity prices. Oil, gas, strategic minerals and agricultural produce account for more than 80% of Russian exports. Russia *will* remain one of the largest arms exporters and *will* continue to sell its latest and most technologically advanced equipment; some of which *may* equal, or surpass, the capabilities of Western-sourced systems. The Russian economy is *likely* to remain dependent on the commodities sector and subject to fluctuating global market forces and price volatility. Some forecasts suggest that, by 2040, Russia could be the largest economy in Europe with living standards approaching Western levels as a result of a 10-fold increase in output per head.[60] However, these forecasts are *likely* to prove over-optimistic given the numerous challenges. Limited investment in the hydrocarbon sector's infrastructure, especially in the gas industry, is *likely* to create a short-term supply problem affecting the domestic energy market and threatening exports. Large increases in domestic energy tariffs to reduce demand *may* lead to internal unrest, and Russian administrations are *likely* to be torn between maintaining revenue streams from exports and minimising internal dissent. Russia's highly centralised political framework is *unlikely* to overcome these challenges and provide the sustained growth required to turn optimistic forecasts into reality. Moreover, the centralised political control, typified by the Putin era, is *likely* to endure and *may* become increasingly authoritarian. The majority of the electorate is *likely* to accept this, especially the growing middle classes that welcome stability. Russia *will* periodically leverage her hydrocarbon resources in pursuit of foreign policy goals.

---

[60] Goldmann Sachs, *BRICS and Beyond*, 2007. (BRICS is the acronym for Brazil, Russia, India and China)

The Russian economy is *likely* to remain dependent on commodities

Japan

Japan *will* remain one of the world's largest economies, despite severe demographic challenges. Economically and militarily, she *will* view China as both an opportunity and as a threat and this paradoxical view *will* drive Sino-Japanese relations. She is *likely* to seek to retain her regional economic influence, *possibly* by forging and exploiting a closer relationship with the Association of Southeast Asian Nations (ASEAN) group, both to counter Chinese influence and to prevent other emerging powers, such as Korea, taking a leading position.

Japan is a major resource importer and *will* face resource security issues.[61] She is *likely* to gradually normalise constitutional restrictions on deploying military forces overseas and invest in her self-defence forces to dissuade and deter aggressors. Wedged between Russia, China, and Korea such changes are *likely* to be viewed with suspicion by her regional neighbours, given historical events. Her alliance with the US is *likely* to remain central to her national security, although concerns over long-term US intentions *may* lead her to seek other partnerships, *possibly* with India as a hedge against the rise of China.

---

[61] Japan has virtually no domestic oil or natural gas reserves and is the second-largest net importer of crude oil and largest net importer of liquefied natural gas in the world. Including nuclear power, Japan is still only 16 % energy self-sufficient. US Energy Information Administration.

Japan's alliance with the US is *likely* to remain central to her national security

The Rising Powers – China and India

The rising powers already seek to join or surpass the contemporary powers in global influence. Their rising status *will* be underpinned by large populations and continued economic development. Their political, diplomatic and military power *will* grow throughout the period to 2040. This group includes China and India.

China

China is *likely* to maintain a pragmatic and supportive approach to the conduct of international relations, sharing the benefits of an effective rules-based system and relying on trade in raw materials, energy and manufactured goods, to support economic development.[62] However, her current policies of non-intervention and non-interference are *likely* to be superseded by a more interventionist approach, as her power and influence increases. She *will* develop political, economic and military strategies to secure trade and communications lanes in the event of tension and *may* try to isolate the region. These strategies are *likely* to result in an expansion of activity and influence in resource rich regions, such as Africa and Latin America, with investment decisions being increasingly challenged by local concerns and Western ethical objections. The Indian Ocean region, and particularly the Asian Meridian (see Hot Topic - The Asian Meridian)

---

[62] This reflects President Jiang Zemin's '16 character' guiding principle on US-China relations: *'enhance trust, reduce trouble, develop cooperation, and avoid confrontation'*.

are *likely* to become areas of geostrategic competition involving China, the US and India.[63]

China's economic growth since 1978 has been the greatest of any large country in history, averaging 10% per year and significantly expanding her share of the global economy. She is the world's largest producer and consumer of steel, the second largest consumer of energy and already, by some measures, the world's second-largest economy. Her future economic development and stability *will* be significant for the global economy, influencing global economic demand and shaping her future political direction. Estimates of China's economic growth vary considerably. According to some she has the potential to become the world's largest economy by 2025, and double the size of the US economy by 2040.[64] However, she faces significant environmental, social, political, financial and demographic challenges that are *likely* to temper economic growth rates, resulting in an economy roughly comparable in size to the US and EU economies by 2040. A symbiotic economic relationship between the US and China exists whereby China holds significant quantities of US government debt in the form of Treasury Bonds, and the US imports competitively priced Chinese consumer goods. This relationship is *likely* to continue, although it *may* change in character as China's internal economic demand increases.[65]

China's continuing economic development is *likely* to establish her as the leading regional power in East Asia and the western Pacific, although she is *unlikely* to directly challenge the US militarily outside of this region.[66,67] War between East Asian states is *unlikely*, but the pace of change and latent tensions are such that the likelihood is higher than in other regions, such as Europe. China's desire for primacy in her near-abroad, allied to nationalistic impulses and historic antipathies, *may* result in periodic military posturing and confrontation with traditional regional rivals such as India, Japan, Korea and the US. Regional arms races, both nuclear and conventional, are *possible*, although efforts to prevent proliferation *will* continue. Potential flashpoints include Taiwan and her relationship with China, and multi-party disputes over potentially resource rich territorial claims in the South China Sea. China is *likely* to represent the most capable potential adversary for the US and she *will* modernise her Armed Forces to counter perceived US, Indian and Asian threats. By 2040, she *will* have developed her power projection and maritime security capability and, if required, be prepared to use military force to achieve her objectives.[68]

---

[63] China practices what they style as a pragmatic 'calculative security strategy', one that emphasises the primacy of economic growth, amicable international relations combined with increasing efforts to create a more modern military, and a continued search for asymmetric strategic advantages. Tellis A.J and Swaine M.D, 2000 RAND, *Interpreting China's Grand Strategy: Past, Present and Future*.

[64] Goldmann Sachs, *BRICs and Beyond*, 2007.

[65] China holds large amounts of US debt in the form of government bonds, and the Americans import large quantities of Chinese manufactured goods. Congressional Research Survey (CRS) report for US congress 23 January 2007.

[66] Any challenge would be indirect, for example, through proxies.

[67] China's 'string of pearls' strategy of 'building presence' is seen by some as an expansionist move. However, Chinese presence through the South China littorals, the Strait of Malacca across the Indian Ocean and on to the Arabian Gulf and East Africa is most likely to be concerned with securing multilateral trade and supply lines rather than a direct precursor to future expeditionary bases in countries such as Myanmar, Bangladesh, Cambodia, and along the Horn of Africa.

[68] China is an advocate of utilising state-led hybrid or asymmetric warfare to further its aims. This is referred in Chinese literature as 'High-Tech Local Wars'. This is extensively detailed in Zhenxing W and Suping Y, *On PSYWAR in Recent High-Tech Local Wars*, Junshi Kexue (China Military Science), 20 December 2000, pages 127-33.

More so than other major powers, China's future path has a wide range of possibilities, ranging from the emergence of a fully democratic China through to the fragmentation, or even collapse, of the state. All are *unlikely*, but none can be completely dismissed. China's future *will* ultimately be defined by whether, and how, she manages to create a system of politics that can sustain social cohesion alongside rising prosperity.[69] China's rise is not guaranteed and internal contradictions are *likely* to disrupt development, lead to challenges to the authority of the state and affect her external policies and interaction. Internal inequalities between a relatively prosperous, urbanised littoral region and an under-developed rural hinterland, and the lack of transparent and accountable governance, are *likely* to periodically create internal tensions that *may* spill over into organised disorder and political violence. Alternatively, rapidly expanding urban areas *may* produce a diversity of political movements campaigning for greater political and social freedoms. Similarly, environmental degradation, social unrest, demographic ageing, gender imbalances, water supply difficulties caused by fluctuations in Himalayan glacial melt, and agricultural degradation *may* all disrupt China's rise, although civil war, complete state breakdown or reversion to the inward-looking policies of the Maoist era are all *unlikely*. Separatist movements, especially in remote ethnically or culturally distinct regions, *will* proliferate, often conducting irregular and terrorist campaigns as they grow in confidence and capability.[70]

India

By 2040, India is *likely* to have overtaken China to be the world's most populous state. She is *likely* to prosper economically and take her place as a major power in a multi-polar world. In 1980, India's share of the global economy was slightly greater than China's, but since then her growth rate has lagged and her economy is, at present, less than half the size of China's.[71] By 2040, she is *likely* to reduce this gap and her economic output is *likely* to be of a broadly similar magnitude to China, the US and the EU. Despite poor infrastructure, problems with the educational system, caste restrictions and the challenges of excessive bureaucracy and corruption, her economy has clear advantages over other developing economies. These include a large English speaking population, robust demographic growth, and relatively stable governance. Given her large and rapidly expanding population, India's output per person *will* remain significantly below that of the contemporary powers, although the middle class is *likely* to grow and the incidence of absolute poverty *may* fall.

India is *likely* to follow an 'India First' policy as it acquires political power and influence, vigorously pursuing her interests in the Indian Ocean region and along the Asian Meridian. India's influence in global affairs *will* increase and she is *likely* to become a permanent member of the UN Security Council. Her diaspora communities, especially those involved in science, business and technology are *likely* to become increasingly influential, especially in the contemporary and emerging powers, but also as a lever for Indian

---

[69] Stephens P, *Geopolitics Doesn't Travel in Straight Lines*, Financial Times, 2009.
[70] China will have ongoing conflict, especially in the regions of Tibet and Xinjiang.
[71] In 1980, China's share of the global economy at purchasing power parity rates was 2% against an Indian share of 2.1%. By 2007, China's share was 10.7% against 4.6% for India. *IMF World Economic Outlook Database 2008.*

influence in the wider Middle East. India is *unlikely* to challenge the global influence of the US and the wider interests of China in Africa and Latin America.

India *will* feel constrained and threatened by historical enmity and potential security challenges from her near neighbours, especially Pakistan and China. She is *likely* to continue her traditional aversion to alliances and maintain a desire for strategic autonomy, while continuing support for legitimate international security missions under the banner of the UN. However, although India *will* continue to invest heavily in the development of her Armed Forces, she is *unlikely* to be drawn into unilateral or multilateral interventions outside of the Indian Ocean region. Internally, India *will* continue to face complex, protracted and bloody challenges from insurgents and terrorists.[72]

India *may* be affected by widespread political and social turmoil in neighbouring states: many face considerable challenges, such as inequality, religious and ethnic differences and population growth. For example, religious and ethnic turmoil is *likely* to continue in Central Asia and the region is *likely* to remain beset by instability in governance. Similarly, an increased frequency of extreme weather events *may* overwhelm governance capacity and affect regional stability, especially in Bangladesh and densely populated low-lying areas of Sri Lanka and Myanmar.

India *will* feel threatened by external security challenges and internal insurgency

---

[72] India is currently dealing with: insurgencies in Assam, Jammu and Kashmir, the Punjab, Nagaland-Khaplang; attacks from Islamic terrorist groups like Harkat-ul-Jihad-al-Islami and Lashkar-e-Toiba; Maoist Naxalist attacks in Eastern India; and, extremist Hindu violence.

The Emerging Powers

The emerging powers are those actors that lack the scale of the rising powers, but retain potential and ambition to be regional powers with a voice at the global level. Some *will* be vulnerable to regional and internal instability. This group includes Brazil, Turkey, Iran, Israel, South Africa, Nigeria and some non-state actors.

Brazil

Brazil's emergence as a major economic power based on strong democratic institutions, a diverse economy, and commodity exports *will* alter the balance of power in the Americas. She is the largest state by area and population and shares a border with all but 2 of the other South American states. Her relationship with the US *will* see a progressive reduction in dependence and greater equality. Brazil's economic development *may* be a catalyst for similar progress by other South American states. However, such economic development throughout the region *may* be complicated by corruption and a resurgent populism that *will* have substantial appeal to the 25% of the population of Latin America which continues to live on less than $2 a day.[73]

The growing influence of Brazil, and any decline in US influence in Latin America, *may* provide the catalyst for the Union of South American Nations (UNASUR) to progressively integrate Latin American economies. However, substantive development into a cohesive political entity, given historic antipathy between some states, is *unlikely*. If, however, integration is successful it is *likely* to result in significant external investment, especially from China, and increasing opportunities for stability and prosperity. Large diasporas from UNASUR states *may* comprise 40% of the total youth population of the US, providing UNASUR with a mechanism to exert wider influence. [74]

Brazil is *likely* to remain the most significant of the emerging powers. She is blessed with significant economic and geostrategic potential and *may* grow her influence to rival that of China and India. In particular, she *may* also be the catalyst for further strengthening of south-south relationships. These relationships by-pass the contemporary powers and establish links directly between rising and emerging powers. The India-Brazil-South Africa (IBSA) group is one example. Whereas in the Cold War states could be broadly categorised with respect to their relations with the 2 superpowers, in a multi-polar world such categorisation *will* be impossible. More numerous and pervasive south-south political, economic and social links are *likely* due to the complexity of the multi-polar geopolitical framework.[75]

---

[73] Omar A, Maloney W and Humberto L, *Poverty Reduction and Growth: Virtuous and Vicious Circles*, World Bank, February 2006.
[74] US Census Bureau, August 2008.
[75] The links are likely to resemble a noodle-bowl model rather than the Cold War hub-and-spoke system.

Turkey

Turkey's geostrategic location, between Russian, EU, Central Asian and Middle Eastern influences, is fundamental to her importance. She also has a youthful population, a strong military and is *likely* to enjoy strong economic growth boosted by a 'demographic dividend'. Moreover, Turkey sits astride energy transit routes that flow from east to west, with energy exports from Central Asia and the Caucasus to Europe passing through Turkey either by ship, via the Bosporus, or in pipelines such as the BTC.[76] Turkey is *likely* to be vital to EU energy security, providing a supply route that bypasses Russian transit lanes.

Turkey links the secular, democratic ideals of Europe to the Islamic perspectives of the Middle East and the wider Central Asian region. While Turkish society *may* take on more explicit Muslim characteristics, overall, despite challenges, she is *likely* to remain wedded to mainstream Western ideals and to retain her secular democracy. Turkey is *likely* to remain closely aligned to the EU, and her accession as a full member is *possible*, providing not only an economic stimulus for both parties, but also an effective link for Europe into the Middle East, the Caucasus and into Central Asia. Equally, it is *possible* that Turkey takes on an increasingly independent role in the region, seeking to define her own position and role separate from European interests; however, Turkey *will* remain an influential NATO state.

Iran

Iran is *likely* to become the most powerful state in the Middle East, although her rise to prominence *will* be contested. She *will* remain the most populous Gulf state despite experiencing a significant demographic shift: 30 years ago, each woman had an average of 6.5 children; by 2008 this had fallen to 1.7.[77] She *will* continue her cultural leadership of the Shia. In addition, she has vast energy reserves and her geostrategic location at the crossroads of Asia and Europe dominates vital supply lines through the Gulf. In comparison with the wider region, Iran is *likely* to continue with its more advanced educational system, for both genders, and she is *likely* to continue to show a greater respect for women's rights than is shown by some of her neighbours. Taken together, her strong cultural, economic and military advantages are *likely* to make her a significant regional power in South West Asia and the Middle East. As such, Iran *will* represent a complex challenge to the contemporary and rising powers, and as her influence grows, she is *likely* to shed her image as a pariah state and be treated with degree of *realpolitik* by the international community.

Iran is *likely* to be a key to stability within the Gulf Region. In the short-term she faces considerable instability that *may* result in changes to both the nature and style of her governance making a more inclusive and moderate Islamic government *likely*. Such changes are *unlikely* to alter her desire for regional leadership and international respect.

---

[76] The Baku-Tbilisi-Ceyhan (BTC) project is a $3 billion investment transporting energy from the Caspian Sea via an oil pipeline from Azerbaijan, through Georgia, to Turkey for onward delivery to world markets. The Nabucco gas pipeline, is scheduled to come on-stream in 2014.
[77] Walker M, *The World's New Numbers,* Wilson Quarterly, 2009.

Iran is *likely* to continue with her more advanced educational system, for both genders, and is *likely* to continue to show respect for women's rights

Iran's oil and gas exports constitute around 75% of government income and 80% of exports. She has the third largest proven global oil reserves and the second largest gas reserves. [78] Despite this, Iran has been forced into periods of petrol rationing, due to a lack of domestic infrastructure investment. In the near-term, ageing fields, domestic subsidies, lack of investment and a restrictive sanctions regime *may* lead to greater dependence on refined energy imports. Economically, Iran has adopted national plans that resemble those of eastern Europe in the 1970's. The large public sector is controlled by groups backed by clerical elements and the Iranian Revolutionary Guard that dominate inefficient, bureaucratic and corrupt 'nationalised' industries, stifling innovation and growth. Iran's long term economic growth is *likely* to be strong if she can fully exploit her energy reserves and diversify her economy. Liberalisation in the banking and financial services' sector is occurring and with an educated population and entrepreneurial class, linked to an economically successful diaspora, this is *likely* to support a more dynamic Iranian economy, which *may* begin to break reliance on the hydrocarbon sector.

Militarily, Iran views herself as a powerful regional military force with the largest Armed Forces in the Gulf Region comprising 545,000 active and 350,000 reserve members.[79] She has sought to manufacture her own defence equipment and imports discrete capabilities from Russia, China and North Korea. She has rebuilt versatile naval forces including attack submarines and has capable air and ground forces. Moreover, the Islamic Revolutionary Guard Corps have military, maritime and air assets that can operate independently of the main Iranian Armed Forces. It is *likely* that modernisation of her Armed Forces *will* remain a national priority although the experience of Iranian proxies in

---

[78] US Energy Information Administration, *Iran Energy Data*, 2009.
[79] Hackett J (ed) *The Military Balance 2008*, the International Institute for Strategic Studies, London, pages 242-244.

Iraq and in Lebanon, and overwhelming US and Israeli conventional superiority, are *likely* to encourage the Iranians to further develop asymmetric tactics.

Iran *may* seek to become a nuclear weapons state by 2040, *possibly* viewing such status as a source of national prestige and security. Iran already has enrichment technology that could be used to produce fissile material for a nuclear weapon and there are widespread concerns, endorsed by the UNSC and IAEA, about possible military dimensions to its nuclear programme. Iran's pursuit of proliferation-sensitive technology has already brought her into confrontation with the international community. Unless international confidence in Iran's nuclear intentions is restored, this *will* remain a global security concern and *may* steer other states to consider a similar course.

Other Emerging Powers

The emergence of powers within sub-Saharan Africa, capable of leading surrounding states towards stability and economic development, is *unlikely*. South Africa and Nigeria have potential, but face many challenges and are *unlikely* to become capable of spreading stability beyond their own borders into the wider region. For example, Nigeria faces social, political and economic challenges from violent groups in the Niger Delta and an increasingly violent divide between Christian and Islamic groups. Nigeria *may* experience decreasing corruption and ethnic violence, as well as the development of stable political structures that allows her to achieve a degree of human security and develop her natural resources for the common good.[80] South Africa is more *likely* to exert a positive regional influence, but despite lobbying for a seat on an expanded UNSC, she too faces numerous challenges and *may* find that the strains of regional instability are too much to overcome. For example, the whole of sub-Saharan Africa *will* be buffeted by global trends such as climate change that exacerbate problems with poor governance, lack of human security and economic and social development.

Powerful mercantile cities, such as Shanghai or Mumbai, *may* become increasingly influential within their host states, and in some cases *may* challenge the states control. Similarly, international governance arrangements *may* lead to some levers of power, traditionally residing with states, migrating upwards into multilateral or supranational institutions. Urbanisation *will* continue and some cities *may* become important power centres in their own right, although others, especially those located in weak states are *likely* to suffer failures in governance and instability. Cities *will* also become more interlinked by their communication and transport infrastructure, attracting the global economic, political and financial elites that benefit from ready access to a global network.

It is *unlikely* that MNCs can become true centres of power by providing alternate governance on a global or even regional scale. However, they *will* remain influential, for example, in 1983, the top 500 MNCs had revenues equal to 15% of global GDP but by 2007 this had increased to over 40%.[81] State-owned MNCs, are *likely* to become increasingly influential, especially in the energy and agriculture sectors and, periodically,

---

[80] Cilliers J, *Africa in the New World*, International Institute of Strategic Studies (IISS) Monograph 151, 2008.
[81] Rothkopf D, *Superclass: The Global Power Elite and the World They Are Making,* London: Little, Brown. Cited in Cilliers J, *Africa in a New World.* IISS Monograph 151, 2008.

are *likely* to act as state proxies. Similarly, media and communication corporations *may* become ubiquitous global brands under the control of state agencies.

Terrorist groups and networks are *unlikely* to achieve more than fleeting impact on global power. Terrorism *will* remain a persistent threat, but while individual groups, such as al-Qaeda, *may* endure and aspire to operate from and establish their interpretation of Islamic rule in failed states,[82] they are *unlikely* to be capable of destabilising well-established states. Other groups *will* rise to prominence and mass-casualty attacks, of similar impact and scale to 9/11, Bali and Mumbai *will* occur. Analysis suggests that terrorism does have a greater chance of coercing target states into making territorial rather than ideological concessions. However, historically, terrorist success rates are extremely low and this is *unlikely* to change. Groups, such as al-Qaeda, that have maximalist objectives and those that primarily attack civilian targets are *unlikely* to achieve their political objectives.[83]

Pivotal Regions

Pivotal regions are those whose future paths are *likely* to have an effect on global stability disproportionate to their geopolitical status. They represent significant strategic choke points, where trends have the potential to converge to give them importance out of proportion to their economic, political or demographic standing. These regions include the wider Middle East, the Asian Meridian, sub-Saharan Africa, the Polar regions and the Korean peninsula.

Wider Middle East

Large segments of Muslim majority countries in the wider Middle East are *likely* to resist social change and strive to retain their traditions and culture. This struggle, stoked by historical grievances, is *likely* to cause social and political tensions out to 2040. Concurrently, modernising factions *will* try to change Islamic society from within, seeking a model that allows traditionalism and modernity to co-exist. This competition between modernity and traditionalism is *likely* to cause widespread instability in the region. Radical movements (see Hot Topic Radicalisation) *will* continue to emerge, and national and transnational extremist groups are *likely* to continue using terrorism as a tactic to achieve their objectives. However, a global caliphate is *unlikely,* although some extremist groups are *likely* to harbour aspirations to establish their interpretation of Islamic rule in failed states. Change, including greater empowerment of women and a transformation in the system of education, is *possible*. These changes *may* ultimately lead to rapid development of Islamic societies, including improved governance arrangements and a more liberalised political and social model.

The Arabian Peninsula and the wider Gulf Region *will* remain at risk of instability and state weakness. Saudi Arabia is *likely* to retain her strategic importance as the world's largest

---

[82] In Iraq in 2007, captured material suggested that al-Qaeda favoured the instalment of a caliphate - or Islamic government. This desire to create an emirate, from which to build a safe haven for expanding its jihad, has been a feature of its message since 2003. Council for Foreign Affairs at: http://www.cfr.org/publication/13007/
[83] Abrams M, *Why Terrorism Does Not Work*, 2007.

oil producer, increasing her share of world production;[84] and by 2040 she *will* experience a population explosion of over 50%.[85] Over the same period, Yemen is *likely* to see over 90% population growth.[86] Consequently, a 'youth bulge' *will* be created in Yemeni society, and this is *likely* to be mirrored throughout the Middle East. While these economies and societies are adjusting to their youth bulges, there are *likely* to be high numbers of unemployed youths who seek social and economic advancement through extra-legal means. Such action *may* be a cause of instability within these countries, which leads to conflict.[87] For example, between 1970 and 1999, 80% of civil conflicts occurred in countries where 60% or more of the population were under the age of 30 and Yemen is *likely* to remain in this category.[88] The collapse of such states is *possible*, especially if economic and political reform does not match the expectations of the population. Such instability *may* provide opportunities for ideological extremists, destabilising not only the Arabian Peninsula, but also the Horn of Africa and the global supply routes through the Red Sea and the Strait of Hormuz. Iraq's fortunes *may* rebound restoring her position as a regional force, although her neighbours are *likely* to seek to moderate any rise. The smaller Gulf States *may* achieve successful niche positions in finance and trade and solidify their place in the globalised core. However, they *will* remain extremely vulnerable to regional instability with wider implications for the interests of other states. For example, many of the Gulf States have large diaspora populations, especially from South Asia, who provide remittance income back to their states of origin. In addition, if instability in the Gulf states forced a requirement to evacuate foreign nationals, such an operation would be on an unprecedented scale, with Dubai alone hosting one million foreign workers of whom around 500,000 are of Indian descent, and around 30,000 originate from the West.[89] The Gulf States are *likely* to retain their relationships with the US and the West, although they *will* seek to maximise their interests with other powers, especially as the influence of China, India and Iran grows.

Israel *will* be pivotal to the geopolitics in the Middle Eastern region, providing a unifying force that brings her opponents and detractors together. She is *likely* to retain an economic profile similar to that of the mainstream European states and continue to be a leader in technological innovation and economic development. However, although her long-term survival seems assured, Israel *will* continue to face significant security challenges, both internally and externally, especially if a long-lasting settlement with the Palestinians cannot be achieved. For Israel, the prospect of a nuclear-armed Iran, or Arab state, *will* remain an existential concern. A Palestinian state is *possible* in the near-term although, in the longer-term, further development of the governance and security sectors *will* be required. A mutually beneficial economic relationship between Israel and an independent Palestinian state is *possible*. However, continued distrust and ambivalence is *likely* to make Palestine a continuing focus for discontent and violence.

---

[84] Saudi oil production is expected to increase from around 12% of global production to around 15% by 2030. International Energy Agency, *World Energy Outlook*, *2008.*
[85] Saudi population is forecast to increase from 26.2 million in 2010 to 40.4 million in 2040, an increase of 53%. *UN Population Division*, 2008 Revision Medium Variant.
[86] Yemen's population is forecast to increase from 24.2 million in 2010 to 46.8 million in 2040, an increase of 93%. *UN Population Division*, 2008 Revision Medium Variant.
[87] Goldstone J, *Population and Security: How Demographic Change Can Lead to Violent Conflict*, 2002.
[88] Yemen currently has around 75% of it population aged under 30. By 2040, this is likely to fall to around 60%. *UN Population Division*, 2008 Revision Medium Variant.
[89] *Central Intelligence Agency (CIA) World Factbook.*

Pakistan *will* continue to face drivers of instability. However, the institutions of state, in particular the Armed Forces and its civil society, are *likely* to prove resilient. In the longer-term, a dynamic intelligentsia and diaspora that mitigate ongoing instability *may* transform Pakistani society and the fragmentation of the state is *unlikely*. Pakistan's nuclear weapons are *unlikely* to fall into the hands of extremists or be deliberately proliferated to other Islamic states. However, the security of Pakistan's nuclear arsenal and its nuclear technological knowledge is *likely* to remain a significant concern for India and the wider international community.

Central Asia is *likely* to remain prone to state weakness and instability and the resource rich area that stretches from Suez through Central and South Asia to Xinjiang has been described, by some prominent commentators, as the 'Global Balkans' of Eurasia.[90] It is an area that engages the interests of many great powers and the Central Asian Republics *will* become increasingly important centres of energy production, in particular gas. However, they are *likely* to be at risk of instability. Afghanistan is *likely* to struggle to retain stability although it *may* sustain sufficient economic growth to improve its longer term prospects.

Sub-Saharan Africa

From 2006-07, the economies of more than 30 African states grew at a rate of 4% or more and many states enjoyed rising levels of prosperity, stability, and the normalisation of governance. Moreover, new technologies, including wind and solar power stations, *may* also improve prospects for many rural Africans. Agricultural production *may* also increase given that only 4% of the continent's farmland is irrigated, and yields would benefit from better access to fertilisers, disease resistant crop strains and improved storage.

Despite these positive signs, many of the states of sub-Saharan Africa are *likely* to remain weak and at risk of instability. With a few exceptions, notably Afghanistan and the Palestinian territories, most of the world's fastest growing populations are located in sub-Saharan Africa, where the population of 800 million people is *likely* to be over 1.5 billion by 2040 and *possibly* as high as 3 billion by the end of the century. Economically, despite opportunities to profit from the exploitation of resources, the states of sub-Saharan Africa *will* remain amongst the least developed, with widespread poverty and inequality exacerbating political, social and cultural tensions. Some bright spots of good governance and rapid economic development, such as Botswana, are *likely* to emerge, but poor governance, instability, corruption, rapidly growing populations and poor public health are *likely* to be the dominant trends. Moreover, considering Africa's limited resilience, the worst case effects of climate change on agricultural production and competition for resources amongst major powers, many states within it *may* fail. Such a failure *may* be accompanied by widespread conflict and humanitarian and migration crises on an unprecedented scale. The Sahel region, the Congo Basin and southern Africa are *likely to* be at particular risk. State fragmentation along ethnic, cultural and religious lines is *possible* with the competing interests of major powers, often focused on resource exploitation rather than development, exacerbating this trend through the sponsorship of proxy groups for their own ends. Disengagement from Africa by the major powers is

---

[90] Brzezinski Z, *The Choice*, 2005.

unlikely, especially for European states and China, given the links that already exist. In particular, the African diaspora *may* grow in importance. However, continuing security challenges and other priorities *may* lead to increased containment rather than development.

The Korean Peninsula

North Korea *will* continue to suffer severe problems, such as energy and food distribution difficulties. As the ruling dynasty dies out, power struggles are *likely.* North Korea is therefore *likely* to become increasingly brittle over time and suffer political collapse, most *likely* resulting in a reunified Korea. The transition *will* be fraught with tension. There *will* be significant scope for rapid mass population movements into neighbouring states. Furthermore, the threat of conflict with a nuclear-armed regime, increasingly aware of its possible demise, is *likely* to be of the greatest concern to the international community. Despite the substantial burden of transition, a reunified Korea, which *may* retain a nuclear weapons capability, as well as substantial economic and military power, is *likely* to become a significant power in East Asia, changing the regional balance of power, and causing concern to both China and Japan.

North Korea is *likely* to suffer political collapse

The Polar Regions

In the Arctic, technological advances and the acute effect of climate change *will* facilitate economic exploitation. The geographic extent of Arctic Sea ice has declined markedly over the past 50 years with the trend accelerating to reach a low in 2007, of only half its previous extent. Shipping routes, such as the North West Passage and Northern Sea Route, are *likely* to be open for longer periods and there *may*, in the summer months, be viable routes across the deep water of the Arctic Ocean, despite extreme weather conditions. The Arctic is *likely* to become a significant global source of fossil fuels and strategic minerals, with most deposits *likely* to be found in Russian territory. The division of the Arctic Ocean by the surrounding states, particularly Russia and Canada *will* give these states significant advantages both as centres of energy resource, and as shorter links to markets in the Far East.

The Antarctic Treaty System, which applies south of 60 degree latitude, is *likely* to remain extant, providing environmental protection and preventing militarisation. However, global resource pressures, coupled with improvements in energy extraction technology pioneered in the Arctic, *may* increase the demand for access to the region and wider economic exploitation is *possible*. Any significant indications of energy resources in the adjacent seas, especially in areas where disputes about sovereignty exist, are *likely* to exacerbate tensions amongst competing regional powers. A 'scramble for Antarctica' is *unlikely*. However within the defined treaty limitations there *may* be significant competition for energy and fishing resources in the Southern Oceans, with the rising and emerging powers challenging the existing patterns of exploitation.
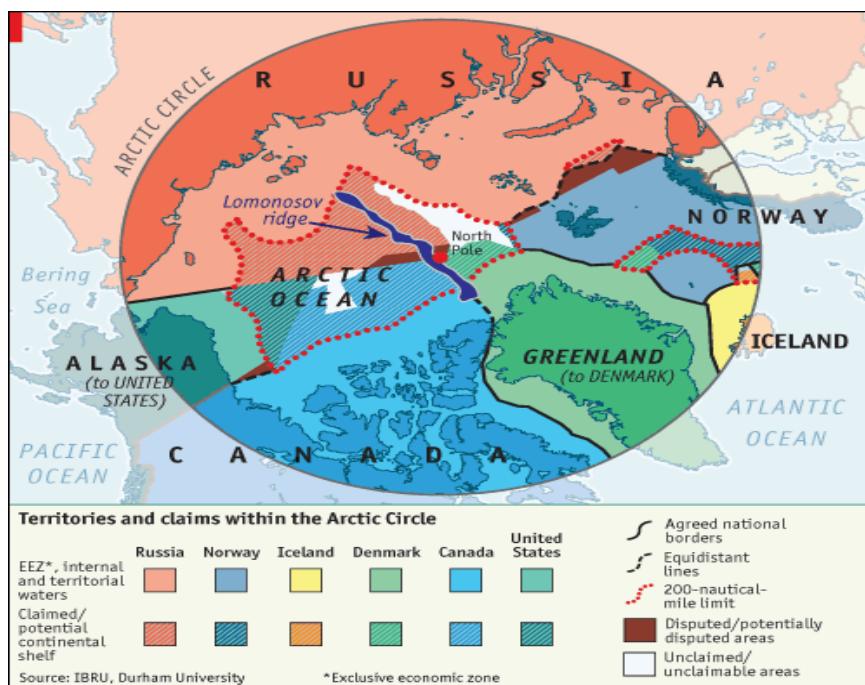
Figure 5 – **Map of the Arctic showing boundaries of claimed & disputed territories**[91]

---

[91] International Boundary Research Unit, Durham University.

Hot Topic – The Asian Meridian

The Asian Meridian is *likely* to be an economically successful region that sits at the intersection of the Chinese and Indian spheres of influence and is *likely* to be a region of geostrategic competition. It is the region from Hong Kong in the North, through South East Asia into Australia. It has a diverse population with large Indian and Chinese diasporas and historic links to the US and Europe, in addition to treaty arrangements such as the Five Powers Defence Agreement.[92] The region sits astride the global trade routes of the Malacca and Lombok Straits through which 20% of global oil production is transported, including 80% of China's oil imports. Over 60% of global shipping travelling through these choke-points is destined for Chinese ports.[93] Similarly, Japan imports over 80% of her energy needs along these routes. The importance of these choke-points is *likely* to grow out to 2040 placing the region at the intersection of *probable* Indian, US and Chinese spheres of influence. Moreover, Australia and Indonesia together account for almost half the world's coal exports and Australia in particular is a large mineral exporter.[94]

Figure 6 – Map showing the Asian Meridian which stretches from Hong Kong to Darwin

---

[92] The Five Powers Defence Agreement links the UK, Australia, Singapore, Malaysia and New Zealand. These states agree to consult each other should a direct threat against Malaysia or Singapore occur.
[93] Xuegang Z, *China's Energy Corridors in SE Asia*, 2008.
[94] In 2007, global coal exports totalled 908 million tons of which Australia exported 247 million tons and Indonesia 187 million tons. Coal Portal.

The region encompasses several states and other city states, such as Hong Kong and Singapore that are major centres of economic and financial activity. In particular, Vietnam has a large population and is *likely* to continue her economic development as an important manufacturing base, becoming increasingly influential within the ASEAN region.[95]

Australia, a partner and ally to the US, is also an Asian power in her own right and a centre of innovation, resource production and stability. She is *likely* to act as a bridge between the contemporary and rising powers and become increasingly influential.

China sources 80% of her oil imports through the Malacca and Lombok Straits

Islamic influences *will* be strong in the Asian Meridian, especially in Indonesia, Malaysia and Brunei, and amongst segments of the population in Thailand and the Philippines. Indonesia, the world's most populous Muslim majority country,[96] *may* experience robust economic development. However, internal problems between differing religious and ethnic groups and the disproportionate effects of climate change in the region are *likely* to inhibit economic and political development. Irregular activity and terrorism in support of separatism are *likely* and state fragmentation is *possible*, affecting energy exports and leading to insecurity and subsequent growth in maritime piracy, disrupting global trade.[97] Any disruption is *likely* to elicit a multinational response with China playing a significant role.

Competition for regional influence is *likely* to be significant, exacerbating instability and possible disputes over resources and sovereignty (see Hot Topic - Frontier Disputes). ASEAN is *likely* to develop its economic interconnectivity between member states but it is unlikely to emulate the EU as a supranational power in its own right. The growth in defence spending along the Meridian *will* continue with investment in maritime and air capabilities being substantially increased. While these forces are primarily for defensive purposes, including countering piracy in the Indonesian and Philippine archipelagos, many states in the region *will* be looking to use them to reinforce claims of sovereignty, both along their borders, in the international straits and to further their claims in the contested Exclusive Economic Zone (EEZ) areas, such as around the Spratly Islands in the South China Sea.

---

[95] Goldman Sachs, *BRICs and Beyond: N-11; More Than An Acronym*, 2007.
[96] Indonesia's population is 232.5 million. UN Population Division, 2008 medium variant. Muslim 86.1%, Protestant 5.7%, Roman Catholic 3%, Hindu 1.8%, other or unspecified 3.4% (2000 census) *CIA World Factbook*.
[97] Indonesia is the world's second largest exporter of coal. *British Geological Survey (BGS) Mineral Profile: Coal*, March 2007.

Hot Topic – Frontier Disputes

Out to 2040, the position of international boundaries and frontiers is *likely* to be a source of tension. These tensions *will* either be between two opposing states, or, by an existing ethnic or nationalist group whose historic territories are divided by an international border. Most frontier disputes are settled amicably through legal arrangements. For example, in 2008 Russia and China settled a century old dispute regarding their Amur River border. However, other frontier disputes are less liable to be settled amicably, especially where ethnic differences are aggravated by inequality and also historical antagonism, and where access and ownership of scarce resources are involved. For example, in 1990, part of the Iraqi justification for the invasion of Kuwait centred on ownership of cross-border oil reserves. Maintenance of territorial integrity and the importance of clearly defined boundaries to both established states and an expanding patchwork of smaller states *will* continue to be an important security concern. Lack of clarity *may* generate tension and instability, and provide a *possible* trigger for conflict. Factors that exacerbate tension and the probability of conflict are *likely* to include: resource ownership; ethnic, religious and ideological differences; the presence and scale of any recent conflict; the involvement of other interested parties; the likelihood of successful negotiations; the presence of a fence or wall that denies movement; and the degree to which a border is clearly defined.

Frontier disputes are less liable to be settled amicably, especially where historical antagonism exists, such as in South Ossetia

There *will* be continued tension over boundaries that artificially divide perceived ethnic, national or religious communities. This is *likely* to result in continuing tension in the Caucasus, along the boundaries of regions inhabited by Kurdish majorities and in sub-Saharan Africa, especially in the Sudan, amongst others.

The UN Convention on the Law of the Sea (UNCLOS) *will* be a factor in maritime boundary disputes. It defines maritime boundaries and the limits of maritime claims. Disputes between states can arise where claims to an EEZ or an outer Continental Shelf overlap. Where the overlaps are generated by features or islands whose positions or sovereignty are disputed, third party intervention is often needed to resolve the issues. The Convention provides its own dispute resolution framework, and the International Court of Justice also decides disputed cases. At present, about 50% of maritime boundaries are determined; the remainder represent the more difficult boundaries in areas with disputes, and progress to resolve them is slow. Drivers for resolution of maritime jurisdiction are provided by the need to exploit oil and the need to manage fisheries and by 2040, one can expect to see fewer unresolved boundaries representing the more intractable disputes. Global hot spots for maritime disputes *will* continue, as currently seen in the South China Sea, the Far East and South America. Military confrontation cannot be ruled out, but it is *likely* to be the exception rather than the norm.

Legend:
- ✳ Maritime dispute
- ✳ Intra-State dispute
- ✳ Inter-State dispute
- ☐ United Nations Law of the Sea (350 nautical miles)

© Crown copyright 2009. Crown copyright material reproduced with the permission of the Controller HMSO.
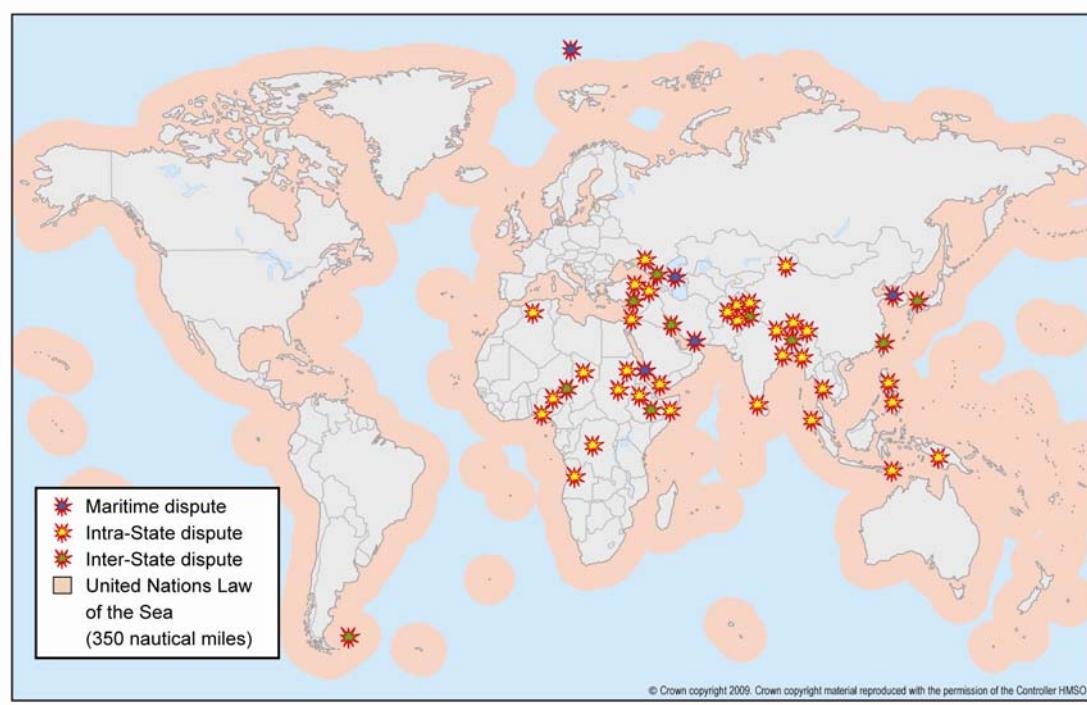
Figure 7 – **Analysis of Frontier Disputes Shows Areas With Most Potential for Conflict by 2040**

Key Theme – Evolving Defence and Security Challenges

Scope

This key theme builds on preceding chapters in order to consider how they will shape conflict out to 2040.[98] Since the Cold War, the likelihood of major inter-state warfare has been perceived as being more remote while instability, societal conflicts and terrorism have frequently led to confrontation and crisis. The sources of potential conflict worldwide have increased and their forms have diversified. The global system has become increasingly interdependent and interconnected and has given conflict, wherever it occurs, a global dimension. Some states and non-state actors, such as terrorist groups, have gained increased global reach. All of these trends are *likely* to continue. However, out to 2040, they are *likely* to converge with others, and further significant change in the character of conflict can be expected. Powerful states, such as China, are *likely* to continue their rise. Along with others, they are *likely* to develop military equipment that rivals that developed by the Western powers, and export it to partners and proxies. While stringent efforts *will* be made to prevent it, WMD are *likely* to proliferate and the likelihood of their usage *will* increase. Instability within states *will* continue. The incidence of armed conflict is *likely* to increase. In an era of persistent challenge, adaptation and evolution, complex problems are *unlikely* to be solved by military power alone, and integrated, multinational approaches *will* be the norm.

Evolving Defence and Security Challenges analyses trends in:

- The Contemporary Military Context.

- Trends in Armed Conflict.

- Technology and Conflict.

- Balance of Military Power.

- The Proliferation of Weapons of Mass Destruction.

- Evolving Legal Norms and Legitimacy.

- Future Conflict.

- Responding to the Challenges of Future Conflict.

The Hot Topics in this theme are ***Defence and Security, The Future of Deterrence, The Importance of Influence and Characteristics of the Future Operating Environment***.

---

[98] This section incorporates work published by DCDC in 2009 and 2010 on the Evolving and Future Characters of Conflict.

2010

Multiple stress zones
Current conflict

© Crown copyright 2009. Crown copyright material reproduced with the permission of the Controller HMSO.

2040

Multiple stress zones
Climate induced multiple stress Zones

© Crown copyright 2009. Crown copyright material reproduced with the permission of the Controller HMSO.
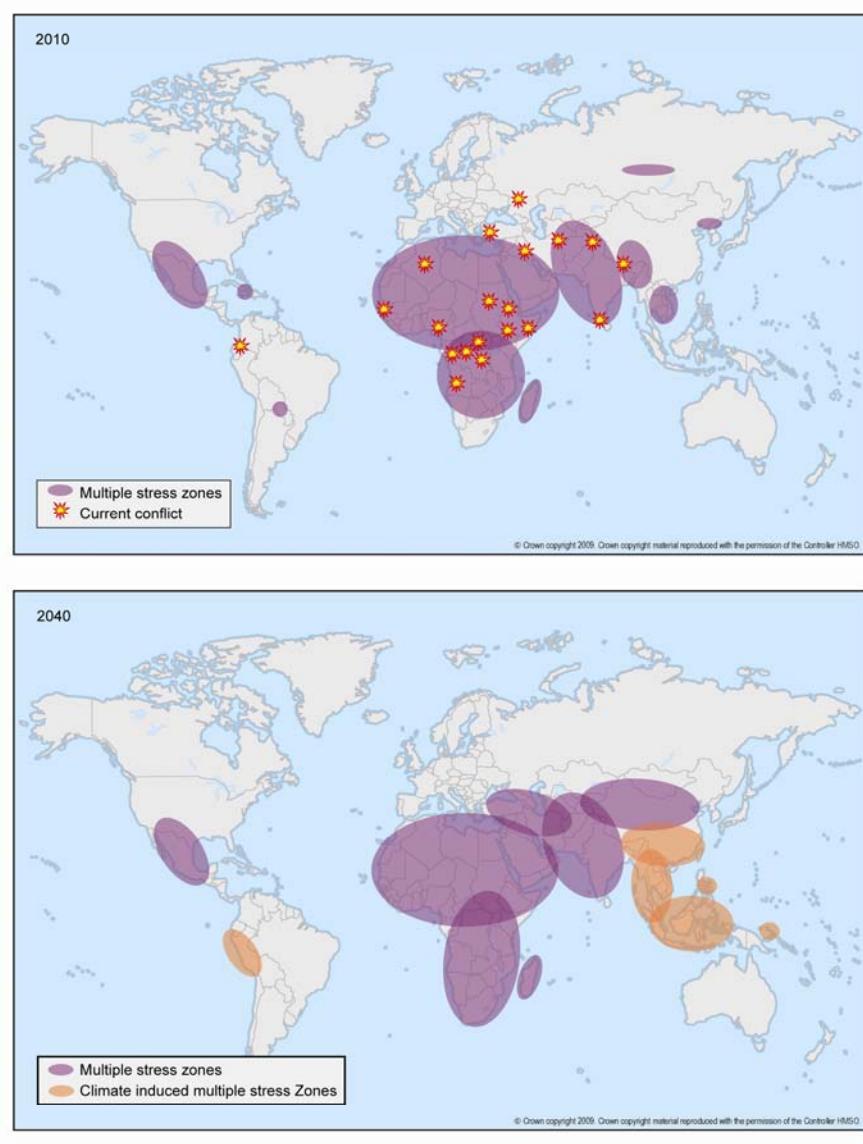
Figure 8 – Current and Future Regions of Multiple Stress

The top map plots **current** estimates of demographic growth, water and food shortage, and crop decline. The shaded area represents regions where 2 or more stresses overlap. A representation of current conflict is then overlaid and, although direct cause and effect is not implied, there is a degree of correlation.[99] The map below takes **forecasts** of the same variables out to 2040 and shows that the multiple stress zones are *likely* to extend into Central and East Asia. This *will* result in challenges for states in these regions and *may* increase the likelihood of conflict. The area shaded in yellow represents the further expansion of multiple stress zones to include densely populated regions at risk from climate-induced coastal inundation.

---

[99] Derived from the IISS Conflict Database, 2008. Considers conflicts with greater than 8000 fatalities since 1997.

The Contemporary Military Context

It is impossible to assess trends in future warfare without first seeking to understand the contemporary military context, both globally and in the UK. Military power is an agent of policy and *will* remain so. However, once started, conflict has its own dynamic that can drive policy. Military power cannot be separated from the diplomatic and economic levers of power. Additionally military power cannot be considered in isolation in the chaotic and complex strategic environment. These levers of power, amplified by the growing power of information, form the armoury of statecraft; the use of wisdom and judgment that blends hard and soft power in an integrated pursuit of national interests; however, these levers can be destabilising if used with miscalculation and adventurism.

Strategy is one element in the practical application of statecraft. It seeks to align objectives, concepts and resources to increase the probability of policy success. It applies rationality and linearity to circumstances that may not be either and, despite appearances and expectations, is therefore primarily an art rather than a science. It is most effective when it anticipates and leads change. Strategy is time sensitive; timing and rate of change matter.[100] Strategic stability, such as that enjoyed by the West at the end of the Cold War, provided little impetus for change, and strategic advantage reduced this impetus further. Western strategy has therefore too often focused on the short-term, and made it difficult to advocate strategies that pre-empt major upheavals in the strategic environment. Such proactive strategies for change can be deferred as a result of the preference for near-term stability and the avoidance of political risk. The attacks of 9/11 significantly disrupted the strategic equilibrium. Out to 2040, more numerous, rapid and complex changes are *likely* to require far-sighted and agile strategies.

The evolution of conflict is not linear, nor is it driven by single factors such as technology, economics, religion or geography. Rather the character of conflict evolves in close relation to changes in the broader strategic context. Technology sets the parameters of the possible, but it is human endeavour and ingenuity, expressed through innovative strategy, tactics and doctrine, that generate radical changes in the character or conduct of war. These radical changes are often termed Revolutions in Military Affairs (RMAs). They are frequently acclaimed in marketing strategies and academic papers, but in reality they are rare. Two understandings of what constitutes an RMA have emerged and are often conflated. The first refers to a relatively rapid change at the operational level of war, usually brought about by harnessing new technologies to new concepts of operations.[101] The application of Blitzkrieg tactics is an example. The second is a concept of revolution in a larger sense, epochal upheavals in which society itself is transformed. The '*Levee en Masse*'[102] during the French Revolution is an example, as are the changes in warfare brought about by industrialisation in the 19th Century.

---

[100] Yarger H, *Strategic Theory for the 21st Century*, 2006.

[101] Roxborough I, *From Revolution to Transformation - The State of the Field*, Joint Force Quarterly, 2002.

[102] During the French revolution, in response to the dangers of foreign war, the Committee of Public Safety established a mass conscription (*Levée en Masse*) and succeeded in training an army of about 800,000 soldiers in less than a year. This was much larger than any army available to other European states, and laid the basis for Napoleon's domination of Europe. In addition to bringing out the creativity of the Committee of Public Safety, the *Levée en Masse* represents a turning point in the history of warfare and the starting point of 'total' war involving all elements of the population, and all the reserves of the state.

At the operational level, information-age technology has spawned concepts such as Rapid Dominance[103] that suggest Western technological superiority allows it to define war on its own terms, as exemplified, by the defeat of Iraq's conventional Armed Forces in 2003. Much current capability and thinking about conflict dates from such operational-level concepts and has produced some clear benefits, such as Network Enabled Capability (NEC). However, the operational-level RMA concepts cannot be a complete solution to the problems of conflict. Adversaries have adapted to counteract the West's preferred way of warfare, seeking a variety of 'high-end' and 'low-end' asymmetric techniques, ranging from suicide attacks and improvised explosive devices through to the innovative use of technologically advanced weaponry and the development of agile, resilient, decentralised organisational structures.

At the strategic level, and over a longer time-scale, the ongoing transformation of society at the global level is *likely* to be reflected upon as resulting in a RMA. The multi-faceted process of globalisation is *likely* to continue this transformation of both global and local societies over the next 30 years, causing comprehensive changes in the character of conflict. Public perceptions *will* matter, both in the West and elsewhere. The nature of the changes cannot be predicted in detail, but they are *likely* to be wide-ranging and focused on national interest, the importance of influence rather than just kinetic activity, on networks of states, groups and individuals rather than hierarchical structures and organisations, and on agility and asymmetry rather than the simple balance of military power.

This societal-level RMA poses several dilemmas for Western defence strategists, especially given the associated requirement to prevail in current conflicts. First, strategy is best when based on pragmatism not ideology. Additionally, it should be derived from, and rooted in, core national interests.[104] The second dilemma is to understand the specific problem, given that future conflict *will* take many forms. This inherent unpredictability has traditionally been mitigated by spreading risk, for example, by maintaining a range of balanced forces as a hedge against uncertainty. For the majority, if not all, states this approach is *likely* to become prohibitively expensive due to the pressure on financial resources combined with the increasing scope of conflict. States are therefore *likely* to seek alternative strategies to manage risk including increased interdependence and burden-sharing with traditional allies, the formation of new partnerships with states and groups that share common interests or values. States are also *likely* to recognise that the military cannot be used to achieve rapid effect at relatively low cost and with limited risk. The third task of strategists is to achieve an asymmetric edge, such that when required, the state maintains a capacity to apply power in order to deter, coerce, shape and seize the initiative, or alternatively to respond to the unexpected. In the past, the Western way of warfare put a high premium on technology and organisation to deliver this edge. While both factors remain vital, achieving sufficient

---

[103] Rapid dominance, also known as 'shock and awe', was a military concept based on the use of overwhelming power, dominant battlefield awareness and manoeuvres, and spectacular displays of force to paralyse an adversary's perception of the battlefield and destroy its will to fight. Ullman H.K and Wade J.P, *Shock and Awe: Achieving Rapid Dominance*, US National Defense University.
[104] Flournoy M, brief to the US Army Leadership Forum, 2009.

mass is already problematic and this *will* become increasingly more so especially as technological advantage is *likely* to wane.

Trends in Armed Conflict

Since the end of the Cold War, the incidence of armed conflict declined, reaching a low in the early 21st century. Quantitative studies reveal that there were fewer inter-state and intra-state conflicts, and despite global population increases, fewer battle-related deaths.[105] However, conflict has become more pervasive both in terms of participation and public perception. The number of states engaged in armed conflict has increased to its highest level since 1945,[106] mainly due to participation in multilateral wars.[107] Moreover, the number of active peacekeeping operations has doubled when compared to Cold War levels, with around half of these being conducted under the auspices of the UN. The number of new armed conflicts erupting each year has been consistent and the decrease in active conflicts since 1990 is due to the resolution or freezing of older conflicts. The public perception of conflict has been shaped by media coverage. Enabled by rapid advances in communications technologies, this coverage has made conflict more conspicuous by distributing near real-time images and information to every corner of the globe.

Since 1945, the average lethality of war has reduced for combatants and annual totals for battle-deaths have declined steadily. However, the decline in battle-deaths alone does not paint the full picture. On average, inter-state wars have typically lasted around 3 years, civil wars just over 5 years, and ethnic wars nearly 10 years. Moreover, since 1945, one-third of large-scale insurgencies have been linked to mass killing of civilians, as in the Democratic Republic of Congo (DRC), Rwanda and Darfur. For example, in the DRC, war resulted in an estimated 145,000 battle-deaths, but around 300,000 violent deaths of civilians, and up to 3 million deaths from all war-related causes, the most significant being disease and deprivation.[108] High numbers of civilian casualties, despite declining numbers of combatant deaths, *will* raise ethical questions regarding the legitimacy of operations, proportionality and the importance of human security. Any lack of legitimacy *will* undermine soft power activities. However, disproportionate civilian casualties are *likely* to continue as long as irregular and societal war 'amongst the people'[109] remains dominant and the incidence of inter-state war, typically associated with high numbers of combatant deaths, remains depressed.

In the aftermath of the 9/11 terrorist attacks, the incidence of armed conflict has increased following a period of decline since the end of the Cold War (see Figure 9). Out to 2040, the incidence of armed conflict is *unlikely* to resume its downward trend and is *likely* to increase, driven by a number of factors. First, the uni-polar US-dominated world order has already started to develop a more multi-polar distribution of power, and this evolution

---

[105] All quantitative surveys can be challenged on the basis of the definitions they use to define types of conflict. However, looking across a range of different datasets, the results are broadly consistent with those described in *Peace and Conflict 2008*. Battle-related deaths refer to those deaths caused by the warring parties that can be directly related to combat. Hewitt, Wilkenfeld and Gurr, *Peace and Conflict,* Executive Summary, 2008.

[106] *Ibid.* Figures are for 2005.

[107] For example, in Afghanistan, Iraq or Kosovo.

[108] Hewitt, Wilkenfeld and Gurr, *Peace and Conflict*, Executive Summary, 2008.

[109] Smith Rupert, General, *The Utility of Force*, Penguin, London, 2006.

will continue. Such a change can have positive effects, by forcing states to find multilateral solutions to common problems. However, it also leads to instability in the international system and is *likely* to offer the opportunity for suppressed state rivalries to re-emerge, increasing the potential for competition and confrontation between regional powers. Similarly, some of the conflicts frozen since the end of the Cold War *may* thaw quickly.[110] Second, global inequality is *likely* to remain widespread and *will* be made more explicit as access to globalised media increases. This access *will* heighten inequality associated grievances, by making them more apparent to those who lack, or are denied, opportunity. Third, population increases, resource scarcity and the adverse effects of climate change, are *likely* to combine, increasing the likelihood of instability and of disagreement between states, and providing the triggers that can ignite conflict. Finally, since 1990, the absence of a clear ideological divide, such as existed between the West and the Soviet bloc, has contributed to the decline in conflict. Out to 2040, political and religious ideologies that espouse populist or belligerent narratives are *likely* to grow in importance (see Hot Topic – The Resurgence of Ideology). All of these factors *will* be exacerbated by periods of global economic recession. Other factors are *likely* to mitigate some of the risks. For example, inclusive and effective global governance institutions and economic interdependence are *likely* to have a stabilising effect. However, on balance, these factors are *unlikely* to further reduce the incidence of conflict.

Regionally, conflict is not evenly distributed, with the majority of recent conflicts erupting in Africa and Asia (see Figure 8). Moreover, in the post-Cold War era, 77% of all international crises involved one weak state, a significant increase on the Cold War era, and suggestive of a link between economic and social development, and conflict. Regions that have a recent history of conflict are particularly at risk, as are states that possess significant natural resources or are of geostrategic importance. Most weak states are located in Africa and Asia (see Figure 4) and the greatest likelihood of future conflict *will* continue to be in these regions.

---

[110] For example, the Russo-Georgia conflict in 2008.
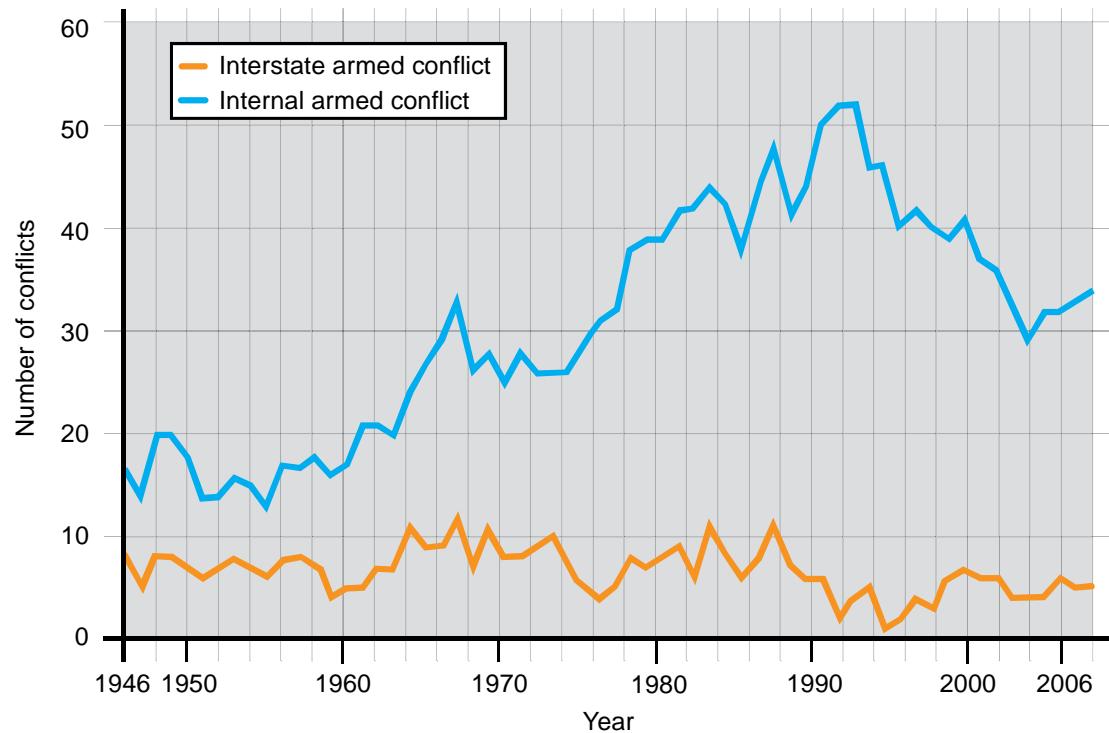
Figure 9 – Global Trends in Armed Conflict[111]

Out to 2040, the UK is *unlikely* to become disassociated from global trends. Political choice *will* continue to be the most important factor in determining when, how and if the UK Armed Forces experience combat. In particular, considerations regarding the UK's role in the international system, its alliance commitments and the degree of engagement to protect global interests *will* be important. Casualty rates *will* continue to have an important effect on these political choices and on public support. Nevertheless, concepts of casualty acceptance and aversion are *likely* to remain linked to perceptions of the importance and legitimacy of the conflict, and the likelihood of success, rather than a simple compassionate response.

---

[111] Source: Centre for International Development and Conflict Management (CIDCM).

Out to 2040, the incidence of armed conflict is *likely* to increase

Hot Topic – Defence and Security

Defence and security are linked, but different, concepts. Defence primarily refers to states and alliances resisting physical attack by a third party.[112] Defence is about the survival of the state and is not a discretionary activity. Security is a contested concept that can never be absolute. It is therefore, to some extent, discretionary. It implies freedom from threats to core values both for individuals and groups.[113] The decline in the incidence of inter-state war and the emergence of transnational threats, especially in the developed world, has resulted in greater political emphasis being placed on security rather than defence. Moreover, security has gradually evolved from the concepts of national and international security to the idea of human security.

Out to 2040, defence and security *will* remain vital, both in the virtual and physical domains, including space and cyberspace. However, defence is *likely* to increase in importance as population growth, climate change, resource scarcity and instability, threaten the ability of states to provide for their populations. These factors are *likely* to result in an emphasis on defending access to the physical necessities of survival. Many of these necessities *will* be international and linked to globalisation, implying the need for major powers to operate globally and for alliances and partnerships that defend common interests. These common interests make it *likely* that the needs of the many often outweigh individual rights. Hence, to some extent, the trend towards human security rather than international and national security, is *likely* to be reversed. It should be noted that defence activity is *unlikely* to be conducted solely by military forces, and should not be conflated with military activity, nor will security activity be purely the domain of security forces.

Military forces *will* retain a vital defence and security role

---

[112] Evans G, *Dictionary of International Relations*, 1999.
[113] Baylis J and Smith S, 2005, *The Globalisation of World Politics,* 3rd Edition, page 300.

Hot Topic – The Future of Deterrence

Out to 2040, discouraging conflict *will* be increasingly important, especially as the strategic balance of military power shifts away from the US to a more multi-polar distribution. Deterrence *will* remain a vital conflict prevention tool. The object of deterrence is to maintain the status quo by preventing real or potential enemies from initiating hostile acts. It is related to, but different from coercion, where the goal is changing the behaviour of an adversary, so changing the situation. To be effective, deterrence must be credible, capable, and clearly signalled such that the target audience fully understands the consequences of their behaviour. The main expression of deterrence has often been nuclear weapons, but most military forces have a deterrence role. As the scope of conflict broadens so *will* the scope of deterrence and many actors can be expected to develop, for example, cyber deterrence capabilities, as well as mechanisms to deter adversaries in the economic, financial and other domains.

Nuclear deterrence *will* be complicated by the emergence of more actors capable of delivering WMD at range. Instability is *likely*, until states develop the necessary understanding of diverse political and strategic cultures required in a multi-polar world, and cope with the reality of horizontal proliferation and a rising number of *de facto* nuclear weapon states. Existing arms control mechanisms are *likely* to endure in some form and relationships between the established nuclear powers are *likely* to remain stable. Relationships between the established nuclear powers and those who are currently developing their own nuclear capability *may* arise, although the challenge of maintaining effective communication *will* be high. Broader participation in arms control *may* be achieved, although this is *unlikely* to reduce the probability of conflict.[114] Effective ballistic missile defence systems *will* have the long-term potential to undermine the viability of some states' nuclear deterrence.

Much activity *will* focus on deterring irregular actors, including terrorists. This includes deterring them from acquiring and employing CBRN materials, but also from committing more conventional violent attacks. Some individuals and groups are *unlikely* to respond to deterrence, but most groups with political objectives, including many of those that espouse religious narratives, are *likely* to act rationally and respond, provided deterrence is intelligently focussed and signalled. This *will* require detailed study of individual groups in order to develop a deep understanding, rather than blanket application of a universal deterrent solution. Even groups that seemingly have nothing to lose, such as groups that espouse suicide attacks, *will* continue to value and protect their ideology, cause and narrative. Moreover, many irregular actors have links to states that *will* recognise and respond to both deterrence and coercion. Some groups that remain resistant to deterrence *will* respond to coercion, including non-kinetic methods such as investment in development, while others *will* necessarily be subject to disruption and attack.

---

[114] Dale W.C and Gray C.S, *Strategy in the Contemporary World*, Edition 3, 2006.

Technology and Conflict

Technology has already broadened the scope of conflict from the land, maritime and air environments to encompass cyberspace and space. It offers new possibilities for conflict and is exploited through innovations in organisation, strategy and tactics. Out to 2040, rapid technological innovation *will* have a significant impact on the evolving character of conflict. It *will* continue to be a double-edged sword, offering advantages to major powers able to afford the most advanced technologies, but also to entrepreneurs and innovators who collaborate to find new uses for existing technologies. These entrepreneurs, including smaller states and non-state actors, *will* rapidly be able to adapt strategies, whereas major powers are *likely* to suffer from institutional inertia and the financial drag associated with large weapons programmes.

For the first half of the period out to 2040, the vanguard for technological development is *likely* to continue to shift from the state to the commercial sector. The proliferation of these commercial systems and technologies *will* allow allies and adversaries to be similarly equipped, if they can afford to buy on the open market. Developing states and non-state actors *will* rapidly be able to exploit low-cost, evolving and emerging technologies to gain an asymmetric advantage. However, for the latter part of the period, the trend towards the commercial sector *may* slow or even reverse as states focus on self-interest and invest in research to combat climate change, resource scarcity and other challenges.

Since the end of the Cold War, the largest suppliers of conventional weapons to the international arms market have been the US, Russia, Germany, France and the UK.[115] The major purchasers have been China and India, with Asia accounting for 37% of trade, Europe 23%, and the Middle East 22%.[116] The overall level of transfers has increased from a low in 2002 and is valued at around $45 billion per annum. Forward orders suggest that the volume of international arms transfers is *likely* to increase during the first half of the period and that Saudi Arabia, Libya and Taiwan are *likely* to feature as major importers.

The future strategic challenges faced by major powers are *unlikely* to be resolved by technological 'magic bullets' alone. However, wealthier states, especially those with shrinking populations, *may* be seduced into favouring complex technological solutions over more traditional, human approaches, despite struggling to meet the associated costs. The dominance of technological quality over quantity, exemplified by the conventional combat phases of the Gulf Wars, where mass was superseded by sophisticated weaponry and improvements in organisation and training, *will* be challenged. The value of the human *will* remain critical in people-centric operations where influence is vital, and some military tasks *will* remain both manpower and equipment intensive. The trend towards highly specialised weapon systems that prevailed throughout the Cold War has resulted in their adaptation for use in new contexts. However, high associated costs, novel weapon technologies and the multitude of potential tasks faced by militaries *will* make simple, versatile, kinetic weapons invaluable. This is true for developed states, but also for

---

[115] Stockholm International Peace Research Institute (SIPRI) Handbook 2008, page 316.
[116] *Ibid*, page 294. Covers the period 2003 - 2007.

irregular actors who *will* seek to use simple, flexible and inexpensive weapons, such as improvised explosive devices (IEDs) to achieve effect at all levels of conflict. Technology inevitably spreads, and no military has ever enjoyed a perpetual monopoly on any capability. The technological advantage enjoyed by the West since 1945 is *likely* to be eroded as technological diffusion and strengthened Research and Development (R&D) activity, particularly in Asia, feeds through to weapons production. For example, in some areas, China's military equipment available for export to potential adversaries is *likely* to be comparable to European equipment by 2020 and approach US standards by 2040.[117] Technological parity is *likely* to challenge a Western paradigm of war; that technology can replace mass and lead to rapid, decisive effect.[118] Moreover, combat between equally matched adversaries is *likely* to result in escalating numbers of casualties. This changing paradigm *will* also require the ability to plan for modes of conflict with adversaries that leverage niche high-tech capabilities and employ innovative concepts of operation.[119] For example, regional powers armed with precision-guided missiles and anti-access technologies, such as submarines, cruise missiles and sophisticated surface-to-air missiles, *may* make traditional power projection strategies infeasible.

The development of networked systems *will* continue. Access to information *will* spur knowledge and understanding, and act as a critical enabler in future conflict. Irregular actors *will* continue to use widely available technology such as the Internet to both conceal and promote their activities. Similarly, developed states *will* seek to integrate and synchronise platforms, sensors and shooters in a quest to lessen the 'Fog of War'. Although technical improvements *will* be considerable, tactical advantage is *likely* to be short-lived as adversaries rapidly adapt.
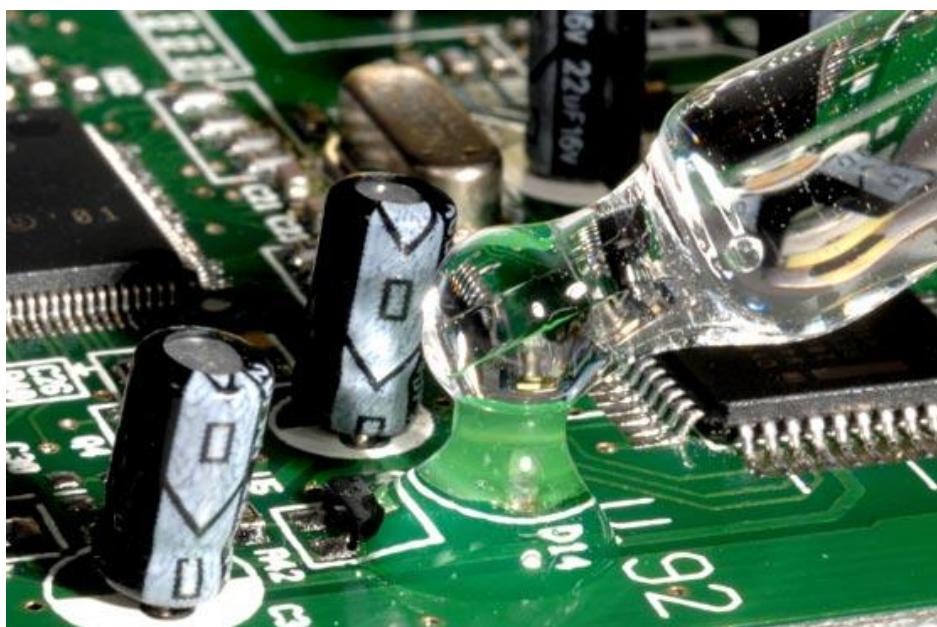
The dominance of technological quality over quantity *will* be challenged

[117] Bowns, Middleton et al, *The Effect of Defence R&D on Military Equipment Quality,* Defence and Peace Economics 2006, Volume 17(2), April 2006, pages 117 - 139.
[118] Bowns, Cornish et al, *A Quantitative Analysis of Modern Conflict,* Chatham House International Security Programme, 2009.
[119] RAND (Europe), *Perspectives on the Future of Conflict: UK MOD Discussion Paper,* May 2009.

The Balance of Military Power

The balance of military power *will* become multi-polar, although the US is *likely* to remain pre-eminent. Confronted with few direct territorial threats and ageing populations, most affluent societies are *likely* to minimise their defence expenditure by investing in conflict prevention, burden-sharing through participation in alliances, and contracting out security. The US is *likely* to be the exception, making by far the greatest commitment to defence, although its economic power and technological advantage is *likely* to become increasingly challenged. These developments are *likely* to make intervention operations increasingly fraught with military risk, unless they command widespread multilateral support. Adversaries *will* seek to prolong conflict if they consider it advantageous, targeting the cohesion of alliances, coalitions and public support. Prevention strategies offer the attraction of avoiding conflict, with associated human and financial savings. However, they *will* require sustained investment, and patient and intelligent implementation, and are *unlikely* to be entirely successful as partnership rests upon a shared assessment of risk and reward. Moreover, success *will* be difficult to measure and require early political engagement and commitment of resources.

Defence spending of the rising powers is *likely* to increase in proportion to their economic growth and their expanding range of global interests. Sino-US rivalry is *likely* and active hostility and belligerency, especially through proxies, is *possible*. However, direct war between the world's foremost powers remains *unlikely*. China is *likely* to seek a range of important asymmetric capabilities in the form of an *'assassin's mace'* of deterrent, compellent and attack capabilities for immediate regional requirements that offset US offshore maritime capability.[120] This is *likely* to constitute 2-tier armed forces, consisting of nuclear weapons and large relatively unsophisticated forces for territorial defence, together with smaller higher-capability forces for power projection, predominantly within their sphere of interest rather than globally. Low-income states *will* continue to operate forces that, in principle, are organised along conventional lines, but *will* probably bear a closer resemblance to the irregular armed groupings operating locally within them. However, the diffusion of technology is *likely* to provide even low-income states with some access to advanced weaponry that adds risk and complexity to the battlespace.

Alliances and partnerships, linked to spheres of influence, are *likely* to be fundamental to the future balance of military power. Their nature and objectives are *likely* to reflect geopolitical reality and be linked to the fears and interests of their constituents, which *may* be both state and non-state. NATO is *likely* to endure and remain the basis for collaboration between western states, performing the vital roles of facilitating political dialogue and military interoperability between members, partners and prospective partners to underpin multinational operations. The defensive alliance at its heart *will* remain extant. A full and constructive partnership between NATO and Russia is *unlikely*. The US, however, *will* increasingly view Asia and Latin America, rather than Europe and the Middle East as the focus of threats to its security. Additionally political difficulties are *likely* to persist, complicating NATO's utility as a collective security implement. NATO expansion, particularly into the Caucuses, is *possible*, but most *probably* through

---

[120] An 'assassin's mace' is used to designate a wide array of technologies that may afford an inferior military an advantage in a conflict with a superior military power.

partnership arrangements rather than formal alliance. Other alliances and partnerships, with political, defence and security objectives *will* emerge, focused primarily on the major powers and their spheres of influence, although they are *unlikely* to be ideologically opposed blocs, as seen during the Cold War. Rather, the alliances and partnerships are *likely* to share some common security interests, such as the protection of the global supply chain, and are *likely* to cooperate with each other, within the framework of a globalised world, rather than simply confronting each other along fixed frontiers.

The defence spending of rising powers is *likely* to increase

Hot Topic – The Importance of Influence

Military operations *will* focus on influencing people. Despite the unifying effect of globalisation, people from dissimilar cultures *will* continue to act and think differently, depending on their personal and group context. Hence, knowledge and understanding *will* be required of how people from different cultures think; what symbols, themes, messages, etiquette and practices are important; how systems of reciprocity or kinship function, and how these establish deep allegiances and social obligations. Relevant groups *will* include domestic audiences, key regional leaders and populations, coalition partners, diaspora communities and broader international opinion.

In conflict and confrontation, most actors *will* place considerable emphasis and dependence on the psychological rather than just the physical. All military activity, including force, *will* continue to be designed to influence, and is *likely* to be planned and executed in support of a campaign narrative. Technology *will* enable the development of extensive social networks that in turn *will* multiply opportunities for those seeking to achieve influence through the distribution of recorded images. This imagery, combined with simple, fluid narratives, can shape both local and global perceptions. Individuals, groups and states *will* be subject to influence from sensational acts of terrorism, such as

mass casualty events or executions, conducted to influence populations. Terror attacks are *likely* to demoralise and encourage, intimidate and motivate with messages highly tuned to specific target audiences in order to alter opinions.

Knowledge *will* empower and enable, even when the physical contest cannot be won. Information and intelligence gathering systems *will* be required to provide knowledge about people's perceptions, beliefs and opinions, and how they can be influenced. Influence *will* be attained when the behaviour of the target audience changes through the coordination of all levers of power including military action, words and images. Influence *will* not just be about messages or media, but how the combination of word and deed are portrayed, interpreted and understood through the lens of culture, history, religion and tradition. Speed of response is *likely* to be vital and first impressions *will* count. Notions such as winning and victory are *likely* to be of little relevance if an adversary can remain credible in the battle space of ideas.

The Proliferation of Weapons of Mass Destruction

Nuclear proliferation *will* be a significant factor affecting global security, especially as the transition to a multi-polar distribution of power brings change and uncertainty. The number of nuclear weapon states has gradually increased, although this increase has not been linear. The long-term credibility of treaties designed to limit nuclear proliferation and the reaction of the international community to proliferation by Israel, Pakistan, India, Iran and North Korea *will* affect the decision-making in states tempted to acquire nuclear weapons.[121] The policing regimes associated with nuclear non-proliferation are *likely* to be increasingly intrusive. Some states, such as Iran, *will* view development of nuclear weapons as both a security guarantee and a source of national prestige. Other states, such as Japan, Saudi Arabia and South Korea, faced with nuclear armed neighbours and concerns over US commitment to their security, *may* react by creating deterrent forces. While this raises the spectre of regional arms races it *may*, paradoxically, bring a degree of high-risk stability to regional relations provided a mutual understanding of motives and red-lines can be reached rapidly. However, some states *may* view tactical nuclear devices as weapons rather than deterrents. States, and extremist groups, lacking the technical ability to develop nuclear weapons and appropriate delivery systems *may* seek to purchase the knowledge, materials and technology via illicit channels. However, terrorist groups are *unlikely* to acquire deliverable nuclear weapons without state sponsorship, but are *likely* to acquire some aspect of a biological, radiological or chemical weapons capability, ranging from simple devices with localised effects through to mass casualty attacks.[122] Although less than 10 states have offensive chemical and biological weapons programmes, the number with the potential capabilities to produce such weapons is *likely* to increase in the future. Some of those who seek to achieve strategic effect at the expense of legitimacy, especially terrorist groups, are *likely* to use them. The choice of agent in the future is *likely* to be determined by the need to defeat defensive measures; circumvention of arms controls; credible deniability of use; and ease of production within existing industrial facilities. In particular, the production of chemical and

---

[121] Such treaties include the Non-Proliferation Treaty and the Comprehensive Test Ban Treaty along with numerous others.
[122] For example, in 2007 Iraqi insurgents used chlorine truck bombs as improvised chemical weapons.

biological agents *will* be difficult to detect and counter when legitimate industrial and pharmaceutical facilities are used. Attacks, akin to those carried out by the Aum Shin cult in Tokyo are *probable*.

Evolving Legal Norms and Legitimacy

Future conflict *will* continue to be characterised by disputed interpretations of legitimacy. Western norms for conflict based around notions of *jus ad bellum* and *jus in bello*,[123] and the widely accepted Hague and Geneva Conventions, are *likely* to be challenged by alternative paradigms for the conduct of conflict. Furthermore, the application of domestic law and international human rights obligations *may* result in unanticipated restrictions. In general, affluent and well-integrated states are *likely* to promote international legal norms, while poor and weakly-integrated states and non-state actors are *likely* to be guided by different norms that develop from their individual circumstances. While the majority of states *will* continue to legitimise their actions under existing international law, constraining international legal arrangements *may* become such an

Future conflict *will* be characterised by disputed interpretations of legitimacy

impediment to the achievement of strategic objectives that they are bypassed or ignored; competition for resources, for example, *may* exacerbate unconventional interpretations of international law.

Conflict classification, and the legal envelope for operations, *will* contribute to the complexity of future conflict, creating major challenges for those engaged in the planning and conduct of operations. The challenges to legal norms and legitimacy include: the blurring of roles between civilian and military, regular and irregular; the chameleon-like behaviour of groups that switch identity, being concurrently organised criminals, terrorists, insurgents and agents of a state; the varying national and cultural interpretations of what constitutes legitimate behaviour; novel means and methods of conflict, for instance in cyberspace; the implications and effects of armed conflict on regional social, economic and financial security; and, the employment and role of Private Military Security Companies (PMSCs). Kinetic operations amongst the people, rather than around them, *will* require the most careful prosecution to remain within the taut legal framework of

---

[123] The laws of war are divided into 2 categories: *Jus in bello*, law concerning acceptable conduct in war; and *Jus ad bellum*, law concerning acceptable justifications to use armed force.

combatant/civilian distinction. Advanced weapons capable of great precision and discrimination *will* be available to both state and non-state actors; however, widespread technological diffusion of communications technology, for instance, *will* also make indiscriminate improvised weapons more accessible. States *will* be more constrained in the conduct of operations than many non-state actors.

Future Conflict

Conflict *will* continue to evolve, reflecting developments in society, politics and technology, and involving a range of transnational, state, group and individual actors. These actors *will* operate wherever they can gain advantage, broadening the scope of conflict beyond the pure military domain. The strategic, operational and tactical levels of war, as well as the physical and virtual environments, *will* become increasingly compressed, porous and difficult to differentiate. Activity at one level, or in one environment, *will* have effect in others. This compression *will* shape the character of military activity, demanding increased discrimination and judgement about how to deal with situations holistically; both from military forces and from the political leaders who employ them. Economic, financial, legal and diplomatic conflict are all *likely*, challenging legal norms, and requiring coordinated and integrated responses in order to protect from and respond to attacks. Orbital space and cyberspace *will* be part of the battlespace in the same manner as the air, land and maritime environments, but activity *will* also expand underground, into the deep ocean and other extreme environments. Complex cross-environment links *will* continue to make it difficult to constrain conflict to geographic localities. The technologies employed and the tactics and techniques practised are *likely* to converge as adversaries rapidly learn and adapt from each other.

Potential adversaries range from potent state military forces through to disorganised and poorly equipped groups, and even individuals. A single adversary *may* constitute an amalgam of regulars, insurgents, terrorists, irregulars, and criminals. Political violence *will* often be indistinguishable from criminal violence. Criminal elements *will* become more sophisticated; they *may* have access to military hardware and *will* be comfortable operating in cyberspace. Many of these groups *will* share information, lessons, tactics and procedures where they see mutual benefit and be unencumbered by bureaucratic process. Many *will* adapt rapidly to changes in the environment or context. These adversaries *may* be structured as distributed social networks with no identifiable structure or coherence, and no recognisable centre of gravity.

The distinction between inter-state and intra-state war, and between regular and irregular warfare, *will* remain blurred and categorising conflicts *will* often be difficult. State actors are *likely* to develop an increased capability to conduct irregular activity and non-state actors are *likely* to employ a broad range of capabilities, some of which have traditionally been associated with states. For example, some non-state actors *will* deploy advanced technological capabilities while continuing to use irregular tactics and formations, sponsor terrorist acts, and provoke criminal disorder.[124] This blurring was demonstrated in the 2006 Lebanon War when irregular Hezbollah units defended territory against Israeli forces, utilised high-tech weaponry such as unmanned air vehicles and stand-off missiles,

---

[124] Hoffman F, *Conflict in the 21st Century: The Rise of Hybrid Wars*, page 58, December 2007.

and sought to provide humanitarian relief to those affected by the conflict. Even in the developed world, some non-state actors are *likely* to deploy capabilities beyond the ability of law enforcement agencies to counter in isolation, requiring the use of military, paramilitary or other security forces, such as cyber security groups. However, not all actors *will* embrace this form of multi-modal conflict, with some restrained by ethical, cultural or legal constraints from operating across the full spectrum. In particular, some states *will* lack the confidence in their own cohesion to develop the force structures necessary to conduct irregular conflict.

Out to 2020, instability, the threats that radiate from weak states and transnational terrorism are *likely* to remain the dominant Western military paradigm. Conflicts generated by horizontal inequalities, in particular, the intersection of economic, social and political inequalities with ethno-nationalism, are *likely* to remain particularly intractable. Internationalised intra-state conflict and associated irregular conflict *will* frequently be characterised by inter-communal violence, terrorism, insurgency, pervasive criminality and widespread disorder as experienced in Afghanistan and Iraq. Military operations in support of stability are *likely* to be multi-faceted and blur elements of high intensity combat, with the requirement to establish security and to provide for the needs of the population. These operations *will* be multinational, and dependent on wide interoperability between a multitude of partners, both civilian and military. Intervention, on the back of US military dominance, to stabilise weak states *will* be a feasible policy response, although the gradual rise of multi-polarity *will* make such strategies less attractive, especially when other major powers oppose such activity. Direct inter-state conflict between major powers is *unlikely* given the legacy of US military hegemony and interdependence that raises the cost of conflict. However, inter-state rivalries are *likely* to be expressed through proxies that have linked or complementary objectives. Many of these proxy forces are *likely* to employ irregular tactics including terrorism, while concealing and refuting links to state sponsors in order to preserve their freedom of action and maintaining a degree of deniability for the state. Proxies are *unlikely* to follow predictable paths and are *likely* to prove difficult to control over time.[125]

From 2020, Western military power is *likely* to evolve, particularly in response to the changing balance of military power and the *likely* proliferation of WMD. Major powers are *likely* to find many areas of shared interest to facilitate cooperation, but they *will* also find issues on which cooperation is impossible. States, such as China and India, are *likely* to close the technological gap with Western powers in certain areas and *will* maintain strong military forces and defence industries that *will* export advanced military equipment to partner states and proxies. This proliferation is *likely* to alter the strategic balance of military forces. Threats *will* still radiate from weak states, but the potential threats posed by some, more powerful, states and their proxies *will* become more relevant.

Total war,[126] harnessing the full power of industrial states, war between major Western powers, and war between liberal democracies, are *unlikely*.[127] However, disagreements

---

[125] For example the Taleban have proven difficult to control for the Pakistani state intelligence services.
[126] For example, World War II.
[127] A discussion of drivers for inter-state conflict can be found in Roberts, Adam, Zaum, Dominick, Routeledge, London, 2008, *Selective Security: War and the United Nations Security Council since 1945.*

between major powers over borders, influence and resources are *probable* and *may* lead to confrontation, including limited wars, where adversaries deliberately exercise restraint in the methods of conflict, their level of commitment or the objectives sought. In such confrontations and conflicts, which are *likely* to be conducted using proxies and be coalition-based, much emphasis *will* be on diplomatic and economic levers of national power.

Responding to the Challenges of Future Conflict

Future strategic challenges are *unlikely* to be successfully addressed through utilisation of single levers of power, or unilateral responses. Military power *will* be necessary, but not sufficient. Similarly, hard power *will* be important, but combining it with soft power in a smart strategy is *likely* to be vital. The national security of major powers *will* dictate that they engage globally, and to a greater or lesser extent, multilaterally, in order to maintain the international system and ensure a degree of shared access to the global commons. For example, international terrorism, transnational organised crime, climate change, the proliferation and *probable* use of WMD, particularly chemical and biological devices, uncontrolled migration and cyber attacks are impervious to single-state or one-dimensional policy responses. In particular, the need for shared access is *likely* to mean the multilateral coordination to secure supply lines, robust alliances and partnerships, and a varying degree of commitment to international legal norms.

States *will* seek to integrate their national levers of power. Military force is *unlikely* to be effective as a discrete

Non-state actors are *likely* to develop capabilities traditionally associated with states

form of response. This need to integrate and synchronise responses is *likely* to result in increased international cooperation and the formation of new alliances and partnerships. Interoperability between joint and coalition military forces *will* be vital. Training of partners, including state militaries, other arms of government and non-state partners, such as PMSCs and others, *will* grow in importance. The parallel challenges of state-sponsored proxies and instability in weak states is *likely* to make investment in capacity building and partnership a significant task. Military education *will* be a vital component in preparing for the diversity of future challenges. Command and control of integrated multinational operations *will* evolve slowly, with organisations capable of directing integrated responses being developed incrementally. Victory in conflict *will* be difficult to

define and winning *may* be reliant upon public perception or stability. It *will* still be possible to defeat an enemy militarily, just as Sri Lankan forces defeated the Tamil Tigers in 2009. However, military victory alone *will* not necessarily lead to strategic success unless an enduring political settlement is achieved.

As integrated approaches are adopted, the roles and activities of civilian and military personnel *will* make the distinction between combatants and non-combatants difficult to discern at an individual level. Extensive use of PMSCs *will* add further complexity to the operating environment. Regular military forces *will* deploy in environments where armed irregular forces, for example gangs, bandits, semi-official militias, PMSCs, terrorists, child soldiers, criminal elements, cyber warriors and tribal groups and insurgents, are operating, often as adversaries, but sometimes as neutrals or even as partners. Armed Forces are *likely* to be organised, trained and equipped to fight both irregular wars amongst the people and high-end threats at the same time. Military personnel *will* find themselves employed in essentially non-military roles, owing to their readiness profile, training and capacity for organised action, often as the first response to natural disasters and other serious civil contingencies.

The future threat environment, fusing all the environmental domains,[128] *will* be complex, as well as contested, congested, cluttered, connected and constrained. This is *likely* to require a shift in mindset by conventional defence and security forces. Conventional military powers have traditionally been built around fixed processes and hierarchal structures that, for both institutional and historic reasons, focus on providing military effect from environmental stovepipes. Such structures *may* need to adapt to maintain their utility when faced by a decentralised, asymmetric and agile adversary. Greater emphasis on open architectures, flattened organisational structures, mission command and decentralised control *may* be required to achieve desired effects. Adapting to the external environment, rather than seeking to control it is *likely* to be fundamental.

---

[128] Land, Air, Maritime, Space and Cyberspace.

Hot Topic – Characteristics of the Future Operational Environment

The individual environments *will* be interlinked and porous, especially with regard to influence and information. The Future Operational Environment (FOE) *will* be complex, but certain features listed below are *likely* to be apparent.

Congested. The FOE *will* be congested. In particular, densely populated urban and littoral regions, especially those lacking effective governance, *will* provide havens in which criminal elements, terrorists and insurgents shelter, organise, and operate. Moreover, instability and the adaptive tactics of combatants *will* force some operations to be conducted within, rather than around, such regions. Operations in these congested regions *will* carry an increased risk of collateral damage and unpredictable second-order effects. On land, operations in Baghdad, Basra and Fallujah provide examples, as do Israeli incursions into Lebanon in 2006 and Gaza in 2009. In the littoral, congestion *will* be in the form of large numbers of vessels, multiple fixed structures above and below the waterline, local air activity, shipping lanes, port access and adjacent dense urban areas with local communication links leading inland. The increased use of joint, manned and unmanned, air assets *will* intensify the congestion of airspace, particularly when control of the air is contested. Similarly, the proliferation of space-based assets, as more actors develop independent launch capabilities, and greater commercial and military of use satellites, *will* serve to make orbital space increasingly congested.

Operations *will* be conducted in congested urban areas

Cluttered. Clutter, particularly in congested environments, *will* provide opportunities for concealment. Adversaries *will* seek to blend into the background. Indigenous actors with detailed local knowledge *will* hold an advantage, as will those that can gather and share relevant information rapidly. Physical targets will often be difficult to acquire and track, and dense urban and littoral terrain *will* provide safe-havens and multiple avenues for attack and escape. On land, adversaries *will* continue to utilise traditional concealment methods, such as the camouflage and concealment techniques used by Serb forces in Kosovo. Low signature targets and fleeting windows of opportunity, in which to engage adversaries, *will* make surveillance and attack difficult. Use *will* also be made of underground facilities. Few spaces are *likely* to remain neutral, with hospitals, schools and places of worship forming part of the operating landscape, again challenging existing internationally recognised norms of combat. In the Air and Maritime Environments, stealth technologies *will* confer an advantage, but in a cluttered environment, it *may* not always be a decisive one. Given the need for precision, time-critical decision-making, and for discrimination, it is *likely* that platforms that effectively combine find and attack functions, and which compress the sensor-to-shooter decision cycle, *will* be required.[129] In cyberspace, the ability to remain concealed, while attacking at range with plausible deniability, is *likely* to provide the opportunity for small hostile groups to achieve strategic effect.

Contested. Adversaries are *likely* to contest any and all environments, often using novel or asymmetric methods. Technological diffusion, including the export of modern military equipment and its subsequent leakage, and innovative use of existing technologies, *will* underpin these challenges. In particular, the diminution of Western technological advantage and the proliferation of anti-access weapons, such as Surface-to-Air Missile Systems, submarines, offensive cyber capabilities and precision guided surface-to-surface missiles, *will* make force projection and sustainment difficult, challenging traditional concepts of expeditionary operations. On land, mobility is *likely* to be constrained by the use of mines, IEDs, or air and space effect, while additional low-cost strategic effect is achieved by car bombs and suicide attacks. In the maritime environment the proliferation of mines and submarine capability *will* threaten sea communications. For example, in East Asia the number of states with submarine capability has risen significantly over the last 10 years.[130] Control of the air *will* be an essential requirement for any operation, enabling freedom of air, surface and sub-surface manoeuvre.[131] Airspace and orbital space will be contested, as they *will* provide intelligence, situational awareness and an almost unhindered view of the electromagnetic spectrum, which is *likely* to provide an asymmetric advantage in combating lower-technology adversaries. However, such technology *will* need to be effectively integrated with other sources of information to ensure that the strategic nuances, the tactical complexities, and the social terrain are properly mapped and understood.[132] Space-denial capabilities, including disruption of satellites, are *likely* to proliferate and increase in effectiveness. In addition to the main theatre of operations, the home base, including the families of Service personnel, *will* be threatened. Many aspects of the contested nature of the FOE *will* challenge existing legal

---

[129] Future Air and Space Operational Concept (FA&SOC) 2009, page1-8, paragraph 122.
[130] Kelvin Fong. Asian Defence Journal. *Asian Submarine Forces on the Rise*, 2009.
[131] FA&SOC 2009, page 2-3, paragraph 206.
[132] *Ibid*, page 2-4, paragraph, 213.

norms pertaining to warfare, resulting in legal and ethical dilemmas.

Connected. The concurrent blurring and broadening of conflict *will* be a global phenomenon, but is *likely* to be most apparent at physical and virtual nodes in cities, littorals and in cyberspace. Examples of nodes include strategic locations, such as centres of governance, in urban areas and maritime choke-points.[133] Activity in all environments *will* tend to gravitate towards these nodes and they *will* require protection. Some are *likely* to suffer episodes of high-intensity warfare intertwined with stabilisation and humanitarian operations, conducted simultaneously across all environments. Networks, such as logistical re-supply routes, sea and air lines of communication, and the electromagnetic spectrum will connect the nodes. Air and space power, in particular, are *likely* to be increasingly reliant on, and vulnerable to, Computer Network Operations (CNO).[134] All networks, both military and civilian, will be subject to both intentional and inadvertent disruption, and *will* need to be sufficiently robust to adapt.

Constrained. In the complex battlespace of the future, Western legal and societal norms *will* place continued constraints on the conduct of operations. The increasing difficulty of discrimination between combatants and non-combatants *is likely* to require more extensive targeting preparation, and the legal and moral requirement to take all feasible precautions in avoiding, or at least minimising, collateral damage[135] *will* lead to the greater use of precision weapons. However, the use of such weapons will still carry risk. Furthermore, concerns about the proportionality of the use of non-precision weapons are *likely* to lead to attempts to further minimise their use.[136] The use of non-precision weapons, or the failure of precision weapons to avoid all collateral damage, while legally permissible, *may* generate adverse perceptions that undermine the legitimacy of operations. In particular, the view that the use of air power is a 'cruel overmatch or a blunt instrument' is *likely* to be encouraged by adversaries who recognise the reach, precision and utility that such technology represents.[137] Furthermore, legal challenges *may* be raised against the use of novel weapons and systems, such as Unmanned Aerial Systems, DEW, non-lethal weapons and CNO. Ethical concerns are *likely* to result in policy constraints on the use of such technologies, and *may* lead to new international treaties and constraints.[138] The application of domestic law and international human rights obligations to an armed conflict situation *will* continue to be debated and reviewed, and *may* result in unanticipated restrictions. Any legal, moral or ethical constraints, which uphold the legitimacy and legality of Western military operations, are *unlikely* to restrict the actions of, or be reciprocated by, potential adversaries.

---

[133] Examples of maritime choke-points include the Bab-al-Mendab, Malacca, Suez and Hormuz.
[134] FA&SOC 2009, page 1-10, paragraph 126.
[135] Article 57 – Precautions in Attack – Protocol 1 (1977) of the Protocols Additional to the Geneva Conventions of 12 August 1949.
[136] As illustrated by the Ottawa Convention (1997) [On the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-personnel mines, and their Destruction], and attempts to limit the use of Cluster Bomb Munitions.
[137] FA&SOC 2009, page v, paragraph 1.
[138] FA&SOC 2009, page 1-7, paragraph 119.

Strategic Shocks

The strategic context in 2040 is not shaped just by trends and drivers. On occasion, single events can provide discontinuities that cut across existing trends and re-shape the strategic environment. Such an event is a ***strategic shock***. Historic examples of these high-impact low probability events include:

- The 2007-8 financial crisis.

- The 9/11 terrorist attacks.

- The collapse of the Berlin Wall.

Strategic shocks have a cascade effect, leading to multiple, apparently unconnected and unforeseen changes. They transform the strategic context, changing behaviour and activity across the board. For example, the 2007 financial crisis began with US sub-prime debt. Failures in this relatively obscure area were magnified by a number of factors including high-levels of interconnectedness, a lack of confidence, and the complexity of the global financial system. The cascade effect brought the entire global financial system close to collapse. This in turn led to a transformed strategic context that had economic, geopolitical and social effects as the shock waves travelled outwards. The medium to long term effects of this crisis are uncertain, however, the implications of this strategic shock may yet be significant, or even catastrophic.

Other complex, interconnected global systems *may* also be at risk of systemic failure. This includes globalisation itself, which can be thought of as an amalgam of multiple complex sub-systems spanning the social, economic, financial and geopolitical domains. These systems are typically difficult to understand, and are subject to no overall control and variable standards of regulation. Moreover, their resilience is difficult to assess and measure, and confidence in the integrity of the system is often fundamental to its effective functioning. Examples include: the global system for trade and the supply lines and infrastructure that underpin it; energy and food supplies; and the global communications system, with its dependence on space-based utilities. Out to 2040, global interdependence and reliance on complex systems is *likely* to continue to increase. This provides many benefits, but *may* make future strategic shocks and the systemic failures more frequent and pervasive than in the past.

This section considers what some of these high impact, low-probability events could be, while recognising that others may be beyond our experience to anticipate, conceive or understand. It is not a comprehensive list. Acknowledgement that shocks *will* happen is important. It is recognition that the future cannot be predicted in detail or with certainty. However, they will inevitably influence defence and security in some way, providing a strong argument for versatile and adaptable defence institutions, equipment and personnel to deal with the unexpected challenges they will present.

The following is a selection of credible strategic shocks:

- **Collapse of a Pivotal State.** The sudden collapse of a pivotal state would threaten regional and global stability. For example, the descent into instability of a major hydrocarbon exporting state, such as Nigeria, Iran, Saudi Arabia or Russia, would have local and regional consequences, disrupting global energy supplies. This would affect global energy markets causing widespread economic, social and political dislocation. Similarly, if internal tensions caused instability within China the global economy could be disrupted by the simultaneous drop in demand for raw materials and reduced supply.

- **Cure for Ageing.** The development of a treatment that could prevent or cure the effects of ageing would have a significant impact on global society. Initial access to such an advance could be highly unequal and only be available to wealthier members of society, mostly in the developed world. The whole fabric of society would be challenged and new norms and expectations would rapidly develop in response to the change.

- **New Energy Source.** A novel, efficient form of energy generation could be developed that rapidly lowers demand for hydrocarbons. For example, the development of commercially available cold fusion reactors could result in the rapid economic marginalisation of oil-rich states. This loss of status and income in undiversified economies could lead to state-failure and provide opportunities for extremist groups to rise in influence.

- **Collapse of Global Communications.** A failure of the global communications system could occur for a variety of reasons; for example the destruction of satellites following an orbital electromagnetic pulse detonation or solar flare, or the complete overload of the global ICT infrastructure. Such an event is not without precedent. For example, in 1859, solar flare activity was linked to the collapse of the telegraph system when spark discharges shocked telegraph operators and set telegraph paper on fire. A similar collapse in the modern world would cause trade, commerce and the Internet to grind to a halt. Military operations dependent on the availability of communications networks would also be put at risk. Remaining bandwidth would see intense competition for access.

- **External Influences.** A number of strategic shocks could occur that are broadly outside the control of society, but would have considerable impact. These include a highly lethal pandemic, a geological or meteorological event of unprecedented scale, such as the eruption of a super-volcano, or the discovery of non-terrestrial intelligent life. In the military domain, the development of a new, as yet unforeseen capability that allows one state to exercise technological dominance over others would have a significant impact on the strategic context. Potential examples could include; quantum decryption, whole-scale application of nano-technology, biotechnology weapons or advanced robotics. This could ultimately result in the defeat of a Western military force on the battlefield in a 'maxim gun' moment,[139] against an adversary who has the technological advantage over the West.

---

[139] The maxim gun moment refers to the Battle of Omburman when the British defeated the Mahdist forces with losses of only 47 on the British side against around 10 000 on the Mahdist. Elements of the 1991 Gulf War, such as the destruction of Iraqi forces on the Basra Road, provide a similar example of military superiority.

Part 2

Dimensions

The section details the underlying trends and drivers and summarises the evidence upon which they are based. This is intended as a reference section. It will also be of interest to some specialist readers.

Social Dimension

Scope

Developments in the Social Dimension *will* be dominated by 3 processes: rapid demographic change; sustained urbanisation; and the impact of globalisation on culture, identity and belief. This section considers the changing nature of social relationships and the place of the individual within society.

The Hot Topics are **Urbanisation** and **International Organised Crime**.

Trends and Drivers

Changing Demographics. The global population is *likely* to grow from 6.9 billion in 2010 to 8.8 billion by 2040.[140] The developing world *will* account for most of the growth, remaining relatively youthful, in contrast to the developed world and China, which *will* experience little population growth and undergo significant increases in median age (see Figure 3). As well as differences in median age, some regions are *likely* to experience skewed sex ratios. For example, in China, as a consequence of the one-child policy and a cultural preference for boys, many regions have shown greater proportions of male births. The nationwide sex ratio rose from 108 male births to 100 female, to 124 in the 2000-2004 period,[141] and in China's under-20 age group there are almost 33 million more males than females. A similar trend is occurring in India, but is less marked.[142] In the West, ageing is *likely* to lead to policies to employ the 'younger old' who previously enjoyed longer retirement periods. This cultural shift *may* yield a second demographic dividend leading to a lower demand for migrant workers and decreasing the social welfare burden.

Language Development. English is *likely* to consolidate its position as the internationally dominant language for data and global services. Other supplementary transnational languages, such as Mandarin, Spanish and Arabic, *may* also proliferate as engagement in globalised communication increases. Sophisticated translation devices are *likely* to become widely available before 2040.

---

[140] *World Population Prospects* 2008 Revision, medium variant.
[141] *British Medical Journal* 2009, 338, b1211.
[142] India has a male to female ratio of 1.08. *UN World Population Prospects* 2008, medium variant.

Risks and Benefits

Inability to Cope with Population Growth. Population growth *will* exacerbate existing economic, environmental and governance challenges. The most rapid population growth is *likely* to occur in regions that already face the greatest economic, social and political risks. For example, the population of sub-Saharan Africa is *likely* to almost double by 2040.[143] If the proportion suffering malnutrition stays constant, then almost 500 million people are *likely* to require periodic humanitarian assistance.

Demographic Dividend. States, such as Turkey, that experience lower birth rates and increased longevity are *likely* to benefit from a growing workforce and a falling dependency ratio.[144] The result is a 'demographic dividend', which occurs when a generation has fewer dependents than its parents. Such a change is *likely* to increase economic activity providing the initial impetus for greater industrial production; the increased supply of new workers can, if handled properly, enable a country to become more productive. There is evidence that demography accounted for about a third of East Asia's rapid growth over the past 30 years.[145] Nevertheless, as they reach retirement age, these demographic bulges can become economic burdens. Many African states have high birth rates and *may* experience such a dividend should the economic and industrial mechanisms required for its support be in place.

Generational Tension. Youthful, economically-exposed populations in the developing world are *likely* to be highly volatile, resulting in periodic social upheaval, widespread criminality and shifting allegiances. Such groups *will* remain amongst those most vulnerable to job losses during periods of economic downturn and *may* make significant contributions to political and social change during times of insufficiency. Inequality of opportunity *may* result in a resurgence of political engagement by younger generations, leading to an increase in activism and radical protest. However, in developed regions where aged populations hold political power (the so-called 'grey vote'), the younger generation *may* feel disenfranchised and turn away from traditional politics.

Migration. The number of international migrants has increased from a total of 75 million a year in 1965, to 191 million a year in 2005 of whom around 10 million are refugees, and up to 40 million are illegal migrants.[146] That number *may* grow to 230 million by 2050.[147] Populations in many affluent societies are *likely* to decline, encouraging economic migration from less wealthy regions. The net flow to more developed regions already shows significant increases (see Figure 10). For example, in 1960, 57% of migrants lived in less developed regions, but by 2005 just 37% did so. Europe had the largest number of immigrants in 2005, followed by Asia and North America.[148] Environmental pressures, economic incentives and political instability *will* continue to drive population movement from afflicted regions. Conflict and crises *will* also continue to result in the displacement

---

[143] The population of sub-Saharan Africa is likely to increase from around 863 million in 2010 to 1.53 billion in 2040.
[144] The UN definition of dependency ratio is the ratio of the sum of the population aged 0-14 and that aged 65+ to the population aged 15-64.
[145] The Economist. *Africa's Population: The Baby Bonanza*, August 2009.
[146] UN Department of International Migration and Development - International Migration 2006 data.
[147] UN Department of Economic and Social Affairs/Population Division, International Migration Report, 2002.
[148] *Trends in Total Migration Stock: The 2005 Revision*, New York: United Nations, 2006, pages 1-3.

of large numbers of people, mainly into proximate regions, which *may* find themselves at risk of instability or exogenous shock. Such movement is *likely* to occur in regions of sub-Saharan Africa and Asia. This is supported by data on asylum seekers that show almost 45% of asylum applications made to industrialised nations originated from Asia. Africa was the second largest source continent with 30% of applications.[149]
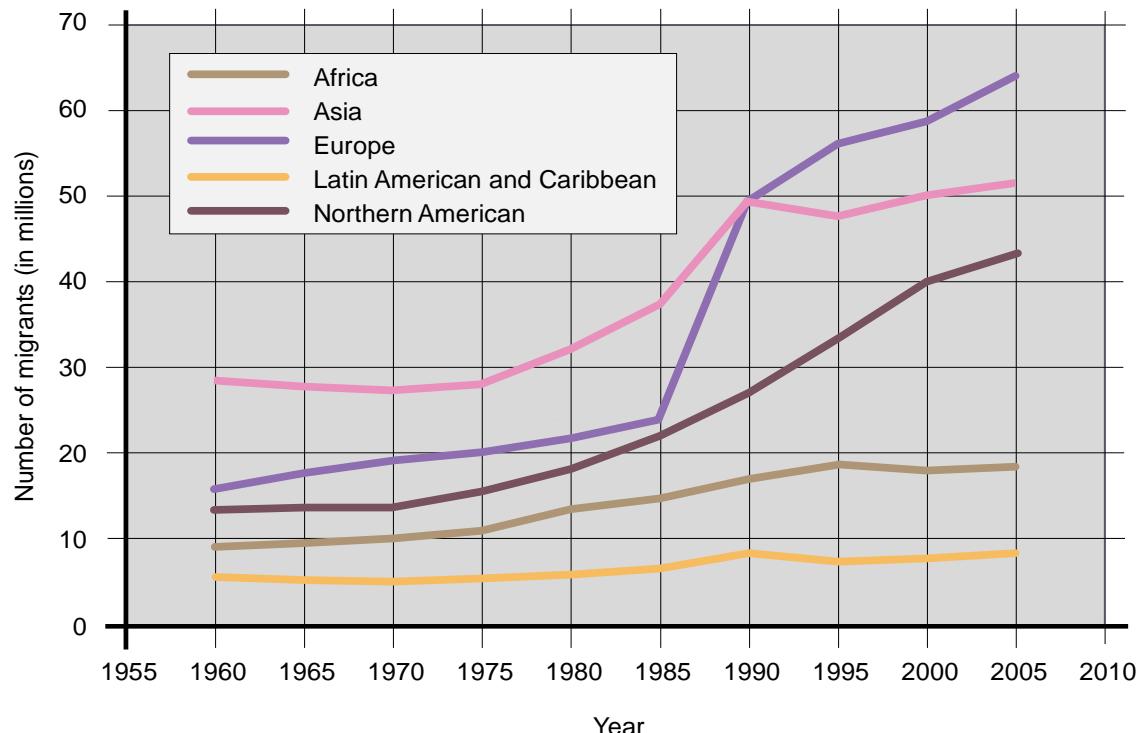

Figure 10 – Estimated Number of International Migrants by Region 1960-2005

---

[149] United Nations' High Commission for Refugees (UNHCR), *Asylum Levels and Trends in Industrialised Countries 2008: Statistical Overview of Asylum Applications Lodged in Europe and Selected Non-European Countries.*

Risks and Benefits

Mass Population Displacement. Conflicts, such as the war in Iraq, have demonstrated the potential for sudden movements of large numbers of people over extensive distances, with the potential for related shocks and second order effects. The United Nations' High Commission for Refugees (UNHCR) has measured a gradual increase in the number of internally displaced persons[150] from 1998 to 2007; this has corresponded with a fall and then rise in the number of refugees over the same period (see Figure 11). This instability is *likely* to fuel radicalisation that *may* result in resurgent nationalism, and act as a catalyst for the spread of instability. For example, in 2005, Kenya produced an official government policy that outlined Somali and Sudanese refugee groups as specific risks to security, accusing them of bringing small arms into Kenya.[151]
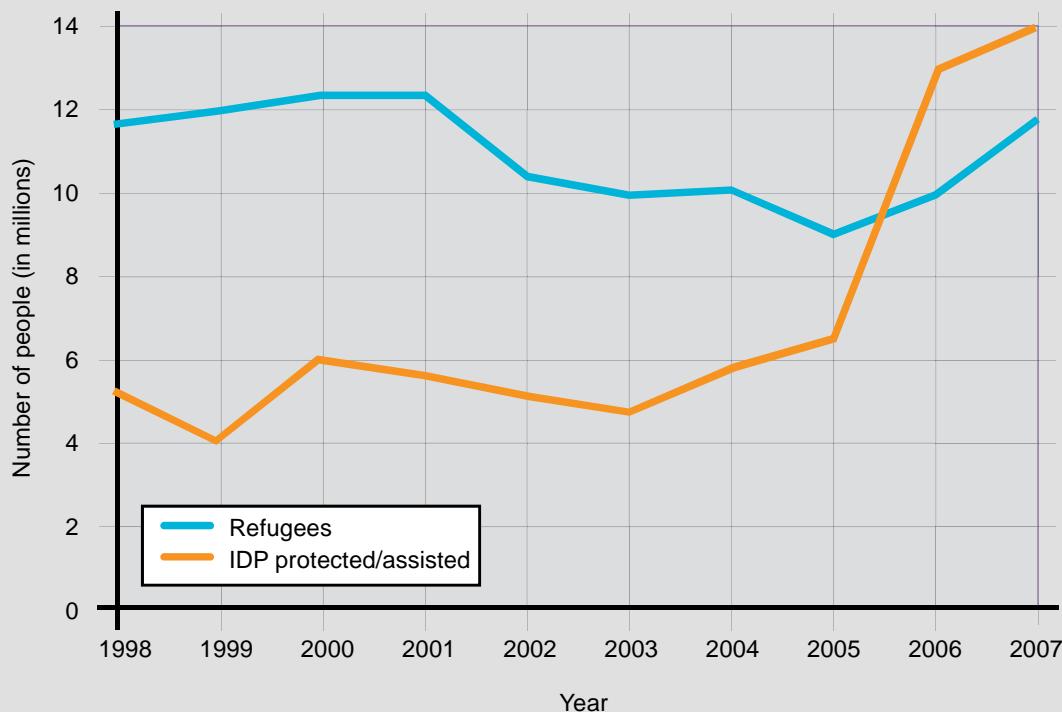
Figure 11 – Mass Population Displacement[152]

Dynamic Diaspora. Societies, including the UK, *will* become increasingly transnational.[153] Growing proportions of their populations are *likely* to consist of ethnic groups that are a mixture of newly arrived immigrants and established second and third diaspora generations. Developed economies are *likely* to sustain an economic gradient for immigration which *may* have a transformational effect on their society and culture. Information and Communications Technology (ICT) developments and advanced mass-transit systems *will* facilitate and increase connectivity between ethnic and national diaspora and their communities of origin. These advances *may* reduce incentives for

---

[150] Internally displaced persons (IDP) are those who are forced to flee their homes but who, unlike refugees, remain within the border of their home country. UNHCR – The UN Refugee Agency: www.unhcr.org

integration and assimilation and allow self-contained 'virtual' communities to exist across continents. Less benignly, diaspora *will* remain a medium for the international transmission of social risk, including: inter-communal violence, extremism and transnational organised crime, especially trafficking, smuggling and illicit trade. Such communities are *likely* to show local responses to transnational issues.

Risks and Benefits

Super-Diversity. Countries which encourage immigration as a means to address labour and skill shortages, involving a mixture of temporary workers and long-term settlers, *will* increasingly experience 'super-diversity',[154] which *may* present challenges to social cohesion and economic stability in host countries. Competition for talented individuals is *likely* to occur as countries begin to offer incentives for diaspora to return to their countries of origin. The risk of a continuing 'brain drain' is *likely* to remain a challenge for some developing countries, although evidence suggests that talented individuals are *likely* to return to politically stable and economically successful countries of origin. Failure to manage migration is *likely* to impose significant resource constraints in destination and transit countries and also contribute to societal tensions.

The Role of the Family. The movement of people in pursuit of economic opportunity and a secure environment *will* create more cosmopolitan population centres and change the character and utility of the family. In conjunction with increased cultural awareness and sustained global migration, societal barriers *may* decline as their significance is increasingly understood, encouraging cross-cultural partnerships. However, certain groups *may* seek to retain their traditional identities and heritage by the establishment of rules and practices that prevent such cultural transformation. Decreasing fertility, informal partnerships and increasing numbers of urban dwellers are *likely* to result in smaller families; however, pressure on housing *may* lead to more extended family arrangements within one household, *possibly* with inter-generational dependencies. Societies with deeply established cultural structures and norms are likely to experience the greatest tension in the face of competing cultural transformation as certain sectors and generations seek to retain their traditions, whilst others wish to adopt newer conventions and practices that they have been exposed to through increased access to communications. For example, the exposure of societies in the developing world to forms of entertainment popular in the developed world such as television soap operas *may* have contributed to changes in family structures as groups become increasingly exposed to the concept of the nuclear family and have increasingly aspirational lifestyles.

---

[151] UNHCR, *Analysis of Refugee Protection Capacity: Kenya*, 2005.
[152] This graph illustrates that by 2007 the total number of IDP and refugees grew to 26 million, equivalent to the population of Romania.
[153] For example, in 2007 the biggest ethnic groups in England were Indian (2.6%), Pakistani (1.8%), Black African (1.42%), Black Caribbean (1.2%), Chinese (0.8%) and Bangladeshi (0.69%).
[154] Vertovec, S, Professor, University of Oxford, *Researching New Intersections of Diversity*, 2007.

Hot Topic – Urbanisation

The global urban population began to exceed the rural population in 2006. By 2040, 65% of people are *likely* to live in urban areas, with the majority of growth in the developing world, especially in Africa and Asia.[155] A considerable proportion of urban growth is *likely* to occur in shanty towns, with the number of slum dwellers doubling to around 2 billion by 2040. Rapid urbanisation is *likely* to lead to urban rather than rural insurgency.[156] Mega-cities[157] are *likely* to remain significant, containing around 10% of the global urban population. However, approximately 50% of urban dwellers are *likely* to live within urban areas of less than 500,000 people. These regions are *likely* to absorb nearly half the projected increase of the urban population and face the greatest shortfalls in infrastructure and service provision increasing the risk of environmental disasters.[158]

Africa's rate of urbanisation *may* be the fastest the world has ever seen. In 1950, only Alexandria and Cairo exceeded 1 million people, but this *may* grow to 80 cities by 2040, plus a cluster of mega-cities headed by Kinshasa, Lagos and Cairo. Such growth *will* increase the resource burden and environmental impact of urban areas, especially as their growth is likely to remain unplanned, and is *possibly* unsustainable. However, although rapid urbanisation *may* result in a spate of failed cities requiring humanitarian assistance, it is also an expected part of the economic development cycle, and has numerous positive effects. These include, for example, better access to healthcare and improved educational and employment prospects.

Urbanisation *will* be driven by a combination of forced migration and instability, the pursuit of economic opportunity, and by the environmental consequences of climate change. However, the most significant growth in urban populations is *likely* to occur due to natural population growth, rather than from rural-urban migration. However, some states, such as India and China, are *likely* to continue to experience significant levels of rural-urban migration. Such movement is *likely* to produce tension in the recipient urban areas. This tension is *likely* to be exacerbated by competition for land, accommodation, access to resources and for employment opportunities. Cities are also *likely* to grow as the regions that surround them increasingly taking on peri-urban characteristics.[159] Regions undergoing transformation through peri-urbanisation are *likely* to experience rapid societal change and mass adjustment to new employment and lifestyles.

Rapid and uncontrolled urbanisation without the required industrialisation to develop an effective infrastructure and associated support structures, *will* challenge urban governance and generate regions of instability, poverty and inequality. Most of the urban poor *will* be employed in the informal sector and *will* be highly vulnerable to externally-derived economic shocks and illicit exploitation.

---

[155] United Nations (UN) World Urbanisation Prospects Database, 2007 Revision.
[156] Evans M, *War and the City in the New Urban Century*, 2009.
[157] A mega-city has in excess of 10 million people.
[158] UN World Urbanisation Prospects Database, 2007 Revision.
[159] Peri-urban regions lie in-between consolidated urban regions and rural ones. Typically they have lower population density, limited infrastructure and mixed land use.

As urbanisation continues, the growth of interdependencies and complex connections between cities *will* increase. This has been exhibited in Asia, where a common economic strategy has been the development of a heavy concentration of investment and urban development in and around coastal regions.[160] The result of this growth is a mega-urban corridor stretching from Tokyo to Sydney through Seoul, Taipei, Shanghai, Hong Kong, Kuala Lumpur, Singapore and Jakarta. As systems become intertwined with other urban regions the increased complexity of networks are *likely* to increase the risk, and the impact of catastrophic systems failure. Due to greater reliance on the Internet and complex logistical supply and travel chains, coupled with global energy requirements and the movement of power through global grids, it is *likely* that such complex, interlinked networks could become increasingly fragile and susceptible to disruption.

Increased urbanisation and continued globalisation *may*, conversely, lead to a resurgence of interest in local issues. Higher population densities *will* foster the requirement to manage shared issues such as pollution, traffic access and neighbourhood crime.[161] An increasingly connected global community *may*, conversely, lead to the local environment becoming increasingly significant both socially and politically as individual cities and regions become their own distinct nodes on the global network, *possibly* reducing the overall importance and relevance of the state.

Access to Information. The pervasiveness of ICT *will* enable more people to access and exploit sophisticated networks of information systems. For example, in 2007 there were 280 million mobile phone subscribers in Africa, a penetration rate of 30.4%. This number is expected to rise to 50% by 2012 and *may* result in total coverage in as little as 10 years.[162] The Internet and associated technologies, together with digitised portable communications, *will* increasingly become the means by which a rapidly expanding array of audio, visual and written information products are distributed. For many people, group membership *will* extend beyond physically proximate communities, reflecting the ability to sustain relationships and identities over distance through globalised communications and travel. The increasing size of available networks *will* also increase economic and finance opportunities for individuals and smaller communities through initiatives, such as micro-finance. This *may* transform how business is conducted with a shift away from traditional hierarchical structures to smaller, networked structures that favour more even distribution of profit. Pervasive ICT *will* also provide diverse opportunities for organised criminal and terrorist groups, such as the Russian Mafia, the Asian Triads and al-Qaeda. Such groups, often based within ungoverned spaces, *will* exploit adaptable and flexible networks that challenge conventional law-enforcement approaches. The ubiquity of communications devices is *likely* to create internal tensions in authoritarian states, such as North Korea and Myanmar, as censorship is increasingly difficult to achieve and access to the 'democratised' Internet very difficult to prevent.

---

[160] In Japan, infrastructure investment was concentrated in the Tokyo-Nagoya-Osaka Corridor, with more than 60 per cent of its urban population being concentrated in this region by 1970. In South Korea, similar concentrations of urban infrastructure and transportation investment has occurred in the Seoul/Pusan regions, containing 70 per cent of the South Korean urban population by the mid 1970's. A similar strategy has been adopted in the development of Taipei/Kaohsing, in the formation of Singapore and Hong Kong as city states, in Jabotabek (the Jakarta region) in Indonesia, Bangkok in Thailand, Kuala Lumpur and environs in Malaysia, and in the coastal regions in China.

[161] Webber M, *The Urban Place and the Non-Place Urban Realm: Explorations into the Urban Structure,* 1964.

[162] *A Mobile Vision for Africa,* African Telecoms News, 2008.

Increasing Media Impact. The media *will* retain an overarching influence shaping an individual's values and beliefs both consciously and unconsciously. However, this impact is *likely* to vary across states, dependent on the censorship and control systems they have in place. The 'democratised' Internet makes it *likely* that almost every member of global society is able to access free information from a variety of sources. Even those without direct access are *likely* to have social contact with someone that can. The growth of a global communications system and the ubiquity and sophistication of mobile communication devices *will* mean that patterns of receiving and accessing information will change. Traditional media sources such as newspapers and scheduled broadcasts *will* remain, but are *likely* to be increasingly reliant on opinion pieces and gossip, focusing on specific scoops in order to sell hard copies. The traditional media *will* continue to attempt to shape the opinion of the general populace and *will* sell themselves on their trust, integrity and reliability. The trend for traditional media to focus on opinion pieces and campaigns is *likely* to be fuelled by the growth of new media forms that include the Internet and entertainment on demand. This *will* affect the profile of people who access media changing them from passive consumers to more cynical multiple source users who will take their opinion from many areas and form an opinion based on those they trust, and their own experience. The rise of Internet-enabled, citizen-journalists and formal, real-time and informal news distribution through the Internet *will* weaken the immediacy and influence of mainstream news providers. Breaking events *will* increasingly be transmitted to individuals directly, often without filters, legal sanctions or safeguards. Consequently, competition in a real-time news environment is *likely* to reduce the integrity of the editorial function, with pressure to release stories, narratives and opinions at the expense of facts.

Breaking events *will* increasingly be transmitted to individuals directly

Altered Identities. Identity is an umbrella term used to describe how people perceive themselves and others. An individual belongs to multiple identity groups, through birth, assimilation, or achievement and each particular group influences their values and beliefs. Historically key influences for identity have been often along ethnic, racial, national and religious lines, however out to 2040 new influences are *likely* to emerge. For example, online social interaction is *likely* to increase in sophistication and scale. Social networking sites fused with 'virtual reality' networking sites, such as Second Life, *may* lead to new ways of interacting, new variations of language and the formation of complex relationships between individuals on a global scale. Similarly, the importance of nationality as an influence on identity *may* decline as individuals become more globally aware. Internet-based working *will* continue to have an increasing importance increasing the extent of home based employment options. The virtual environment *may* also lead to individuals having increased difficulty interacting with the values and laws of the real world, having been able to permanently live out their fantasies and fictional lifestyles.

Declining Civic Values. The spread of transnational networks are *likely* to impact on an individual's identity. Many people in affluent societies are increasingly *likely* to regard their relationship with the state in consumerist rather than civic terms, while governance standards in many developing societies are *unlikely* to keep pace with economic and social change. Civic support systems *may* decline producing an increased reliance on local communities, extended family networks and personal patronage.

Gender Equality. The significance of the divide between societies that are progressing towards gender equality and those that are not, *will* continue to grow. Progress towards equality *will* be uneven and conditioned by cultural assumptions, demographic trends and economic circumstances. This issue is *likely* to remain a defining theme during the 21st century, influencing international political, economic and cultural relationships. In the developed world, increased demand for labour mobility is *likely* to be paralleled by trends towards an expansion in the number of women in the workplace, where they are increasingly *likely* to occupy leadership positions in business and politics. In the developing world, urbanisation is *likely* to provide increased opportunities for women in both employment and education, and challenge some cultural norms.

Hot Topic – International Organised Crime

Although measurement is difficult, international illicit trade is estimated to account for around $1 trillion of global Gross Domestic Product (GDP) per annum. In addition, it is estimated that a further $1 trillion is extorted by organised crime and that between $0.6-2.8 trillion is laundered annually. This can be compared to a global GDP of around $61 trillion and could make the value of global illicit trade around twice that of global military budgets.[163,164] These large financial movements, which have been funded by illegal trading, fraud, arms trafficking, people smuggling, extortion, smuggling and the drugs trade *will* continue to distort the normal political and economic process. The reach of international criminal gangs stretches from the ungoverned spaces in the developing world through to the highly regulated and policed developed world. Corruption is endemic in many parts of the world, including developing and emerging economies and deters inward investment, business confidence and international trust.[165]

Globalisation *will* provide diverse opportunities for organised criminal groups, which are *likely* to increasingly exploit adaptable and flexible networks that allow them to be based in ungoverned spaces. These 'black holes' are *likely* to challenge conventional law-enforcement approaches. Organised criminals and illicit groups are *likely* to increasingly take advantage of legitimate company structures to conduct or hide their criminal activity, leading to higher levels of global corruption and illicit trade, often involving the use of cyberspace. They are also *likely* to collaborate with, and *may* be indistinguishable from, paramilitary, terrorist and insurgent groups as well as weak and corrupt governments. They are *likely* to exploit growing consumer markets in rapidly growing economies. Organised criminals are *likely* to be more aggressive in defence of their assets and markets and in promoting their interests.

International organised crime *will* grow in volume, reach and profitability, and present a major challenge to governance, legal arrangements and international financial regulation. It is *likely* to exploit new ventures and markets in areas of accelerating economic growth and opportunity. Many states and other actors *will* continue to rely on narcotics and other forms of illicit trading to maintain liquidity in their economies. However, the illicit trade in narcotics *may* decline in response to a combination of legalisation and increasing intolerance of the social impact and cost in the developed world. Criminal networks *will* exploit new technologies to circumvent law enforcement activities and to gain further financial advantage. The lines between crime and political ideology *will* continue to be blurred with extremist groups utilising criminal networks, and vice versa, to further their aims. Some states are *likely* to use criminal transnational networks as proxies for their activities giving the states a deniable and asymmetric capability against other powers. In regions with little or no governance, or poorly developed market economies, international criminal groups *may* provide the only avenue of trade and economic growth in the absence of other, legal, activity.[166] A more nuanced approach by the major powers to international crime originating in the developing world, especially in failed or failing states *may* have to be undertaken if the conditions of failure are not to be further exacerbated.

---

[163] World Bank, Kaufmann D, *Myths and Realities of Governance and Corruption* and IMF, 2008.
[164] Global Spending on Defence is around $1.46 trillion, SIPRI, 2008.
[165] *International Global Corruption Barometer 2007,* Transparency International.
[166] For example, the development of industries that manufacture counterfeit drugs is welcomed in some parts of Africa.

Resource and Environment Dimension

Scope

For most of its history, humankind has striven to secure resources in order to improve living standards and prosperity. During the last century, unprecedented numbers of people lived in conditions of increasing affluence and most of those who did not, aspired to do so. However, the trend in resource consumption is unsustainable; socially, environmentally and economically. The Resource and Environment Dimension considers how the aspiration to achieve ever higher standards of living, or to sustain existing levels, *will* be constrained by the nexus between resource availability and environmental limitations. In doing so, it considers the physical and environmental challenges that *will* condition political and social choices, the interplay of demand with supply, the environmental effects, and the consequences that may arise. These challenges include climate change and the production, distribution and consumption of resources including energy, food, water, strategic minerals and information.

The Hot Topics are **Climate Change and Weak States**, **Food and Water** and **Minerals**.

Trends and Drivers

Climate Change. Climate change is a Ring Road Issue. Overwhelming evidence indicates that the atmosphere *will* continue to warm at an unprecedented rate throughout the 21st century. This warming *will* affect production, availability, storage and use of energy, food and freshwater. Concerted attempts to reduce emissions of greenhouse gases, including carbon dioxide, methane, nitrous oxide and others, in addition to potential limits on availability of readily accessible hydrocarbon resources, *will* stimulate intensive investment in research to develop low-carbon energy production, as well as a focus on conservation.

Risks and Benefits

Extreme Weather Events. It is *possible* that the effects of climate change will be felt more rapidly and widely than anticipated leading, for example, to an unexpectedly large increase in the frequency and intensity of some extreme weather events, such as storm surges, challenging the collective and individual capacity to respond. Europe *may* experience extreme high summer temperatures and sustained heat waves with a frequency not seen in modern times. While northern Europe *may* experience a small increase in annual mean precipitation, mainly in the winter, the Mediterranean *may* become more arid.

Solar Output Variation. The sun is the earth's primary energy source and short-term fluctuations in solar activity *may* confuse, mask or amplify the long-term effects of greenhouse gas accumulation in the atmosphere, resulting in inappropriate rates of mitigation and adaptation. The subsequent severe climatic or economic consequences *may* serve to amplify the degree of cooperation between states as they struggle to overcome the economic, humanitarian and societal difficulties generated.
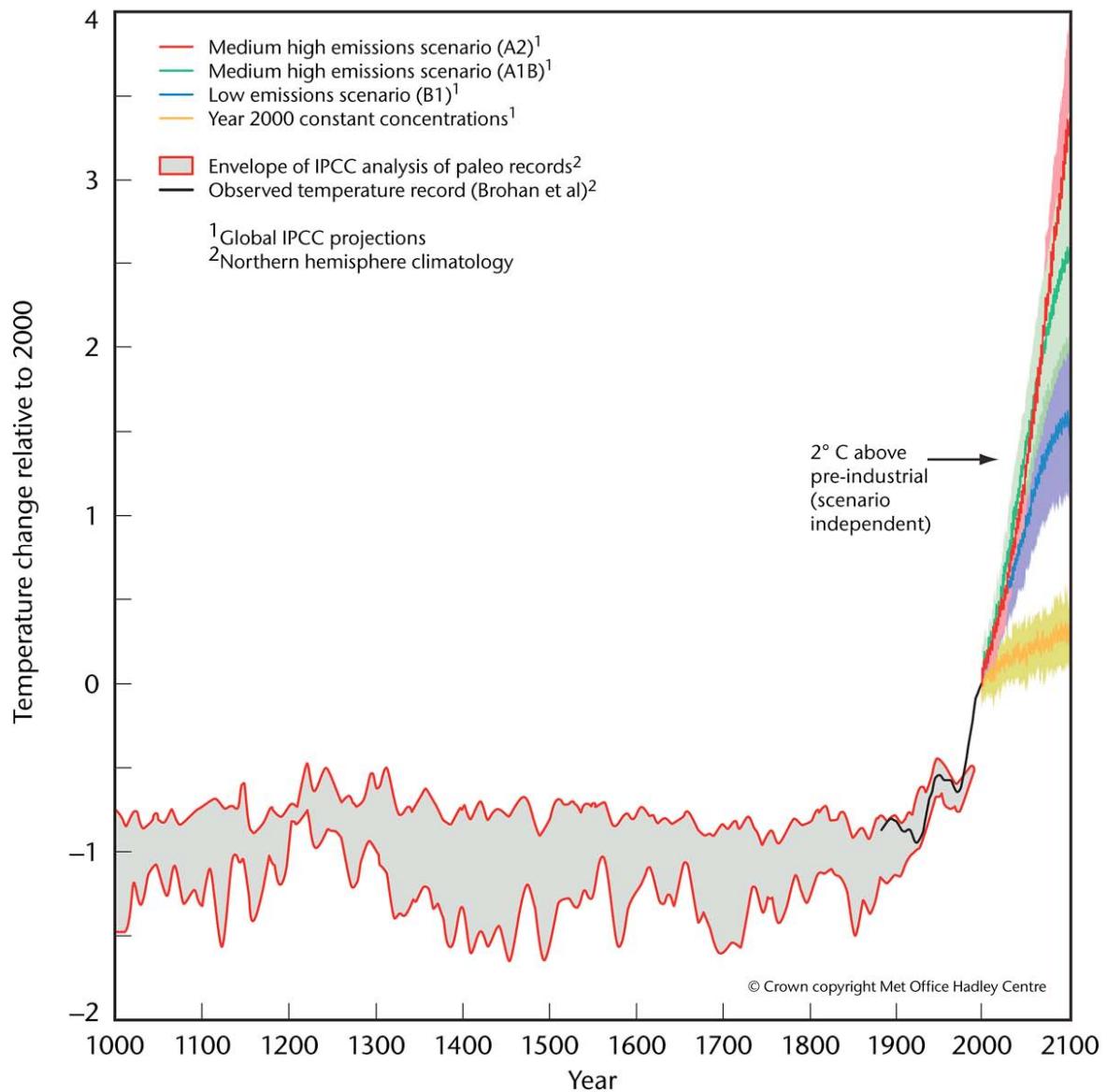
Figure 12 – Predicted Temperature Increase 1960-2100[167]

---

[167] UK Met Office, Hadley Centre.

Hot Topic – Climate Change and Weak States

Weak states have limited capacity for governance, and many are *unlikely* to adapt to the environmental challenges of climate change.[168] Weak states are *likely* to have youthful populations, large families and be dependant on rural production for their income. Extreme weather events and increasing temperature *will* exacerbate instability due to immediate shortages of food and water. Longer-term effects *may* include a degradation of agricultural land that increases internal and regional migration. Weak states *will* be insufficiently prosperous to procure alternative supplies through external markets. In addition, they often have poor human rights records and suffer endemic corruption which weakens governance and service provision, increasing the likelihood of recurring instability. As the severity and incidence of internal instability increases, exacerbated by climate change, long-term societal changes can occur, such as the creation of large numbers of orphaned children or the displacement of large ethnic or tribal groups.

Conflict in Darfur provides an example of how climate change *may* affect weak states. Prior to conflict, tensions were driven by drought. Although conflict began as a regional rebellion, the underlying cause was *probably* desertification, with a drop in rainfall of between 16% and 30% shifting the desert boundary 60 miles over 40 years.[169] This desertification *probably* limited the ability of local eco-systems to support agriculture, resulting in tension and ultimately conflict between rival groups. The Sudanese government lacked the necessary infrastructure and resources to respond to the crisis. The initial regional uprising was suppressed through the recruitment of Arab militias, the Janjaweed, which waged a campaign of ethnic cleansing against Africans, resulting in around 500,000 deaths and 2 million environmental refugees.

By 2040, global temperature rises are *likely* to increase desertification in regions bordering the Sahara, *possibly* leading to similar examples of climate-induced instability and conflict. Countries such as Chad, Niger, Mali and Eritrea are susceptible to the same impacts that *may* result in conflict between tribal or ethnic groups. Elsewhere, changing patterns of rainfall distribution within the Monsoon belt in the Arabian Sea and South Asia *may* result in similar instability. Even stable governments *will* face increasing challenges as demonstrated by the flooding of New Orleans and the Mississippi Delta in 2005.

Energy Demand. Global Energy use has approximately doubled over the last 30 years[170] and, by 2040, demand is *likely* to grow by more than half again. Despite concerns over climate change, demand is *likely* to remain positively correlated to economic growth[171] with fossil fuels, meeting more than 80% of this increase.[172] Urban areas *will* be responsible for over 75% of total demand. Industrialising states are *likely* to continue their energy-intensive economic growth: infrastructure and increasing transportation are *likely*

---

[168] A weak state lacks the will and capacity to use its domestic and international resources to deliver security, social welfare, economic growth and legitimate political institutions.

[169] United Nations Environment Programme (UNEP). *Environmental Degradation Triggering Tensions and Conflict in Sudan,* 2007.

[170] International Energy Agency, *World Economic Outlook,* 2008. Usage in 1980 was approximately 7 million tonnes or equivalent (MToe), rising to 11.7 MToe in 2007.

[171] International Energy Agency, *Energy Statistics of Organisation for Economic Cooperation and Development (OECD) Countries*, 2007.

[172] International Energy Agency, *World Economic Outlook, 2008*, page 4.

to account for over 85% of increases in global demand, with China and India accounting for 45% of this increase.[173] Most states *will* have to import energy, raising fears of dependence on unstable producer states, and stimulating conservation measures, diversification and the development of alternative supplies. A switch away from fossil fuels to using electricity as the predominant transmission medium is *possible.* However, the infrastructure costs and technological challenges, especially in aviation, would limit any transition to wealthier regions of the world and certain sectors, such as domestic usage and some forms of transportation. Fossil fuels *will* continue to be used in developing regions that cannot afford to change.

Risks and Benefits

Disruption of Supplies. The periodic disruption of energy supplies from major exporting states *will* cause global price spikes, which, in the most severe cases, *may* trigger wider political instability, especially in economically vulnerable regions. Such disruption, *possibly* caused by instability within producer states, resource nationalism, organised crime, terrorist attack, disruption of transportation, or infrastructure bottlenecks is *likely* to result in multilateral action to restore supply chains. Prolonged constraints on the free market in energy *may* arrest or limit the globalisation process. Similarly, rapid fluctuations in the supply of strategic resources, such as food or minerals, are *likely* to cause significant and unpredictable economic, social and political dislocations, *possibly* on a global scale.

Energy Security. The issue of energy security is one in which governments, and defence organisations, *will* increasingly have to be engaged if states are to maintain their standards of living, and to ensure adequate supplies of natural resources, at reasonable prices. States who perceive that energy security is impacting on national survival are *likely* to challenge conventional interpretations on the legality of the use of force. However, the cornerstone of the UN Charter, which prohibits the threat, or use, of force in international relations, *will* remain firmly in place.

Changing Energy Mix. The energy mix *will* evolve responding to cost, availability and technological developments. There *will* be continued utilisation of all current energy sources, and fossil fuels are *likely* to continue to account for over 75% of total energy usage.[174] Oil *will* remain the dominant fuel, given its importance in the transportation sector and the availability of infrastructure that supports its distribution. However, by 2020, production growth of easily accessible oil and gas is *unlikely* to match demand growth and therefore coal usage is *likely* to show the greatest proportional increase, by over a third in absolute terms.[175] Use of other liquid fuels, principally first generation biofuels derived from foodstuffs such as maize, is *unlikely* to increase in significance due to their adverse impact on food production. However, new generations of biofuels, such as those derived from waste biomass using cellulosic processes, are *likely* to become a viable alternative. Nuclear power provides only around 5% of global energy production.

---

[173] Shell, *Shell Energy Scenarios to 2050,* 2008.
[174] Fossil fuel usage drops from just over 80% to just below 80%. Continuing this trend out to 2040 suggests they will account for around 75%. International Energy Agency, *World Economic Outlook*, 2008, page 4.
[175] International Energy Agency, *World Economic Outlook*, 2008, page 5.

This is *unlikely* to increase in the short term because nuclear reactors take several years to design and build. However, the desire to minimise carbon emissions is *likely* to lead to increased investment in nuclear energy and a rapid rise in nuclear fission production by 2040. Modern renewable technologies, including wind, geothermal, tidal, wave and solar energies, *will* grow rapidly from a low base. Along with hydro, they *will* take on an increasing share of the electricity generating capability.

Risks and Benefits

Proliferation of Civil Nuclear Power. There are over 430 nuclear fission reactors operating around the world in 31 countries, with some 30 under construction, and a further 200 or more planned.[176] Much of this expansion *will* be in the developing world.[177] Accidents, such as at Chernobyl, and attacks on nuclear facilities have been rare, but the trend towards mass casualty and economic targeting by terrorists and irregular groups makes attacks on these institutions more *likely* in future. Moreover, the spread of nuclear materials and know-how *will* require an intrusive set of safeguards to prevent their use in weapons' programmes. Finite uranium reserves are *likely* to require the development of breeder reactors and reprocessing facilities, further complicating control of nuclear materials.[178]

Volatile Energy Markets. Energy supply *will* struggle to meet growing demand leading to upward pressure on prices. When supply and demand for energy are closely matched, rapid increases in demand to which supply can not react quickly can lead to large variations in price; therefore markets are *likely* to be volatile. For example, from 2007 to 2008 the price of oil spiked from below $60 per barrel to almost $150 before falling back to $40,[179] affecting economic performance and investment decisions. Such destabilising movements of energy markets are *likely* to be detrimental to those countries unable to compete on price, resulting in more states following the example of China in establishing bilateral arrangements that seek to circumvent global markets. This bilateralism, fuelling tension amongst those who are excluded, *may* lead to political and even military interventions in order to protect access and safeguard supply.

---

[176] Centre for Security Studies, *The New Appeal of Nuclear Energy and the Dangers of Proliferation*, 2009.
[177] US Department of State, 2008, *Report on Proliferation Implications of the Global Expansion of Civil Nuclear Power*. To that end, 10 developing states are already assessed to be giving serious consideration to developing civil nuclear power and a further 20 have long-term plans underway.
[178] Oxford Research Group, *Secure Energy? Civil Nuclear Power, Security and Global Warming*, March 2007.
[179] The Economist. *NYMEX Light Sweet Crude Oil Futures.* Accessed 27 January 2009.

Changing Patterns of Behaviour. Growing material prosperity is *likely* to result in behavioural changes with associated effects, such as changes in consumption, diet and health. The proportion of the world population considered to be middle-income has increased rapidly over the last 30 years and, out to 2040, *may* increase by a further 80 million per annum if rapid economic development continues in countries such as India, China and Brazil.[180] Consumption of food, water, energy and minerals *will* remain positively correlated with increasing prosperity despite efforts towards conservation, recycling and environmentalism.

Growing material prosperity is *likely* to result in changes in consumption

---

[180] Goldmann Sachs, *The Expanding Middle: The Exploding World Middle Class and Falling Global Inequality*, July 2008.

Hot Topic – Food and Water

By 2040, the global population is *likely* to increase to 8.8 billion requiring concomitant increases in the supply of food and water. Given that agriculture accounts for over 70% of global freshwater usage, the availability of food and water *will* be intimately related.[181] Over 900 million people were undernourished in 2007. This represents a declining proportion of the global population, but in absolute terms is 80 million more than in 1990–92, with the largest increases in Asia and in sub-Saharan Africa.[182] Similarly, it is estimated that around 2.5 billion people live in regions suffering from water scarcity, predominantly in Africa, the Middle East, as well as Central and East Asia. Of these almost 900 million lack access to safe drinking water causing more than 5 million deaths per year. Fertiliser production is an energy intensive process, and the challenge, with a heavy reliance on science and technology, *will* be to produce more food on less land with less water, fertiliser and pesticides, while using less energy.

	Arable Land (as a % of global total)	% of Global Population
SE Asia & Pacific	29	53
OECD, Europe, Central Asia	46	22
Africa	11	11
Middle East, North Africa	4	5
Latin America, Caribbean	10	9

Table 1 – Regional Distribution of Available Arable Land

A disparity already exists between population size and availability of land for food production in different regions. Global population growth *will* be unevenly distributed with much of the growth *likely* to occur in regions, such as sub-Saharan Africa and the Middle East, that already suffer from stresses to food and water supplies. Much of the growth *will* be highly concentrated in sprawling urban centres that are *likely* to outgrow the ability of their hinterland to provide for them. Asian countries with large populations and limited agricultural land are *likely* to continue to invest in agricultural production abroad. Moreover, climate change *will* affect food production, cultivation and animal husbandry patterns, with some regions unable to grow current food staples, such as rice and vegetables. Some previously fertile, densely populated regions *will* suffer declines in agricultural production. Similarly, changing precipitation patterns *will* increase pressure on water supplies and their associated industries and are *likely* to cause the number of water

---

[181] UN Food and Agriculture Agency, *Aqua Stat*.
[182] UN Food and Agriculture Organisation, *The State of Food Insecurity in the World*, 2008.

stressed regions to rise. When shortages are threatened, the adoption of export restrictions for food, and disputes over water flows, are *likely* to increase, affecting global supply, aggravating shortages and eroding trust. For example, extreme weather events in 2005–07, including drought and floods, affected major cereal-producing countries, and world cereal production fell by 3.6% in 2005 and 6.9% in 2006 before recovering. In 2008, the ratio of world cereal stocks to utilisation was under 20%, the lowest in 3 decades, with major cereal producers including China, the European Union, India and the US holding significantly low levels of cereal stocks compared with earlier years.[183] Two successive years of lower crop yields in a context of already low stock levels resulted in high global food prices, export restrictions and subsequent political, economic and social difficulties, such as food riots in West Africa, Haiti and Egypt.[184]

Competition for land usage *will* increase. For example, bio-fuel production utilised around 100 million tonnes of cereals (4.7% of global cereal production) in 2008. Concerns over energy security are *likely* to lead to continued production of subsidised maize-based bio-fuels out to 2020. This is *likely* to place stress on food production and to be a significant source of demand for some agricultural commodities, such as sugar, maize, cassava, oilseeds and palm oil. Food prices *will* remain highly correlated with volatile petroleum prices which impact on fertiliser and transport costs. Sustained economic growth in developing countries, especially China and India, has already increased their purchasing power and the overall demand for food. This *will* continue with shifts in diet associated with increasing prosperity, such as increased meat consumption, having knock-on effects to the production of other food-stuffs and to associated demand for water. For example, it is estimated to take 10kg of grain to produce 1kg of beef.[185] Genetic and scientific modification of crops to improve yields is *likely* to be necessary, to provide both for human and animal consumption, especially the introduction of pest-resistant, drought resistant and saline-tolerant crops capable of producing high-yields in challenging conditions. However, biotechnology research is *likely* to remain dogged by commercial, political and ethical issues that *may* slow the introduction of such crops, particularly in Europe.

World marine fishery resources have remained relatively stable since 1990, despite the deterioration of some fish stocks in specific regions. However, the contribution of aquaculture to global supplies of fish, crustaceans, molluscs and other aquatic animals increased from around 4% of total production in 1970 to over 32% in 2004, growing more rapidly (8.8 percent per year since 1970) than all other animal food-producing sectors.[186,187] Production from aquaculture has outpaced population growth, with per

---

[183] Lower stock levels contribute to higher price volatility in world markets because of uncertainties about the adequacy of supplies in times of production shortfalls. UN Food and Agriculture Organisation, *The State of Food Insecurity in the World*, 2008.

[184] Guardian, *Who is Fighting Over Food?* April 2008. Available online at http://www.guardian.co.uk/news/blog/2008/apr/09/foodriots (accessed 23 February 2009).

[185] The US government provides $7 billion a year (2007) in federal subsidies to its own farmers to cultivate bio-fuels. It is estimated that 8-12 kilograms of plant protein are required to produce one kilogram of meat, hence the price of feed grains rises and farmers plant such varieties in preference to food grains. Oxford Research Group, *Food, Poverty and Security*, May 2008.

[186] Aquaculture refers to the farming of fresh and saltwater organisms including molluscs, crustaceans and aquatic plants. Unlike fishing, aquaculture, also known as aqua-farming, implies the cultivation of aquatic populations under controlled conditions.

[187] Food and Agriculture Organisation (FAO), *The State of World Fisheries International Aquaculture 2006*, page 16. Compared with 1.2% for capture fisheries and 2.8% for terrestrial farmed meat production systems over the same period.

capita supply increasing from 0.7 kg in 1970 to 7.1 kg in 2004, representing an average annual growth rate of 7.1%. East and south eastern Asia are *likely* to remain the regions most dependent on marine produce in diets. Out to 2040, the marine environment *will* continue to see significant increase in demand. Fishery resources are *likely* to stagnate,[188] with stocks remaining under constant heavy pressure and requiring careful husbanding to prevent major species becoming further depleted or extinct. Technological advances in aquaculture, combined with sheer necessity, *will* lead to further increases in farming activities, especially in the littoral regions, but *possibly* in oceanic regions. Aquaculture output is *likely* to increase by more than 50% placing stress on fragile ecosystems and adversely affecting biodiversity.
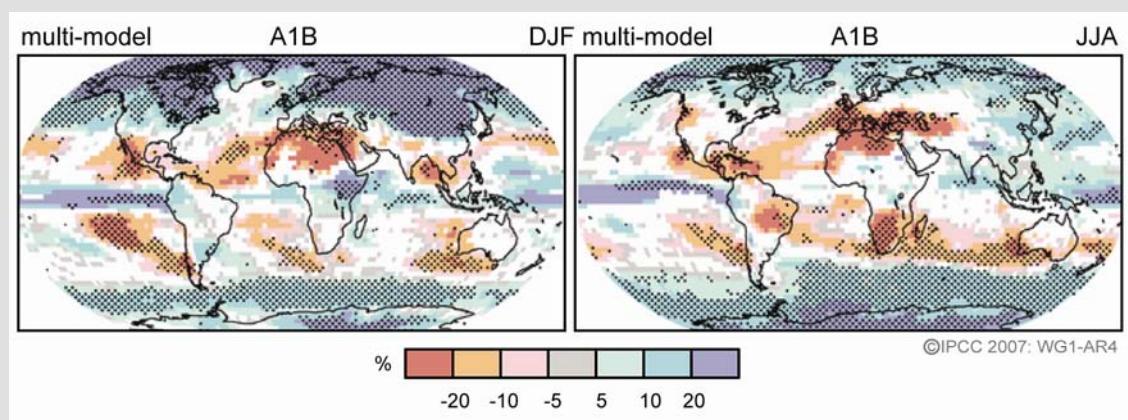
Figure 13 – Projected precipitation changes 2090s (% relative to 1980-99)[189]

By 2040, one-third of the world's population *will* live in areas of water stress. Any increase in global temperatures *will* raise the moisture carrying capacity of the atmosphere and *may* lead to an overall increase in precipitation, especially in the Tropics and at high latitudes. However, mid-latitudes and semi-arid low latitudes *may* see less precipitation and increasing evaporation leading to decreased water availability. Asia, especially India, is particularly dependent on meltwater from Himalayan glaciers and *may* see an initial surge followed by a long-term decline as glaciers retreat. *Per capita* water consumption *will* continue to rise depleting existing water supplies, especially aquifer-borne fossilised water that is extensively exploited in desert and urban areas.

Access to freshwater is an essential component of economic development, stability and health. Over 260 river basins are shared by 2 or more countries and 13 are shared by 5 or more countries. Many of those shared water resources are situated in regions, namely the Middle East and Africa, also facing the challenges of high population growth, stagnant economic growth, and political instability. Any increase in pollution, particularly from agricultural fertilisers and the poorly managed by-products of industrialisation and rapid urbanisation, *will* further threaten water availability and lead to a decrease in

---

[188] Food and Agriculture Organisation, *The State of World Fisheries International Aquaculture 2006*. page 151. Figures are by weight.

biodiversity.[190] In China only 50% of cities treat waste water and 5 of the 7 major river systems are classed as severely polluted.[191] Furthermore, water extraction from the Colorado River, the Rio Grande and the Yellow River already results in them failing to reach the sea for at least part of each year.[192] Water scarcity *will* be offset in the developed world through conservation and *probable* increases in the use of desalination. However, the desalination process is energy intensive and is *likely* to require increased investment in nuclear fission plants to generate the large amounts of energy required. In the developing world, increases in efficient use of water through improved irrigation, such as drip-fed systems, are *likely* to be employed.

Water extraction from the Colorado River, the Rio Grande and the Yellow River already results in them failing to reach the sea for at least part of each year

Risks and Benefits

Food Price Spikes. Increasing demand, and climate change, *may* affect the supply of key staples by, for example, drastically depleting fish stocks, or significantly reducing capacity to grow rice in South East Asia or wheat on the US plains. A succession of poor harvests *may* cause a major price spike, resulting in considerable economic and political turbulence, as well as humanitarian crises of significant proportions and frequency. Genetic and scientific modification of food is *likely* to be necessary, both for human and animal consumption and for biofuel production.

Conflict over Water. Inter-state conflicts caused by disputes over water distribution are *possible*, but historical experience indicates that countries generally seek equitable

---

[189] UK Met Office Hadley Centre.
[190] UNEP. *Freshwater Biodiversity: a Preliminary Global Assessment.*
[191] World Resource Institute 2008, *Watering Scarcity*, page 12.
[192] Centre for Strategic and International Studies. *Global Water Futures.*

solutions to water disputes, and this is *likely* to remain the case. International agreements concerning access to water, such as those between India and Pakistan and between East African states, are *likely* to provide a basis for compromise. International trade, and the off-shoring of agricultural production to fertile regions *will* serve to mitigate the most acute water stress. However, increasing water stress *will* contribute significantly to tensions in already volatile regions, *possibly* triggering conflict. More importantly, localised water scarcity is *likely* to inhibit economic development and generate internal conflict within states as groups compete for access.[193] Water management problems, such as pollution or localised flooding due to increased precipitation, run-off from urban sprawl and rapid glacial melt, are *likely* to challenge the ability of already weak states to provide for their populations. The most adverse consequences of water management problems are *unlikely* to be confined to remote rural regions. They are *likely* to be centred on rapidly expanding urban areas. Those regions most at risk include north Africa, sub-Saharan Africa, the Middle East and southern and Central Asia, including China.[194]

Mass Population Displacement. Combinations of food and water insecurity, climate change and the pursuit of economic advantage *may* stimulate rapid and large population movements destabilising neighbouring regions. In particular, sub-Saharan populations *will* be drawn towards the Mediterranean, Europe and the Middle East. In Southern Asia, coastal inundation, environmental pressure on land and acute economic competition *may* affect large populations in Bangladesh and on the east coast of India. Similar effects *may* be felt in the East Asian archipelagos, while low-lying islands *may* become uninhabitable. The developed world *will* face significant illegal migration pressure, and ethical dilemmas in determining how to deal with humanitarian effects.

Environmental Impact. Water and air pollution, and soil degradation through acidification, contamination, desertification, erosion, or salination *will* remain problems, especially in densely populated, rapidly industrialising states. Environmental degradation, the intensification of agriculture, and pace of urbanisation *may* reduce the fertility of, and access to, arable land. Technological and organisational solutions *will* emerge, such as improvements in the use of fertilisers, as *will* behavioural solutions, as waste becomes increasingly socially unacceptable and processes and accepted norms adapt. Environmentalism *will* remain a powerful movement, enjoying a broader base of support that encompasses elements of the developing world.

Biodiversity. Biodiversity is *likely* to become prized as research into the extent and variability of different forms of life yield significant technological and health advances. On land, diversity *will* be reduced as a side-effect of mass agricultural production techniques, industrialisation, urbanisation and through continued erosion of natural habitats, especially tropical rainforests. In the maritime environment, pollution and climate induced changes *will* degrade biodiversity, especially in Australasia where coral habitats are *likely* to be particularly affected. Bio-diverse regions are *likely* to be valued more highly by the global community than local communities, often resulting in tension between conservation and economic use.

---

[193] For example, many commentators assess the water scarcity to be a major contributory factor to conflict in Darfur.
[194] Xinhua News Agency. In 2007, the Yangtze River fell to its lowest level since 1877. The Yellow, Colorado and Murray-Darling Rivers fail to make it to the sea for at least part of the year.

Geophysical Risks. Between 1980 and 2000, 75% of the world's population lived in areas affected by a natural disaster and, since 1998, around 500,000 people have been killed by earthquake activity alone,[195] with the 2004 Indian Ocean tsunami accounting for over 40% of this total. Population growth, urbanisation in geophysically unstable regions, variable construction standards, and limitations of predictive and warning mechanisms suggest that casualty figures of this magnitude *will* be typical out to 2040. Demands on land usage *will* lead to increasing habitation in areas of significant risk, such as those susceptible to volcanic and seismic activity or low-lying coastal areas subject to inundation by tsunami. The net result is *likely* to be an increase in the scale of humanitarian crises and associated migration pressures.

Resource Nationalism. Resource nationalism is state control or dominance of particular resources, especially energy, and the use of this power to achieve national political objectives. In 1978, international companies controlled production from 70% of oil and gas reserves; at present they control only 20% with national or state-dominated oil companies controlling access to 75% of proven conventional reserves.[196] National Oil Companies (NOCs) already account for 14 of the top 20 oil and gas production companies.[197] This control is *unlikely* to change significantly although most NOCs *will* continue to recognise the interdependence that exists between producers and consumers. However, resource-rich states, especially those with ideological, geopolitical and populist agendas, such as Iran, Russia and Venezuela, or groupings such as Organisation of the Petroleum Exporting Countries (OPEC), *will* use, or threaten, all available levers of power to advance economic and foreign policy goals.

Risks and Benefits

Resource Wars. Supply disruptions caused by scarcity, hoarding or withholding of vital resources *may* cause conflict both between states and within states as groups vie for access. States that are unable to access the necessary materials to allow their population to survive and prosper, either through international markets or bilateral arrangements, *may* resort to the use of force. The range of outcomes associated with climate change heightens this risk.

Exploitation of Extreme Environments. The search for alternative sources of energy, minerals, food and water, enabled by the assured transfer and access to information, *will* become more urgent. Consequently the exploration of extreme environments such as: space; the Polar regions; the deep ocean; and deep underground regions is *likely* to increase. The US Geological Survey estimates that around 14% of the undiscovered

---

[195] US Geological Survey, 2009. Earthquake Hazards Program.
[196] Stanislaw J A, *Power Play: Resource Nationalism, the Global Scramble for Energy, and the Need for Mutual Interdependence,* Deloitte 2008.
[197] Petroleum Intelligence Weekly (PIW), 2008. Ranked on reserves, of the top 20 oil and gas producers worldwide, 14 are national oil companies or newly privatised national oil companies. PIW's ranking shows that Saudi Aramco, Gazprom, NIOC, Pemex, Sonatrach, INOC (Iraq), PetroChina, KPC, Petrobras, Petronas, Yukos, Lukoil, PDV (Venezuela) and NNPC are among the most important oil and gas companies in the world. PIW's ranking on all measures ranks Saudi Aramco, PDV, NIOC, Pemex and PetroChina in the top 10 oil companies in the world.

global oil and gas reserves are likely to be located in the Arctic.[198] Although environmental restrictions and technological difficulties inhibit exploration and production in this region, Arctic warming is *likely* to be at least double the global average, significantly improving future exploration prospects. Petrochemical companies, aggressively developing new extraction technologies, are *likely* to pursue production, undeterred by environmental limitations, constraints and concerns. The reduction in Arctic ice coverage is *likely* to continue, creating a strategically significant year-round northern sea route, offering shorter and more direct trade links between North America, Europe and Asia. Similarly, technology *will* generate commercially viable space applications. As the Apollo programme demonstrated, the exploration of remote and hostile environments is *likely* to stimulate and deliver technological innovation.

Technological Innovation. Diminishing availability of low cost, easily accessible hydrocarbon resources, and the need to reduce carbon emissions, *will* stimulate intensive research to find alternative forms of energy, although a rapid decline in hydrocarbon use is *unlikely*. Unconventional sources, such as oil sands and tars, are *likely* to become competitive as new technologies and processes mitigate higher extraction costs, high levels of associated emissions and environmental constraints. Methyl hydrate, especially in oceanic margins, is *likely* to become economically viable as a fuel source, although extraction from deep-water poses significant challenges. A technological breakthrough in the development of nuclear fusion may occur. Many incremental steps towards harnessing the energy of nuclear fusion have already been made, but a commercially available fusion reactor is *unlikely* in the next 30 years. Improvements in transmission mechanisms may stimulate developing states to specialise in low emission electricity generation for export to the developed world. For example, large-scale solar power generation in previously unproductive regions of North Africa *may* spur changing political relationships with Europe.

There is *likely* to be an increase in the exploration of extreme environments, such as the deep ocean beneath the Polar Ice Caps

---

[198] US Geological Survey Factsheet 0349, *Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas Deposits North of the Arctic* Circle, 2008.

Hot Topic – Minerals

During the Cold War a number of strategic non-energy minerals, essential for national economies and security, were regarded as vulnerable to supply disruption. These minerals, including chrome, nickel, cobalt, manganese and platinum (chiefly produced by South Africa and the then Union of Soviet Socialist Republics) were not available domestically and could not be guaranteed in time of crisis.

Out to 2040, a range of new factors influencing availability and supplies of certain critical minerals *will* remain vulnerable to disruption. Demand for minerals is *likely* to continue to increase in response to population growth, continuing industrialisation and higher material prosperity. New discoveries allied to technological advances *will* provide sufficient reserves, such that accessibility, rather than availability, is the primary concern.
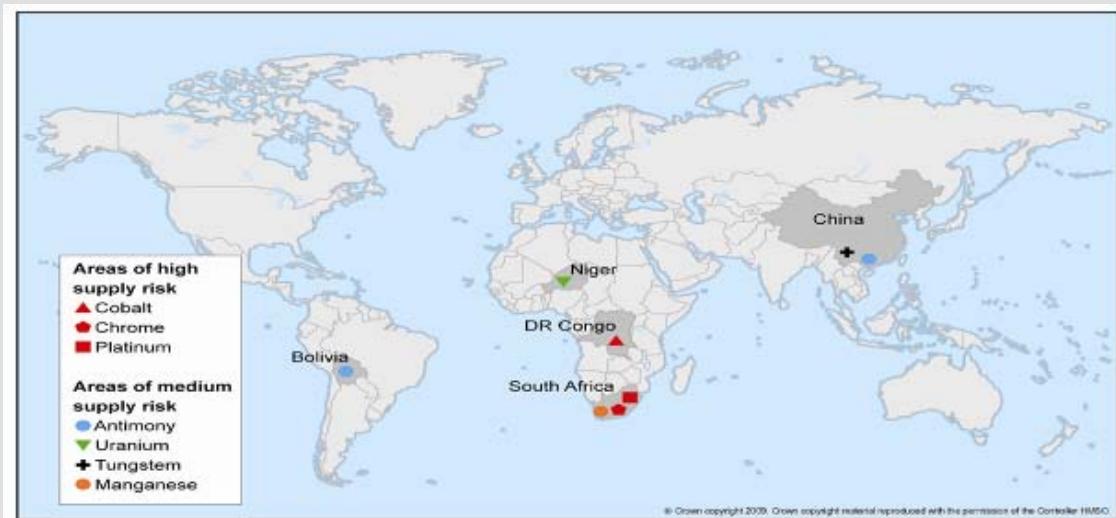
Figure 14 – Distribution of Strategic Minerals (British Geological Survey)

Increasing demand for natural resources from developing economies, especially China, is *likely* to continue. Differing standards of financial and environmental regulation and transparency are *likely* to lead to growing influence in producing regions, such as Africa. Production of certain minerals, such as the Rare Earth Elements (REE), antimony and arsenic, is currently dominated by China. However, if supplies were disrupted alternative deposits are *likely* to be available for exploitation. In contrast, the location of fewer tungsten deposits are known and the impact on global markets of disruption to Chinese supplies is *likely* to be significant.

Commodity	Chief Usage	Annual Production (Mn Tonnes)	Major Suppliers (% world production)	Threats/Risks
Chrome	Steel Alloys	19.2	South Africa, India Kazakhstan	Large deposits rare, South Africa has largest resources and production.
Cobalt	Steel and Special Alloys	0.059	DRC (37%), Canada, Australia	DRC has largest resources and production. China dominates metal production. Alternative sources are by-product of high-cost nickel operations.
Platinum	Exhausts, Industrial Processes	0.0002	South Africa (75%), Russia	Large deposits rare, South Africa has largest resources and production.
Antimony	Flame retardant, alloys	0.174	China (86%), South Africa, Tajikistan, Bolivia	China dominant, small-scale mines.
Rare Earth Elements	Electronics	0.12	China	China dominates supply, but deposits known elsewhere. Short-term disruption if new applications increase demand.
Titanium	Paint (as titanium dioxide (TiO2)). Aerospace Alloys.	6.1 TiO2 content	Australia, Canada, South Africa, China	New process for production of titanium metal may increase demand and lead to rapid depletion of existing reserves.
Tungsten	Cutting tools	0.074	China (83%)	China has largest resources and production. Deposits rare.
Uranium	Fuel for nuclear power generation	0.046 U3O8 equivalent	Canada, Australia, Kazakhstan, Niger	Rapid increase in nuclear power generation, but deposits widespread.
Manganese	Steel alloys	31.2	China, Gabon South Africa, Brazil, Australia	South Africa has largest resources, but production fairly widespread.
Tin	Solder and special alloys	0.25	China (98%), Indonesia	China dominant, but large resources

Table 2 – Global Mineral and Metal Resources

Certain minerals, such as iron ore, nickel, aluminium and coal, are not particularly vulnerable to disruption as supplies are widely distributed throughout the world. Other minerals, such as silver and gold, are also low risk as they are not critical to industrial processes and can be substituted. Various minor metals produced in very small quantities, such as gallium and germanium, are generally by-products of other more widely used metals, such as aluminium, copper, lead or zinc, and are recovered only from a few deposits. Their production is therefore inextricably linked to that of the major metal and cannot be easily raised to meet increasing demand.

Economic Dimension

Scope

Global economic growth has been driven by economic globalisation over the last 30 or more years, generating pervasive networks of connections and interdependencies between the major economic powers. The economic landscape has evolved rapidly: centrally planned economies such as the Soviet Union have collapsed; many Asian economies have enjoyed spectacular growth, particularly China which has embraced a market aware philosophy; and the EU has matured into a cohesive economic bloc. These changes have created a multi-polar economic landscape. The Economic Dimension considers drivers and trends related to economic growth, material expectations and economic power, in order to determine how they will affect the global economy.

The Hot Topic is the **Global Economic Recession**.

Trends and Drivers

Economic Growth. Over the last 30 years, the global economy has grown at a rate of 3-4% and output has increased 4-fold.[199] There has been regional variation: the newly-industrialised Asian economies have raised output 12-fold, while the G7 group of industrialised states have had a 5-fold increase. However, sub-Saharan Africa has experienced only a 3-fold increase, despite more than doubling its population and potential workforce during that time.[200] Growth in the global economy *will* continue, accompanied by general improvements in material well-being. However, economic growth, combined with the continuing rise in the global population, *will* intensify the demand for natural resources, minerals, and energy. When allied to demographic ageing and environmental and political challenges, the *likely* result is a reduction in global economic growth rates. This growth *will* continue to be uneven, fluctuating over time and between regions, with sub-Saharan Africa *likely* to lag behind other regions primarily because of governance challenges, linked to endemic corruption. The most rapid growth is *likely* to be in developing economies that experience a 'demographic dividend' that boosts the workforce as a percentage of the population. Other states which have large workforces and maturing macro-economic frameworks such as China, India, and *possibly* Brazil, Mexico, Turkey and Vietnam are also *likely* to grow rapidly.[201]

---

[199] Trend economic growth refers to average growth of an economy over a cycle of expansion and contraction. It is a moving average. IMF, *World Economic Outlook 2008*, page 3.
[200] 1980 to 2007. Based on IMF World Economic Outlook Database 2008 and *UN Population Division*, 2008 Revision, Medium Variant.
[201] Goldmann Sachs, *BRICs and Beyond,* 2007.

Risks and Benefits

Rapid Climate Change. Unexpectedly rapid climate change is *likely* to significantly shrink the global economy. Feedback mechanisms *may* cause the rate and magnitude of climate change to be greater than consensus forecasts, making mitigation and adaptation difficult and expensive. For example, the costs of stabilising atmospheric carbon dioxide levels *may* reach 2% of annual global output by 2050, although this estimate masks large variations across countries and regions.[202] US could suffer only a 1% cost, but India and Africa *may* suffer costs of up to 5% of output.[203] Failure to develop technologies in time to alleviate the worst effects of climate change is *likely* to result in severe economic dislocation, causing a reduction in consumption per head of up to 20%,[204] with associated political, social and security implications, especially in states that are subject to the most extreme effects.

Economic Globalisation. Economic globalisation is one aspect of the wider process of globalisation (see the Globalisation Ring Road Issue). Since 1980, the global economy has integrated rapidly, driven by technological innovation that has dramatically reduced the costs of transportation and communications. For example, in real terms the unit cost of air transport fell by 80% between 1930 and 1990, and the cost of a 3 minute trans-Atlantic phone call fell from $250 in 1930 to virtually zero.[205] Globalisation, based on persistent technological innovation, is *likely* to remain the most significant driver of long-term economic change. Nevertheless, liberal trade and investment policies that have accelerated globalisation since the end of World War II *will* be subject to periodic challenge, and *may* be temporarily reversed. In particular, the exposure of local markets to externally-derived risk *may* lead to unilateral protectionist action or preferential bilateral arrangements, especially in situations where social or regime stability is threatened. Hence, while globalisation is *likely* to continue, there are significant risks, and it cannot be ruled out that economic de-globalisation *may* be the defining trend out to 2040.

---

[202] *Stern Review on the Economics of Climate Change*. Executive Summary, page xiii. The initial estimate of 1% was increased by Lord Stern in later comments. The IMF (*World Economic Outlook 2008*, page139) estimates 2%.
[203] IMF, *World Economic Outlook 2008*, page139.
[204] *Ibid*, page139.
[205] Wolf M, *Why Globalisation Works*, page 120. Current prices, allows for inflation since 1930.
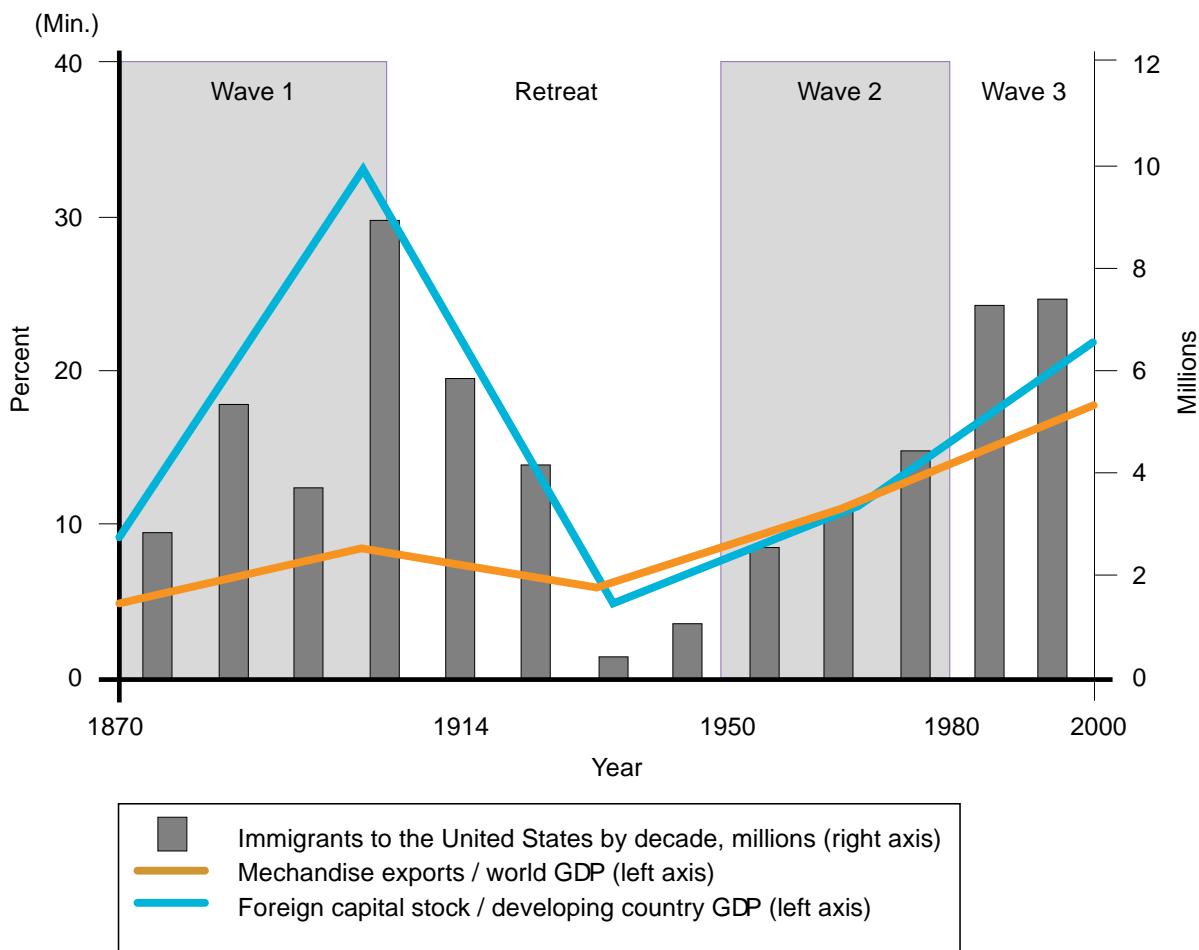
Figure 15 – Waves of economic globalisation 1870-2000[206]

Risks and Benefits

Economic De-globalisation. The period from around 1870 to 1914 is considered as a previous era of rapid globalisation. However, globalisation crumbled between 1914 and 1945, when global economic integration, as measured by international trade, capital flows and international migration, receded (see Figure 15).[207] Out to 2040, barriers to trade, migration, as well as capital and intellectual flows introduced in response to geopolitical insecurity, protectionist interests, or macroeconomic instability, *may* reverse the globalisation process and result in a period of economic de-globalisation. Such a period *may* be characterised by: decreasing interdependence; increased competition and confrontation in international relations; regional or ideological blocs coalescing around common economic, political, social, cultural or security interests; and inter-state and inter-bloc rivalries.

[206] Her Majesty's Treasury, *Responding to Global Economic Challenges: UK and China*, October 2005.
[207] Ferguson N, *Sinking Globalisation*, Foreign Affairs, March/April 2005.

Material Expectations. Material expectations, fuelled by access to increasingly globalised communications and media, *will* be heightened by continued global economic growth, and by visibility of high standards of living in affluent states. Visible marginalisation, economic inequality and a sense of grievance, where they occur, are *likely* to increase in significance and become major political issues, *possibly* based around transnational agendas that advocate violent activism. Capitalism, allied to market-driven economies, has proven the most prevailing (and accepted) political-economic ideology, and this *will* continue in some form. Individuals, especially in developing states, *will* aspire to attain increasing material wealth. However, the sheer scale of the gap means that a low-income state is *unlikely* to become a high income state, and vice versa, within the space of 30 years. The past 50 years has seen improved average living conditions for most of the world's population, but inter-state and intra-state income inequality has remained extremely high. Global output growth per head is *likely* to continue, but at a reduced rate,[208] especially in developing economies that have seen a 50% rise since 1980.[209] The least developed economies *may* see the lowest rates of per capita growth as sub-Saharan Africa declined during the 1980s/90s.

Risks and Benefits

Inequality of Opportunity. Circumstance-based inequality is associated with criminality and *may* be a significant factor in initiating and prolonging conflict. However, reactions to inequality are context dependent and specific outcomes cannot be predicted with confidence, although states with high levels of inequality, between individuals, and particularly between groups, *may* be at greater risk. The coincidence of economic disparities with other inequalities, such as ethno-nationalist, political, or cultural fault lines, is crucial to understanding how inequality affects the probability of violent conflict. The juxtaposition of such inequalities is more *likely* to result in armed conflict being initiated and prolonged.

Global Trade. Since 1950 world trade has grown more than 27-fold in volume terms, 3 times faster than growth in world output, which expanded 8-fold during the same period.[210] The driving forces behind this growth in trade are cheaper transportation and communications, more open trade policies, and changes in economic organisation, such as cross-border integration by Multinational Corporations (MNCs). When the global economy grows, and the majority of major economies participate in that growth, a significant backlash against trade liberalisation is *unlikely* and international trade *will* grow.[211] However, trade growth *may* be temporarily reversed in response to periodic economic, resource or financial crises. Moreover, environmental crises and rising transportation costs, linked to climate change and high energy prices, *may* lower, or even reverse trade growth, especially in manufactured goods.[212] The tension between faltering global agreements on trade liberalisation and the continued drive by MNCs to integrate

---

[208] World Bank, *Global Economic Prospects 2008*, page 44.
[209] 1980 to 2007. Based on IMF *World Economic Outlook Database 2008* and *UN Population Prospects: 2008 Revision*.
[210] World Trade Organisation, (WTO) *World Trade Report 2007*, page 243.
[211] *Ibid 2007*.
[212] Transportation costs vary with demand, however environmental costs (emissions) may also become a real cost in the long term.

production vertically[213] is *likely* to result in the rise of regional trade agreements. This *may* provide a basis for a more regionalised structure of political and economic blocs. Around 400 regional and bilateral trade agreements already exist with many coming into force since negotiations on the Doha round began in 2001.[214]

Risks and Benefits

Protectionism. The desire to protect national industries from foreign competition remains a threat to globalisation, just as it was during the inter-war years when the infamous Smoot-Hawley Tariff Act was instituted by the US Congress.[215] Irrespective of success in the global trade negotiations, it is *unlikely* that the World Trade Organisation (WTO) can maintain the momentum of tariff reductions established over the last 30 years, given the scale of earlier reductions and the drift towards states protecting certain sectors of their economies from competition and disruption. Further multilateral agreements *may* be completed. However, the increasing complexity of bilateral arrangements is *likely* to lead to a 'noodle bowl' set of links between states that favour rationalisation by regional, rather than global, trade agreements.[216] Outright protectionism on a global scale is *unlikely* to take hold, but protracted trade disputes involving major powers are *possible*. Such disputes would result in increased competition and confrontation between states.

Distribution of Economic Power. Economic power has long been wielded by wealthy, high-income states such as the US and, to a certain extent, by the EU and its individual members, to achieve desired outcomes. This can be done through the negotiation of trade arrangements or through coercive sanctions. However, rapid economic growth in developing economies, increasing economic interdependence, and competition for strategic resources *will* erode the utility and effectiveness of economic power. The trend towards a multi-polar economic landscape is *likely* to continue. As resource scarcity starts to impact, China, India, and resource-rich states such as Russia, Iran, Saudi Arabia, and *possibly* Brazil are *likely* to use economic levers to achieve geopolitical ends more frequently. By 2040, China's and India's output is *likely* to be of a similar magnitude to US and EU output, although their per capita income *will* remain significantly lower. Hence, 2 of the 4 largest global economies are *unlikely* to be high income states. The manner in which this disparity is perceived, and the extent to which China and India focus on internal development rather than wider global challenges, is *likely* to be fundamental to the global economic and strategic outlook.

---

[213] Vertical integration is the organisation of production whereby one business entity controls or owns all stages of the production and distribution of goods or services.

[214] Lamy P, WTO President. 17 January 2007. '*But as the WTO and it predecessor, the GATT, have evolved, a myriad of preferential trade agreements have been concluded by WTO members. By 2010, around 400 of such agreements could be active. These preferential agreements contradict the non discrimination principle which is one of the cornerstones of the WTO.*'

[215] The Smoot-Hawley Tariff Act was signed into law on June 17 1930, and raised US tariffs on over 20,000 imported goods to record levels, and, in the opinion of most economists, worsened the Great Depression. Many countries retaliated with their own increased tariffs on US goods, and American exports and imports plunged by more than half.

[216] Baldwin R, *Multilateralising Regionalism*. By 2010, there are likely to be over 90 Free Trade Agreements affecting bilateral flows in East Asia.
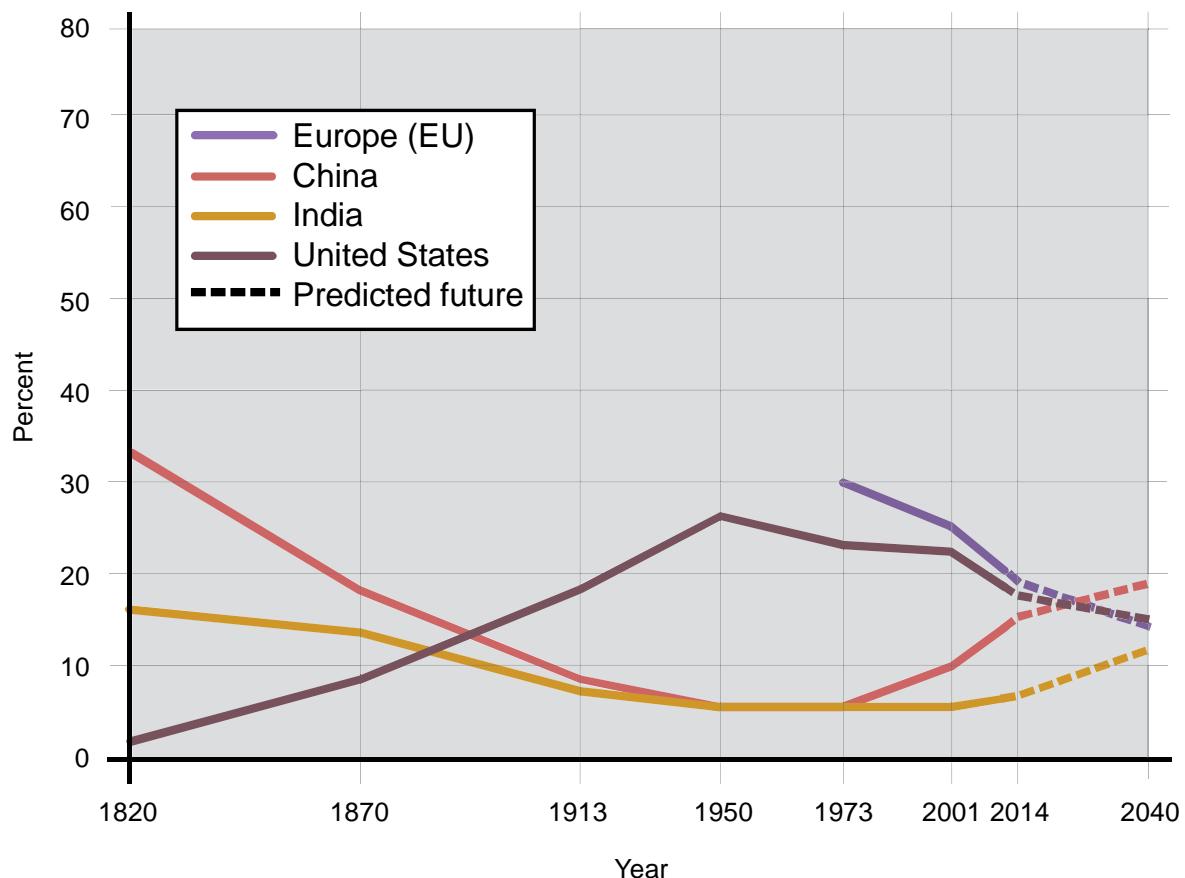
Figure 16 – The changing share of the world economy 1820-2040[217]

System of Global Economic Governance. The contemporary global economy bears little resemblance to the fragmented post-World War II period when the current global economic governance regime was constructed. Although institutions created 60 years ago have adapted, the IMF and the World Bank are struggling to become representative and to remain relevant. Efforts to develop global institutions that are structured, funded, and empowered to act as a stabilising force for international financial markets *will* continue. Out to 2040, they are *likely* to find ways of enhancing the participation and voice of emerging economies.[218] However, difficulties in gaining international consensus for change means that an effective system of global economic governance is *likely* to evolve slowly and face continued challenges.

---

[217] Based on Maddison and IMF/World Bank projections.
[218] Breugal, *Global Governance*, December 2006.

Risks and Benefits

Sovereign Wealth Funds.[219] A Sovereign Wealth Fund (SWF) is a pool of money derived from a country's reserves, which is set aside for investment purposes that benefit the country's economy and citizens. State-owned investment vehicles, particularly those of China, Norway, Russia and the petroleum exporting countries of the Middle East, have grown rapidly and hold almost $5 trillion in assets.[220] States with large SWFs *will* be significant investors in developed and emerging economies over the next 30 years. They are a visible aspect of interdependence between states and are *likely* to be invested rationally for profit, as well as for political ends. However, individual investment decisions *will* be controversial and subject to scrutiny by suspicious host countries.

Poverty. Between 1990 and 2002, global average incomes increased by approximately 21% and the number of people living in absolute poverty declined by an estimated 130 million; global child mortality rates fell from 103 deaths per 1,000 live births a year to 88; life expectancy rose from 63 years to nearly 65 years; an additional 8% of people in the developing world gained access to clean water; and an additional 15% acquired access to improved sanitation services.[221] Economic growth is *likely* to lead to a continued reduction, albeit unevenly distributed, in absolute poverty. Improved access to information is *likely* to stimulate growing concern over comparisons between living standards. However, given projected population growth in the least developed countries, the total numbers of people affected by poverty *may* increase, especially if the global economy grows less rapidly than expected. These increases are *likely* to be concentrated in particular regions that are afflicted by conflict, poor governance, and the worst effects of climate change, (such as sub-Saharan Africa).

Risks and Benefits

Instability and Income Ratios. Strong economic growth, especially in Asia, has resulted in the growth of a global middle class. The global population of over 6 billion can be classified between high, middle and low-income in to the ratio 1:3:2.[222] However, future population growth is *likely* to be concentrated within low-income states. Hence, as the global population rises towards 9 billion a ratio of 1:3:5 is *possible*, accentuating the challenge of economic inequality. Within the low-income strata there already exists a 'bottom billion' that are *unlikely* to rebel because they are too preoccupied simply with survival.[223] It is those above this level where the majority of instability is *likely* to be concentrated as individuals and groups seek to improve their situation.

---

[219] The funding for a Sovereign Wealth Fund (SWF) comes from central bank reserves that accumulate as a result of budget and trade surpluses, especially from revenue generated from the exports of natural resources. The types of acceptable investments included in each SWF vary from country to country; countries with liquidity concerns limit investments to only very liquid public debt instruments.

[220] 'McKinsey Global Institute in a recent report forecast a dramatic increase in the assets of sovereign-wealth funds over the next few years. It predicts that Asia's sovereign assets, which at the end of 2007 stood at $4.6 trillion, will rise to at least $7.7 trillion by 2013 on conservative growth assumptions, and to as much as $12.2 trillion if economic growth continues at the fast pace of the past seven years.' *The Rise of State Capitalism*, The Economist, 18 September 2008.

[221] UN Millenium Project.

[222] The more optimistic scenario is that strong economic growth may continue the rapid growth of the global middle class by 80 million a year, or around 2 billion by 2040, accompanied by an associated decline in inequality. Goldman Sachs, *The Expanding Middle: The Exploding Middle Class and Falling Global Inequality*, 2008.

[223] Collier P, *The Bottom Billion*, 2007.

Patterns of Labour Mobility. Remittances from migrants in developed states, worth $240 billion per annum, or more than twice the level of international aid, are the largest source of external capital in many developing countries and directly benefit 10% of the global population.[224] Over half of the 16 million highly skilled expatriate workers in the 4 main destinations (US, Europe, Canada and Australia) have originated from outside the OECD area.[225] Out to 2040, highly capable and skilled individuals, particularly those in niche or scarce areas, *will* continue to attract substantial rewards for their services and are *likely* to be mobile within the global economy. This flow of skilled migrants *will* become more complex and *will* be affected by the growth of research and entrepreneurial opportunities in developing economies, fluctuating migration policies, and changes to traditional career models in business and academia. This *may* result in a 'brain circulation' rather than a 'brain drain', as developing economies continue to rise, and opportunities and safeguards become more predictable; a reverse flow of people to countries of origin *may* accelerate.

Risks and Benefits

Economic Migrants. Large differentials in *per capita* income are one driver for migration, inducing, for example, large-scale rural-urban migration in China, and international migration from Latin America into the US and from Africa into Europe. Cross-border income discrepancies can be extremely high. For example, Spain has an average income of $31 000, but Morocco's is only $4 000. The tension between the desire of migrants to pursue economic and other opportunities in developed countries, and the willingness of host populations to accept continued migration *will* determine the future level of controlled migration. The developed world, particularly Europe, is *likely* to require immigration in order to maintain its workforce and skills base, and to compensate for its declining indigenous workforce. However, in phases of below trend economic growth, political pressure is *likely* to limit immigration in order to protect indigenous employment, leading to a surge in illegal migration, which *will* remain a security challenge.

Capital Flows. The volume of cross-border capital flows, both net and gross, is *likely* to increase, maintaining a high-level of financial interdependence between states. Gross capital flows have increased markedly over the last 30 years. For example, turnover on the foreign exchange markets generates flows of several hundred trillions of dollars per year. However, the majority of these trades represent short term speculative flows rather than longer-term investments, and net international flows, as a proportion of global output, are smaller than at the turn of the 20th century.[226] The tension between the interdependency created by capital flows, and the instability that can be generated by capital flight, *will* continue. Financial instability *may* be one trigger by which protectionist-minded populations force de-globalising policies onto reluctant governments.

---

[224] *Global Economic Prospects 2006: Economic Implications of Remittances and Migration*, Washington: World Bank, pages 86-89.
[225] OECD Science, Technology and Industry Scoreboard 2005, *Towards a Knowledge-based Economy*.
[226] At its peak, British net overseas investment, mainly in India, ran at 9% of GDP while British claims on the rest of the world were equal to 2 times GDP. This is significantly higher than any developed country today. Wolf M, *Why Globalisation Works*, 2004.

The volume of cross-border capital flows is *likely* to increase

The Role of Multinational Corporations. Over the last 30 years, industrial production has been de-centralised and geographically distributed in an unprecedented manner. Countries, regions, and firms have specialised in particular stages of a product's manufacture in response to competition, internationalising the markets for goods, services and labour. Such specialisation requires large-scale transportation of components, and this has been facilitated by technological advances in transport and communications, and trade liberalisation.[227] MNCs and out-sourcing have emerged as integrating factors in the globalised economy, producing networks of interdependence between states that are unprecedented in scale and pervasiveness. This integrating effort is *likely* to persist out to 2040. The rise of state-owned enterprises (5 of the 10 largest MNCs are currently state-owned by the Chinese, Brazilian and Russian governments) is *likely* to continue, as is the proportion of MNCs based in emerging rather than developed economies.

Risks and Benefits

Defence Industrial Base. Ownership and production within defence firms has become increasingly internationalised as MNCs seek competitive advantage. For example, in 1988 of the 15 leading European defence suppliers, 8 were state-controlled and 2 more had been in the recent past. By 2006, only one of the top 15 had a majority state holding.[228] The geographical distribution of critical technologies, Research and Development (R&D) activity, and production has shifted from a national to an international base with the *possibility* of disruption to procurement chains especially in times of tension and conflict.

---

[227] Wolf M, *Why Globalisation Works*, page 120, 2004.
[228] International Institute of Strategic Studies, *European Military Capabilities,* page 108, 2008.

Hot Topic – Global Economic Recession

The International Monetary Fund (IMF) considers there have been 5 global recessions in the last 30 years. Further global economic recessions *will* happen over the next 30 years, and governments are *likely* to respond to them with protectionist policies designed to shield their own economies and workforces. However, they are *likely* to temper the extent of such policies, to maintain the integrity of the international system for global trade and capital movements. In extremis, protectionist measures that cause the reversal of economic globalisation are *possible.*

The global recession of 2008-9 is illustrative of the *probable* response to, and effects of, future recessions. Its overall effect is *probably* to accelerate the shift of power from Europe/US towards Asia, and to diminish Western soft power by making its economic and financial systems less attractive. First, wide-ranging interdependencies within a complex global financial system made counter-party risk difficult to identify and allowed a localised crisis in US sub-prime mortgages to trigger a global financial crisis. Other complex globalised systems, such as supply chains, *may* be vulnerable to similar systemic shocks, suggesting a requirement to monitor, analyse and evaluate their resilience. Second, it *will* be in the interest of major powers to find methods and mechanisms to deal cooperatively with the effects of recession, or of systemic failures.

The probable effect of the 2009 recession is to accelerate the shift of power from Europe/US towards Asia

Economic and financial interdependency raises the cost of failure to act and provides stimuli to use innovative methods, such as coordinated central bank action, and revitalises cooperation through representative groupings, such as the G20. However, they *may* not always be successful in doing so. Third, global recessions *will* cause an increase in the incidence of poverty, at least temporarily, and are *likely* to promote grievance and dissatisfaction among those who suffer economic hardship. This in turn is *likely* to breed political violence, criminality, societal conflict and destabilisation of those states or regions unable to cope. Finally, economic crises *will* affect governments' finances. There *may* be downward pressure on defence spending making measures, such as aid or intervention, unaffordable.

Geopolitical Dimension

Scope

The Geopolitical Dimension considers the drivers that will influence the future global political system. Two issues are *likely* to dominate out to 2040: the changing distribution of global power, from a uni-polar to a more diverse and complex structure; and the potential resurgence of political ideologies, driven by liberal democratic values, autocracy, religious, nationalist or other influences.

The Hot Topic in this section is the ***Resurgence of Ideology***.

Trends and Drivers

Global Interconnectivity. The interdependence of the global system, under-pinned by physical links, international governance and norms, and a belief in the positive benefits of international markets and trade, is *likely* to act as a double-edged sword. It *will* act as a stabilising influence between major powers by raising the costs of confrontation and conflict, but is also *likely* to destabilise states and regions that are unable to cope with the increased competition and social change that interconnectivity brings. Interconnectivity and interdependence is epitomised by the symbiotic relationship between China and the US. On one hand both states are *likely* to see each other as a security challenge, but they *will* continue to exploit the economic opportunities that exist between them. However, the interconnectivity of the global system also represents a significant systemic risk to highly-integrated economies given that failure of one part is *likely* to have broad impact.

The Constituents of Power. Power is the ability to influence others. The constituents of power *will* continue to comprise a mix of 'hard' and 'soft' elements.[229] Hard power is military, economic and some elements of diplomatic activity that can be used to coerce or pay others to change their behaviour. Soft power is the power of attraction based on culture (when it is pleasing to others), values (when they are attractive and consistently practiced), and policies (when they are seen as inclusive and legitimate).[230] Soft power is at its most effective when under-pinned by hard power. The degree to which a state or group can combine hard and soft power into an amalgam of effective statecraft *will* determine their ability to achieve strategic objectives. Some states, especially in Europe, are already reluctant to use the military element of hard power. This trend towards a post-military society is *likely* to remain strong, but not irreversible. The ability of the Western liberal democracies to utilise power is *likely* to be challenged by the rise of alternative power bases in Asia, in particular in China and India. Moreover, all elements of power are *likely* to be wielded by a broader spectrum of actors and agencies, even by organised criminal, terrorist and insurgent groups.

The Role of the State. The state *will* remain the basic unit in international relations, although it *will* face challenges and the authority vested in it *will* vary. Most states *will* retain authority over the full spectrum of activities, whereas others, such as those in the

---

[229] Nye J, S*oft Power, The Means to Success in World Politics,* Public Affairs, page 31, 2004.
[230] Nye J, *Get Smart*, Foreign Affairs, August 2009.

EU, *will* voluntarily divest some to regional or supranational authorities. Others, such as some states in Africa, *will* have little practical authority. Transnational movements and groups *will* remain influential and are *likely* to further erode some aspects of state power. The varying levels of authority *will* complicate the ability of states to achieve and sustain multilateral partnerships and agreements.

Global Governance. The UN *will* continue to offer a framework for international discourse. It *will* continue to be the global service provider, offering international coordination and direction in specific areas through bodies such as the World Health Organisation (WHO), UNHCR and United Nations Educational Social and Cultural Organisation (UNESCO). The permanent membership of the UN Security Council is *likely* to expand, but it *will* struggle to deal with conflict and tension. Other global institutions *will* face considerable challenges.

Differing Political Systems. Any assumption that Western liberal values and processes would become the global norm has already been severely challenged. Out to 2040, there *will* be an era of competing political systems, ranging from liberal democracy through to autocracy and theocracy. Tension between regions, states and nationalist identities, and corruption among ruling elites, are *likely* to constrain the spread of democracy. Liberal democracies *will* still dominate in the West. However, the arguments of some democratic movements *may* not be perceived as strong enough to solve the problems in some developing states that maintain, or turn to, more autocratic or authoritarian political systems. The populations of some states *may* favour stability, the promise of economic growth and limited de-regulation at the expense of fully representative government. Political systems based on tradition, be it ethnic, tribal or religious, are *likely* to remain features of the global political system, as are dictatorships.

Transnational Extremism. Transnational armed criminal, terrorist or insurgent groups, experienced in conflicts around the world *will* be part of the strategic landscape. Many extreme political groups *will* have a transnational following, and *may* increasingly employ sophisticated methods of coercion, including cyber attack and Weapons of Mass Destruction (WMD). They *will* remain highly unpredictable and a continued cause of tension and instability especially in regions that have underlying governance and economic problems, such as in sub-Saharan Africa and *possibly* Latin America. Most *will* demonstrate features associated with organised criminality, terrorism, disorder and insurgency, fuelled by perceived or actual grievances. There is *likely* to be an increased sponsorship of irregular activity by states, seeking to utilise and exploit, through proxies, gaps in the international system, either to assert themselves or to secure advantage without exposing themselves to state-on-state risks. Acts of extreme violence, including mass casualty attacks, *will* continue to be used by groups with sophisticated networks and the ability to exploit the media in order to maximise the impact of the 'theatre of violence'.

United States Transition. The status, culture and actions of the US *will* have a decisive effect on the evolution of the international system, as it adjusts to an uneven, *possibly* unbalanced transition from a uni-polar to a multi-polar world.

Risks and Benefits

US Decouples From Europe. A shift in US strategic focus towards Asia, internal demographic change, and a changing balance of power in the Americas, based on Brazil's economic growth, *may* result in a significant reduction in US engagement with Europe, challenging the viability of North Atlantic Treaty Organization (NATO) as the dominant provider of European security and defence architecture. However, the US *will* seek to safeguard its continuing economic investment in Europe and its interests in the Middle East and the Arctic. These are *likely* to ensure continuing defence and security cooperation with European partners, *probably* at reduced levels, but with a correspondingly greater investment in expeditionary and continental-US based capabilities.

The Rising Powers. China's economic development *will* be one of the most significant factors in the future of the globalised economy. Other growing, or resurgent powers are *likely* to be of influence, with Brazil and *possibly* South Africa strengthening their status as regional powers.

Weak States. Many states and some regions *will* fail to attain the necessary level of economic and political development to compete in a sustained and successful manner in the global economy. These states are *likely* to be beset by a mixture of environmental, demographic, economic and political pressures with consequent impact on their stability and security. They can be regarded as weak states. Some weak states *may* fail completely, with sub-Saharan Africa and Central Asia, regions of global concern. The degree to which weak states impact on others is *likely* to depend on the security of supply of strategic resources to the globalised economy and whether internal instability spreads to neighbours, either through migration or conflict. Responses to weak states are *likely* to include humanitarian assistance, containment and stabilisation.

Some states *may* fail completely, with sub-Saharan Africa of global concern

Ungoverned Space. Some geographical regions, including weak states and rapidly growing cities, *will* not be subject to legal, legitimate or conventional administration. Where this occurs, power is *likely* to be wielded by groups ranging from warlords and armed criminal gangs through to traditional tribal or religious structures. Each region *will* be unique and engagement by outside powers *will* require an understanding of the individual context of the region. Some of these regions are *likely* to subsist through illicit trade and institutionalised criminal activity, while others *will* be ineffective in curbing instability. Many are *likely* to suffer conflict and be a source of instability in neighbouring regions. The risks associated with these spaces, including endemic criminal activity, the basing of terrorists, irregular activity and conflict, are *likely* to increase and add to the burdens of maintaining the integrity of the international system. Similarly, states that are unwilling or unable to invest sufficiently in maritime security, are *unlikely* to be able to patrol and enforce their jurisdiction and internationally binding maritime obligations in their territorial seas and economic zones. This *may* lead to activity stretching from maritime pollution, dumping of hazardous materials, illegal fishing, smuggling (of drugs, people and other forms of contraband) up to piracy attacks. This *will* be particularly important when an area of sea adjacent to a weak state encompasses key communication nodes, such as the Straits of Malacca or the Bab-el-Mandeb.

The Proliferation of Weapons of Mass Destruction. Access to technology that enables the production and distribution of WMD is *likely* to increase. Many states *will* feel that they require the prestige and deterrent value of WMD systems to reinforce their regional power.

Risks and Benefits

Security of Chemical Biological Radiological and Nuclear materials. Wider possession of WMD and Chemical Biological and Radiological and Nuclear (CBRN) technology and materials, by states with inadequate capacity for ensuring security and safety, *will* increase the risk of proliferation and incompetent handling. Catastrophic environmental damage is *possible*. Nuclear armed states that are vulnerable to instability *will* be of particular concern.

Non-State Actors. MNCs, large non-governmental organisations, as well as organised criminal groups, all work across the global stage. However, the authority of the state is *likely* to remain dominant. Non-State Actors are only *likely* to gain a similar degree of influence in areas where governance has broken down or is particularly fragile. Large MNCs, such as Gazprom, are increasingly state-owned and controlled, and other large corporations *will* have to work within the state based legislative framework if they are to gain access to resources and markets. While media and communication corporations *may* become ubiquitous global brands, the control by the state of the physical environment and operating space mean that it is *unlikely* that these corporations *will* have the means, methods or opportunities to usurp the power of the state. Non-governmental organisations, especially those associated with particular interests, *will* play niche roles and have influence within liberal democracies, but it is *unlikely* that their approaches of utilising the media, direct action and lobbying will have much impact on more authoritarian states.

Hot Topic – The Resurgence of Ideology

Religious belief *will* retain a significant influence on the vast majority of the global populace especially in the Americas, Africa and increasingly throughout Asia. Tension is *likely* between religious and secular groups. Strategic drivers such as economic recession, resource scarcity, social change and conflict are *likely* to contribute to the increasing significance of belief-based groups. Single issues *may* also emerge that divide opinion and forge identities, such as attitudes toward abortion, gender, the environment, religious law and the teaching of evolution.

The Christian Faith has around 2.2 billion adherents and an annual growth rate of around 1.4%. It is *likely* to remain the largest religious grouping.[231] Islam has an estimated 1.3 billion adherents and an annual growth rate of 2.0%, with most growth coming from the developing world; it is *likely* to remain the world's fastest growing major religion. New groups *will* continually form, grow and disband. Evangelical and individually-focused religious groups are *likely* to be increasingly socially engaged, working to provide welfare support and focusing on an individual's needs, moving away from a traditional organisation-centred model of belief. The spread of evangelical Christianity in Africa, Asia and South America *may* transform traditionally Western-based Christian institutions, giving them an increasingly non-European emphasis.

Religious ideology *will* continue to be a generally positive influence on behaviour, although at times it *may* also be a source of tension and conflict. Inter-faith and intra-faith conflicts *will* occur, for example between Christian and Muslim groups in parts of Africa. However, religion *will* often be the tool to motivate popular support in response to other grievances. Religion *will* often be the pretext rather than the source of conflict. The growth of new religious groups *may* result in tension, especially in areas that have long-established religions and traditions that experience considerable increases in minority faiths.

Islam *will* remain politically influential, although any form of pan-Islamic movement is *unlikely*. The largest Islamic group, with the widest geographical spread are the Sunnis that predominate parts of the Middle East, Southern India, the Malacca Straits, and through South Asia up into Russia. Tension between some Sunni and Shia's *will* continue to be a source of instability. Sectarian conflict within Islam is *likely* to continue. Any rapprochement between Islam and Judaism is *unlikely*. The situation *will* be defined by continuing confrontation between a prosperous Israel and surrounding states that are *likely* to struggle economically and suffer from governance issues exacerbated by nationalist or violent political movements. Orthodox Islamic groups are *likely* to question the legitimacy of ruling regimes and seek to replace them with theocratic governments. Any such change would create tension, not only with the West and others who depend on access to Middle eastern resources, but also with Iran.

Europe is *likely* to remain broadly secular although a number of new belief structures *may* arise based more on reason than on faith. Consequently a new form of sacred secularism *may* arise which reacts strongly against any attempts to incorporate faith-based beliefs into the political and legal system and *may* itself form its own movement competing with both traditional and resurgent forms of religious belief. Tension is *likely* to occur from the

---

[231] *The List, The World's Fastest-Growing Religions*, Foreign Policy, 2008.

increased competition for ideas and membership between those who define themselves as secular and those particular brands of faith undergoing significant a 'spiritual void' in the developed world.

Nationalism is *likely* to remain significant. When coupled with destabilising grievances, it is *likely* to be a rallying point for dissent, often directed against migrant communities and within states with marked ethno-religious divisions. Potential areas of concern *will* be in the Balkans, the Caucasus, the Middle East and Africa. Nationalist sentiment in East Asia *will* remain strong, and *may* be a significant factor in relations between states. State fragmentation along nationalist fault-lines is *possible*, especially if economic performance deteriorates, and separatist movements, such as those in Tibet and Xinjiang, *will* continue. Russian nationalism is *likely* to be a destabilising influence for her near neighbours, especially in states with large concentrations of ethnic Russians. Equally, Russia *will* suffer from internal security problems with its own disaffected minorities. Cities and states with large diaspora communities affected by instability in their homelands *may* become proxy conflict zones themselves.

Many former Communist states, including Russia and China, have adopted hybrid methods of governance that attempt to accommodate capitalism and stability. Robust economic growth and moves towards individual freedoms has often suppressed potential discontent amongst their populations. However, should economic growth be halted or reversed, a return to more severe forms of authoritarianism, and even Marxism, is *possible*.

Environmentalist groups have grown in strength in the developed world. However, climate change is *likely* to put environmental issues into the global political consciousness. These groups are *likely* to exert considerable influence and *may* develop into niche political global movements. Some 'green' and 'new age' groups *may* resort to more direct action, rather than just political agitation, and in some extreme examples this *may* include violence.

Science and Technology Dimension

Scope

The interrelated effects of globalisation, including market-manipulation, the unpredictability of consumer demand and the multiplicity of complex routes to market, *will* lead to rapid technological change. Issues relating to the perceived benefits and drawbacks of technological development and their global supervision are *likely* to remain highly charged. The Science and Technology Dimension therefore considers broad trends, focusing on how innovation may unfold over the next 30 years. These broad trends include: the rapidly expanding global appetite for profits derived from technological advances; the influence of certain emerging economies; and the resulting potential for technology breakthroughs and their societal impact.

The Hot Topics are **Cyberspace***,* **Space, Ballistic Missile Defence and Novel Weapons**.

Trends and Drivers

Pace of Development. Trend analysis indicates that the most substantial technological developments are *likely* to be in the areas of: ICT; sensor/network technology; behavioural and cognitive science; biotechnology; materials; and the production, storage and distribution of energy. Advances in nanotechnologies *will* underpin many breakthroughs. Developments in individual areas are *likely* to be evolutionary, but where disciplines interact, such as in the combination of cognitive science and ICT to produce advanced decision-support tools, developments *may* be revolutionary, resulting in the greatest opportunities for a novel or breakthrough application.

Commercial Imperative. Global economic growth, resource pressure in its widest sense and increasing socio-economic dependency ratios[232] *will* fuel demand; creating opportunities for innovation and investment. Development is increasingly *likely* to be directed towards commercial imperatives. For example, business enterprises accounted for 68% of OECD Research and Development (R&D) expenditure.[233] This aspect *will* drive innovators to identify maximum applications and markets for their discoveries, with interdisciplinary R&D *likely* to lead to the most revolutionary outcomes.

Research and Development. Increasing volumes of R&D *will* take place outside established centres of research, with rapid proliferation and expansion of information and research facilities in developing economies. The academic sector *will* become increasingly transnational as information technologies allow virtual collaborations. This is *likely* to lead to a decline and *possibly* even a reversal in the technological dominance of the West, with China and India poised to become technology leaders in some fields. Intellectual property and commercial exclusivity are *likely* to be under constant pressure from inadvertent disclosure, penetration and espionage. Under these conditions,

---

[232] The UN definition of dependency ratio is the ratio of the sum of the population aged 0-14 and that aged 65+ to the population aged 15-64.
[233] OECD Science, Technology and Industry Scoreboard 2007.

knowledge and innovation *will* become more diffuse and internationalised, accelerating the development process.

Risks and Benefits

Defence and Security – Research and Development. R&D funding can be divided into 3 broad categories: private sector; government non-military; and military. The first of these is much larger than the others and is *likely* to grow. However, it is increasingly *likely* that defence and government budgets *will* be unable to service the totality of the defence and security R&D need; novel approaches[234] to address the shortfall *will* be sought. The development of specific military technologies *will* out of necessity remain largely a government activity. For the remainder, the industrial base *will* be stimulated through 'seed corn' initiatives that promote development of novel technologies. Other avenues that are *likely* to be pursued include forming international, value-adding partnerships in military R&D. These are *likely* to sustain and acquire key enabling technological knowledge and capability, pull through technologies from multiple sources, particularly civil R&D, and harness the capabilities of academia and other civil research institutions. However, even where the civil sector is the dominant driving factor, transforming non-defence technologies into military advantage *may* require significant expenditure in defence R&D.

Unintended Consequences. The accelerating pace of innovation and possible rewards *will* increase the likelihood and frequency of breakthroughs. Any of these *may* result in unintended consequences; some are *likely* to be positive. However, some *may* have catastrophic effects or present potential threats, perhaps through perverse applications, such as the use of genetic engineering to produce designer bio-weapons. The rapid asymmetric insertion and exploitation of extant commercial technologies by adversaries, and the extent to which they can render existing defence capabilities obsolete or ineffective, *will* be of significant concern. The rate of innovation and adoption by society of certain technologies *will* pose significant challenges when compared to the traditional, long-term requirement and acquisition cycles. Conversely, there *may* be political pressure to adopt a precautionary approach, deliberately restraining such development.

Information and Communications Technology. By 2040 it is *likely* that the majority of the global population will find it difficult to 'turn the outside world off'. ICT is *likely* to be so pervasive that people could be permanently connected to local or global networks, with inherent challenges to civil liberties. Even amongst those who make an explicit life-style choice to remain detached, choosing to be disconnected *may* be considered suspicious behaviour. There are a number of socio-economic trends that *will* lead to pervasive ICT including: a widening global economy, greater cultural assimilation and awareness of technology, and a steady reduction in the unit cost of ICT associated goods. The pervasiveness of ICT *will* be enhanced by the advent of more common functionality, supported by global service provision and developments in infrastructure, such as cloud computing.[235] The related trend of convergence *will* be driven by manufacturers trying to

---

[234] Such as open architectures, spiral acquisition and integration, enterprise model and systems engineering.
[235] Cloud computing will transfer information and the processing means to 'the cloud', a dispersed system of internet-based databases, rather than a physical infrastructure 'owned' by the entity performing the processing.

find a competitive advantage over their rivals by merging more functions into a limited range of smaller devices. ICT investment *will* also be driven by new business models that help sustain the insertion of new technologies. Significant changes are *likely* to be observed in applications, mobile devices, and tailored information and interaction modes rather than in infrastructure. Constrained investment in infrastructure *will* be perceived as a factor that stifles innovation in the developed world, but arguably less so in the developing world, which has the potential to 'leap-frog' a generation of fixed infrastructure technologies.

ICT is *likely* to be so pervasive that people, across the globe, can be permanently connected

In addition, there *will* be far-reaching improvements in processing power and data storage[236] resulting from innovations such as spintronics[237] in silicon. Improved architectures enabled by advances in grid computing, photonics and *possibly* quantum computing (which *may* increase processing capabilities by 100 billlion times), are also *likely* to lead to more intensive, diverse and perverse applications. Wearable and implanted wireless ICT is *likely* to become available to all that can afford it.

---

[236] Such as Magneto-resistive Random Access Memory.
[237] Spintronics involves manipulating a property of electrons called spin and its research has enabled ultra dense memory in hard drives. Manipulating electron spin using magnetic fields can switch light being guided through metals used for information processing, including routing infrared light in optical communications or, modified for lower-frequency electromagnetic waves, and processing radio signals in cell phones.

Network Growth. Technological advances, and a greater understanding of social, physical and virtual network behaviour, *will* converge to drive new types of network architecture and applications. These *will* be increasingly accessed by remote and distributed means. Technology applications such as those supporting social networking *will* continue to reconfigure and enable new social models and means of interacting. This *will* raise fundamental issues about privacy, security, legal frameworks and the mechanisms for influence. The rate of growth of hardware development is *unlikely* to reduce before 2020, and software technology *may* fail to keep pace with these advances, contributing to an increasing proportion of major project failures. The growth of many networks is *unlikely* to be governed by top-down planning; such growth is *likely* to occur in a decentralised manner, often analogous to nature. In order to improve effectiveness and reduce vulnerability increased understanding of network topology and nodal behaviour, including people, *will* be required.
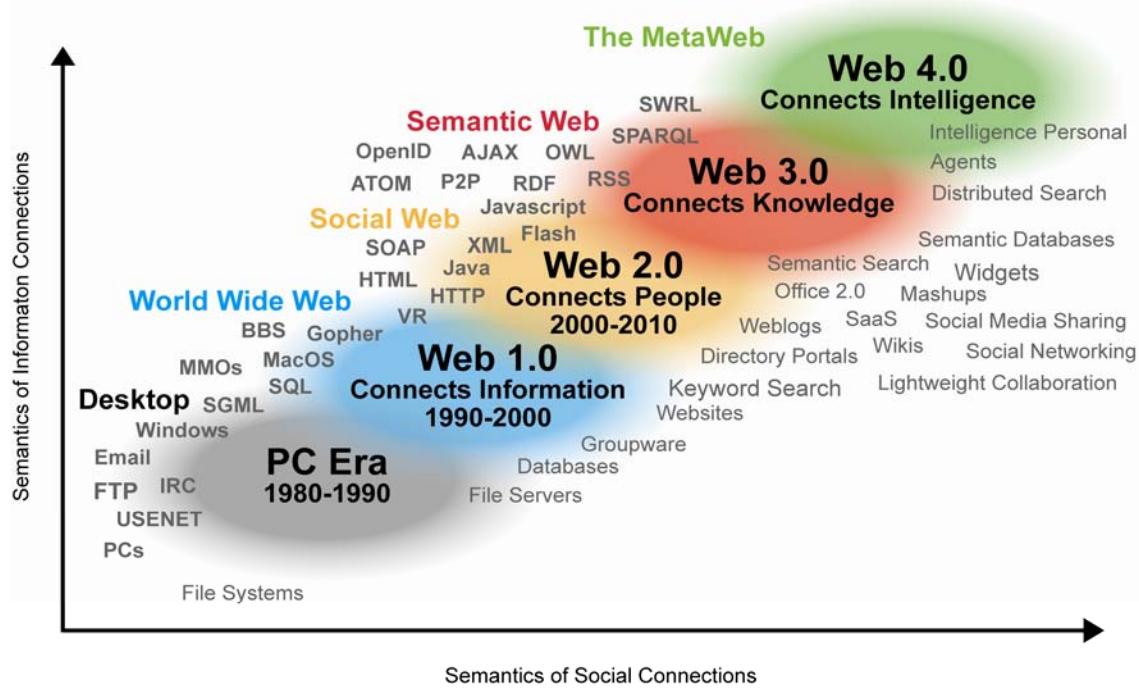
Figure 17 – The MetaWeb[238]

There *will* be changes in network technology driven by: the need to improve end-to-end security; the requirement to support large numbers of Internet-enabled devices; and the ability to directly convert from optical to wireless connectivity. The evolution of ICT devices *will* be driven by their increasingly wide range of applications and rising demand by society. Increased Internet penetration across the globe, particularly in heavily populated areas, *will* influence Internet content and ownership.

---

[238] Radar Networks & Nova Spivack, 2007 at www.radarnetworks.com
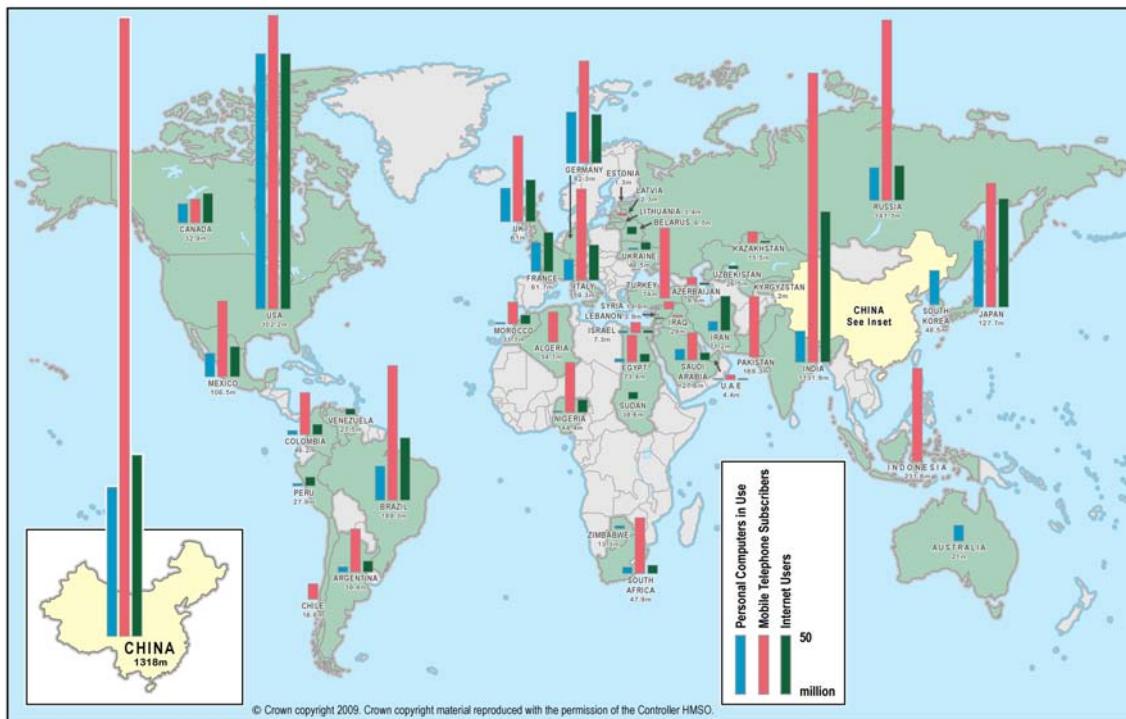
Figure 18 – **Global Internet Penetration**

Advances in Simulation. Advances in social science, behavioural science and mathematical modelling *will* combine, leading to more informed decision making. Advanced processing techniques and computational power *will* permit a more comprehensive level of modelling, potentially enabling more effective pattern recognition. This is *likely* to improve the identification, representation and explanation of systems and processes. As a result, simulation *will* become an increasingly powerful tool to aid policy and decision makers. Simulation *will* also blur the line between virtual and real environments.

Virtual Databases. Networks *will* undergo continual evolution of form not just scale. For example, incremental development of the 'semantic web'[239] *will* occur, enabling machines to recognise, identify, capture, manipulate and interpret data with minimal or no human intervention. The semantic web, and associated technologies, *will* effectively create an integrated data store, with an unprecedented level of access that can be exploited by reasoning techniques to provide more sophisticated forms of analysis. The exploitation of these techniques *may* expose hitherto unseen patterns, interactions and associations, with potentially wide-ranging, unforeseen and unpredictable consequences. Sophisticated data-mining tools *will* include automatic data reduction/filtering along with automated algorithmic analysis to enable faster access to relevant information. Virtual Knowledge Bases *will* store knowledge extracted from traditional documents or messages within large meta-data (database) structures, and in logical formats that intelligent software can interpret. Virtual Knowledge Bases *will* provide: improved searching and alerts to stored

---

[239] The 'semantic web' is the abstract representation of data on the World Wide Web, which makes more of the content able to be processed by computers as opposed to humans. This facilitates more automated assistance and more effective discovery, integration, dissemination and reuse.

information; the ability to answer questions across the whole knowledge store in near natural language form; and automated situation reports on demand and in response to events to enhance situational awareness.

Risks and Benefits

Cryptography. The requirement to maintain high grade cryptographic security *will* be imperative for commercial, defence and security requirements. Potential developments such as 'quantum key distribution' *will* aim to guarantee secure communication between users, preventing and also detecting any information interception attempts. However, the advent of quantum information processing, before the widespread application of quantum encryption, *may* exponentially increase the speed and effectiveness of attacks on data, meta-data[240] structures, networks and underlying infrastructures. Development of algorithms, such as Shor's,[241] *will* break crypto keys with a one-way function, and make public key systems vulnerable to attack, increasing the susceptibility of coded information to be deciphered. Further challenges *will* arise if quantum computing can be realised before 2040; potentially stagnating other developments in either encryption or processing.

Authenticity of Information. The information environment *will* become increasingly crowded, with a proliferation of traditional web-page based sites,[242] instant messaging and voice over Internet Protocol applications,[243] and new forms of social media.[244] Information *will* increasingly be transient in nature, generated and tailored to meet need, provide the context to queries, and interact with cyberspace by these and more advanced mediums. As a consequence it *will* become progressively more difficult to identify sources and validate the information that has been provided. Access to personal data, and its subsequent exploitation, *will* have to be safeguarded with commitments to protect user privacy and control. The majority of new content *will* be 'opinion-based', rather than formed through objective analysis and peer review, and *may* start to alter collective perceptions of truth. The continuing rise of the Internet *will* also give rise to different models for social interaction. Of increasing significance *will* be the ability to create, and support, online grouping by interests rather than by geography. This *will* be enhanced by unlimited contribution, and *may* be unconstrained by societal pressures, such as self-regulation or peer consensus. Combined with the increased timeliness and volume of information, this *will* challenge effective and precise decision-making at all levels. Society *will* increasingly use new media, relying on the Internet, rather than traditional sources such as newspapers. The impact of mobile phone videos posted on the Internet has transformed public confidence, scrutiny and interaction with institutions, forcing official organisations to respond to micro-events perceived to be of disproportionate significance to the public. Empowerment through the use of the Internet is *likely* to increase public demand for transparency and accountability.

---

[240] Meta-data is structured data and describes the characteristics of a data resource.
[241] *Polynomial-Time Algorithms for Prime Factorization and Discrete Logarithms on a Quantum Computer* – Shor, P.W, SIAM Journal on Computing, volume 26, issue 5, 1997.
[242] For example, the number of Internet hosts worldwide grew by a factor of 15 between 1998 and 2008.
[243] Current examples include, Skype, ICQ, and Windows Live Messenger.
[244] Current examples include blogs, wikis, podcasts, photo and music sharing, social networking.

Avatars and e-Identity. The increasing pervasiveness of ICT *will* result in individuals or groups creating multiple personalities and identities for work, financial and social means, for legitimate and illegitimate reasons. The ability to identify people unambiguously in different environments *will* become more complex, having significant implications for tracking extremist groups, organised criminals and terrorists, and making the application of justice, often across national borders, problematic. Trusting the e-identity of other parties in e-transactions needed for secure, successful global commerce *will* be fraught with difficulty.[245]

Behavioural and Cognitive Science. It *will* be more difficult to quantify the direct application of advances in cognitive science than it is in nanotechnology or biotechnology. However, indications are that certain interdisciplinary advances, such as neuro-imaging technologies, *may* make the mapping of brain activity with behaviour more reliable. Modelling techniques are *likely* to become more powerful and increasingly capable of more accurately understanding the complexity of human behaviour and performance at various scales, and over different time constants.
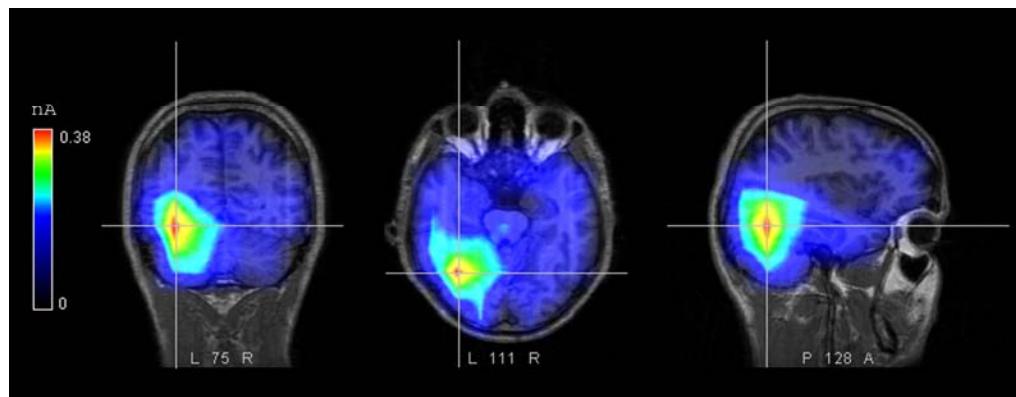
Advances in neuro-imaging *may* make the replication of brain activity more reliable

Understanding and describing such phenomena *may* lead to an ability to 'map the human terrain', linking intelligent socio-technical systems, with experiential learning and other information parameters such as culture and language. Extending cognition via new technologies, potentially through direct, seamless brain-machine interfaces, is *likely* to be facilitated through 'cognitive prostheses' that either augment or enhance vision, language, auditory, learning and memory capabilities. These devices *will* seem like modular 'plug-ins', and at other times, an entire cognitive system. Examples *may* include a 'bionic eye' using an electronic contact lens as a display or a medical sensor, or brain implants with electronic chips to aid memory and restore other cognitive functions. In addition, notwithstanding the potential ethical and legal issues, future drugs *may* be used to enhance the cognitive faculties of people, provide the ability to detect and identify potential intent, and manipulate the cognition senses to install the effects of fatigue or fear.

---

[245] Research is underway to try and resolve this issue using a concept called zero knowledge proofs, Lysyanskaya A, Brown University, *Providence, Security and Privacy*, Institute of Electrical and Electronics, May-June 2007, Volume: 5, Issue: 3, pages 69-71.

Risks and Benefits

Human Behaviour. New imaging technologies that can assess brain structure, function and metabolism *will* revolutionise human behaviour sciences. Understanding the genetic information associated with the development of brain and peripheral nervous systems and known genetic markers *may* assist in describing the human susceptibilities to brain injury, and identifying which pharmacological agents *may* be used to sustain performance. These approaches *may* be used to optimise human performance, and lead to real-time remote monitoring of personnel through mood detectors and sensors. This could minimise psychological and physical imbalances caused by extreme conditions of duress, fatigue, information overload, and the exceeding of an individual's ability, that lead to errors. Although neural signalling agents are *likely* to assist in understanding the brain activity associated with evoking cooperation and trust, they *may* also indicate neurological changes that characterise confrontation.

The Role of Artificial Intelligence. To deliver intelligent machines, further maturation of Artificial Intelligence techniques and technologies *will* be required. However, specific approaches for improving machine intelligence are progressing in the areas of the expression of emotion, language interaction, and face recognition. These *will* be used as interim substitutes before direct machine intelligence is realised. Research *will* seek to map or 'reverse engineer' the human brain, in order to understand the 'software of the human mind'. This work is *likely* to lead to the development of 'neural models' which, combined with other systems, such as sensors, *may* provide more human-like qualities for machine intelligence. The simulation of cognitive processes using Artificial Intelligence is *likely* to be focused, in the short term, on probability and pattern recognition and, in the longer term, to aid knowledge management and support decision-making, with potential diverse applications across government and commerce. Reliance on Artificial Intelligence *will* create new vulnerabilities that are *likely* be exploited by criminals, terrorists or other adversaries.

Personalised Education. Advances in the understanding of human cognition and efforts to measure cognitive potential are *likely* to reshape the educational environment. Screening (genotyping and brain imaging) for cognitive abilities and handicaps *will* enable and shape personalised education, leading to a decline in traditional models, with new emphasis on online, on-demand and automated interactive training and tutoring, where providers of education and training *may* also become the managers of learning.

Visual Analytics.[246] Research on perception and integration of visual motor information *will* lead to virtual reality improvements. Visual Analytics *will* become a full blown 'interaction science' that optimises virtual reality and other environments to fit the constraints of human cognition to optimise the processing of large data sets.

---

[246] The science of analytical reasoning facilitated by interactive visual interfaces.

Biotechnology. Biotechnology encompasses a wide range of issues entailing the biological modification of organisms and non-living materials to develop new properties, which have application in medicine, food science and agriculture, and industrial manufacturing. Developments in biotechnology are *likely* to be swift as indicated by the significant increase in global biotech revenues ($23 billion in 2000 to $50 billion in 2005) and the purchase by large pharmaceutical companies of 'biotech' firms in order to secure the most effective avenues for future drug development. The biotech industry has the potential to resolve resource issues and significantly improve healthcare. However, it is also *likely* to lead to new WMD threats, such as the delivery of lethal pathogens that could be targeted against specific groups. Biomedical developments are *likely* to see a disproportionate number of breakthrough events, similar to those achieved by physics in the 20th century. These developments *will* be driven by evolving challenges in public health, including an ageing population, health care disparities, emerging or re-emerging infectious diseases, and diseases that reflect the pressures of modern societies such as obesity and mental illness. The high initial cost of biotechnology R&D and the large variation in the quality of processing, delivery and distribution networks are *likely* to make the application and benefits of biotechnology uneven. Advances in the understanding and the subsequent manipulation of DNA *will* lead to significant progress in many areas, such as genetic engineering and microbiology. Stem cell and tissue engineering *may* offer novel forms of treatment for missing, damaged or diseased tissue.
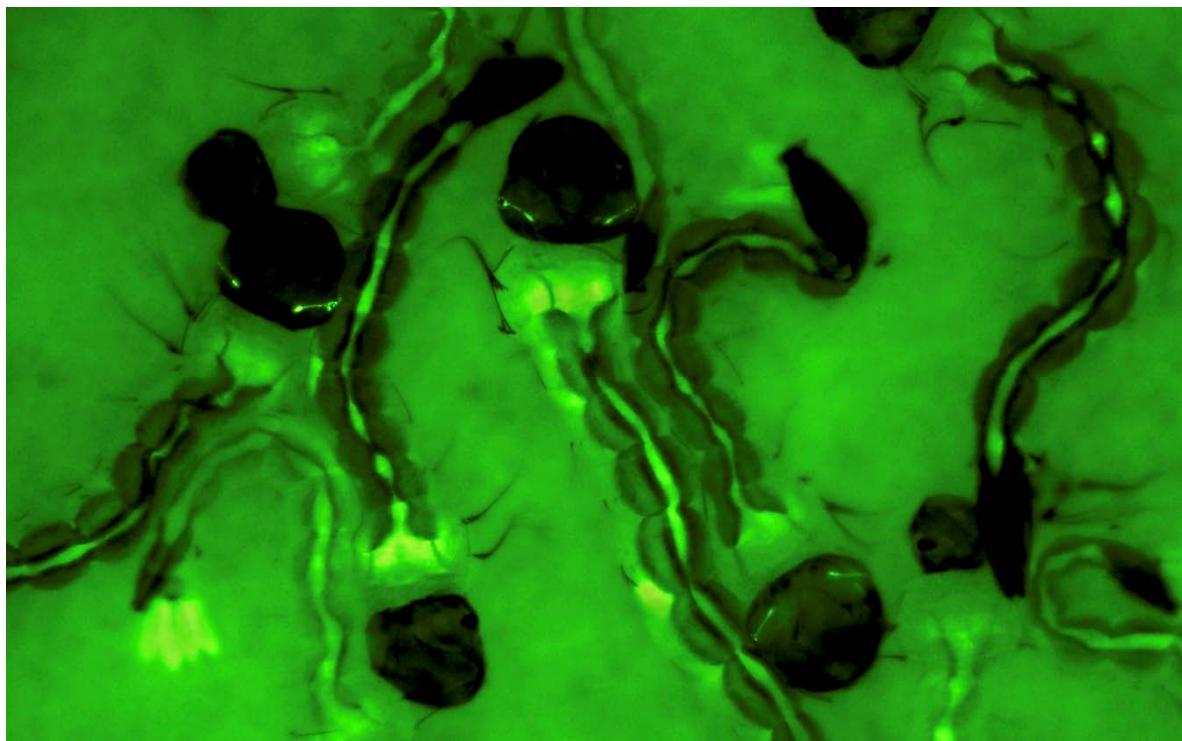
Biomedical advances, such as the genetic modification of mosquito larvae, *will* be driven by evolving challenges in public health

Specific areas of interest *will* be where biology intersects with other sciences (for example biomimetics)[247] *possibly* realising a wide range of diverse applications. These include: the design and manufacture of synthetic biological functions and systems; screening and filtering pathogenic genomes for desirable gene attributes; and the personalised delivery of medicine using pharmacogenomics.[248] Other developments *will* offer the ability to engineer specific cells and bacteria. Human genome mapping has led to research in gene manipulation which *may* eliminate hereditary diseases and birth defects. Prediction and screening for conditions *may* be accurately performed before symptoms become apparent. The costs and time-cycle for DNA system design, sequencing and synthesis *will* continue to reduce, with significant reduction in design-to-synthesis timescales. Biotechnology also has the potential to increase food production by improving yield, resilience, quality and nutritional value. Genetic modification *will* be used to produce healthier foodstuffs. For example, 'golden rice' containing fortified Vitamin A is already available in Africa and South East Asia.

Risks and Benefits

Life Extension. An increase in human life span is *likely* to occur through the better control or eradication of degenerative diseases and cancer, precisely customised drugs, gene therapy and the mitigation of ageing (and *possibly* even reversal of ageing characteristics). While increasing life span is *likely* to be a global phenomenon, disparities *will* remain according to socio-economic status, race and geography. The Western world *will* maintain an advantage through better medical and health care, sanitation, diet and quality of life. Projected quality of life *will* also improve through the use of regenerative medicine, tissue engineering, 'bio-gerontechnology',[249] bionic implants, memory enhancing drugs, increased use of animal transplants or human organ cloning, and the development of artificial sensors capable of interfacing with the human mind. The sequencing and reading of the human genome is *likely* to lead to medical advancements and preventative treatments. Delaying the onset of biological ageing *may* lead to improved knowledge retention, particularly with those seeking to delay retirement from employment. However, the consequences of increased longevity *will* put huge demands on resources, including the provision of social care and pensions, medical care, food and employment. The development of medical prostheses, and biological autonomic tools, such as artificial immune systems, *may* augment and enhance human physical capabilities, while reducing stress and fatigue. Biomechanical and electronic systems, such as exoskeletons, *will* be closely integrated to individual user interface devices to gain effective use. Such augmentation capabilities *will* house wearable sensors, coupled with actuators to monitor and respond to limb movements. This provides the wearer with increased strength, endurance and dexterity. Use, and distribution, of these developments *will* raise significant ethical issues in some parts of the world.

---

[247] Biomimetics is the concept of taking ideas from nature and implementing them in another technology, such as engineering, design or computing.
[248] The branch of pharmacology which deals with the influence of genetic variation on drug response in patients.
[249] Related technologies that offer the means to accomplish control and improvement in the human condition, and improvements in lifespan.

Proliferation. The ready availability of biotechnology-related equipment and precursor materials, with associated decreasing costs, *will* create new dual-use purposes that lower entry barriers for everyone, including those intending deliberate misuse. Potential exploitation and effective weaponisation by individuals, groups, or states *may* allow the design and insertion of new and highly virulent biological-weapons and synthetic agents, using novel delivery systems, to target humans, materials or crops. Focus *may* be directed towards: the misuse of naturally occurring pathogens; exploiting mature bio-processing technologies; rendering vaccines ineffective; and enabling the evasion of diagnostic and detection modalities. The wide availability and increased pace of DNA sequencing technology, coupled with the greater knowledge of pathogenic genomes, *will* enable the development of lethal pathogens that are resistant to a wide spectrum of antibiotic and antiviral therapies. As the technologies become widely used and accessible, the manipulation of genomes *will* require less specialist scientific knowledge. The incidence of ethical, cultural, religious or legal controls and constraints is *likely* to be uneven, offering those with less regulatory constraints a potentially asymmetric advantage.

Advances in Material Science. The design and manufacture of materials at the molecular level *will* result in 'designer' materials, with in-built capabilities to sense and modify their behaviour or functionality, introducing a new manufacturing paradigm. Most advances are *likely* to occur where material science combines with, or adopts, principles employed with other innovative disciplines including electronics, nanotechnology and biology. Smart materials,[250] such as shape-changing memory alloys, that sense and respond both to their control systems and operating environment, *will* have wide applications, for example in jet-engine noise reduction. These materials *will* also possess the ability to indicate the need for, and potentially undertake, self-repair or maintenance. The developments in nanotechnology are *likely* to lead to: improved resistance to extreme pressure and temperature; greater elasticity, without loss of toughness; and step changes in tensile strength, already evident in the development of carbon nano-tubes. There *will* be increased opportunities for biologically developed smart materials. Smart nano-materials *will* facilitate the development of textiles that detect biotoxins, such as microbial cross-infections, in the environment, and protect the wearer against infection. 'Meta-materials' *will* have significant impact on stealth and countermeasures, providing opportunities to manipulate visible light, and utility in sensors. More efficient batteries, as well as energy-saving materials and devices, *will* be manufactured using smart materials. They *will* transform the construction, maintenance and performance of infrastructure, machinery and transport, making equipment lighter and more enduring. The production of new materials *will* be possible by processing under the extremes of temperature and pressure, under which conditions inert atoms or molecules *may* combine to change their structure and properties. New materials *will* also enable exploration into increasingly hostile and inaccessible environments including: the exploration of space; deep underground; deep underwater; and heavily contaminated environments. Their use *may* help to deliver breakthrough events.

---

[250] Materials in which certain properties (structural, thermal, optical etc) can be significantly altered in a controlled manner by external stimuli or environment.

New Energy Technology. New sources of power generation *will* become commercially available and viable before 2040. Out to 2020, while advances *may* be evolutionary rather than revolutionary, the efficient use and management of power *will* increasingly be a key driver, particularly for the design of new devices. Hybridisation, along with fuel additives and smart design, *will* improve the energy efficiency of engines. Smart, conformal designs for low-power systems for efficient charge recovery, and the use of power scavenging techniques, *will* be examples of potential innovation. For short periods of operation, batteries are *likely* to remain the preferred power source; however, as energy demands increase, improved fuel cells adapted to suit the operating environment *may* become the preferred option for longer operations. Nonetheless, demand for traditional lithium-ion type batteries, *will* increase due to an increased uptake of hybrid and electric vehicles.

Other developments in battery technology *will* see advances in lithium-ion batteries or super-capacitors and emerging batteries based on new chemistries such as carbon, aluminium, zinc with air, and lithium-sulphur. Developments *will* also include the use of alternative cathode and anode materials such as lithium-iron phosphate and lithium-titanate, promoting safer use by avoiding the failure mechanisms of traditional lithium-ion batteries, while providing cost effective alternatives. The requirement for the power network to connect billions of devices, and operate reliably, *may* see the use of 'smart power grids' for effective electricity distribution. The grid *will* be flexible, accommodating distributed power generation from renewable sources and energy-efficient techniques. However, there *may* be a slow adoption of these technologies by utility firms until the technologies become mature and reliable. Bio-fuels *will* increase in importance, although initially they *may* be constrained by the perceived impact on the energy balance, environmental footprint, food supply, and changing lifestyles and diets. Other issues to be resolved *will* include the longevity of bio-fuels and legacy issues of compatibility with existing equipment, though this is *likely* to be addressed by future generations of bio-fuels.

Synthetic fuels from alternative hydrocarbon sources *will* become increasingly important and *may* contribute to the energy security of some nations. Solar power *will* become more efficient, less expensive, and more widely used. Harnessing solar energy from space *will* gain increasing attention, although this source faces several major challenges including: transferring power efficiently to the surface; infrastructure costs; and the potential to initiate confrontation in space. There is *likely* to be a strong market for smaller, more efficient autonomous power supplies, which is *likely* to lead to accelerated research in ethanol, methanol, hydrogen and radical fuel cell options. The future of hydrogen and fuel cell vehicles *will* largely depend on developments in the availability and capability of hydrogen infrastructure and storage systems. Although there *will* be renewed interest in power beaming, including the resonant magnetic field approach to reduce losses, the challenges of range, efficiency and safety *will* need to be overcome.

Solar power *will* become more efficient, less expensive and more widely used, including via new technology such as this solar updraft tower

Nanotechnology. Nanotechnology focuses on manipulating matter at the atomic and molecular scale, generally at less than 100 nanometres in size. At this size, and using other scientific disciplines, the characteristics of matter can be changed. This *will* create new and unique properties with profound and diverse applications. Advances in nanotechnology, at the interdisciplinary frontier where physics, chemistry and biology meet, *will* be a key enabler of technological advance, involving: new additives and coatings; materials and sensor development; and medical treatments and heath diagnosis. Products *will* be smaller and more energy efficient. They *will* be designed and manufactured with atomic precision and less production waste. Out to 2020, defence applications, in convergence with other disciplines, are *likely* to be predominantly in sensors, electro-optics and materials, including biologically active agents and surface-engineered materials. Additionally, integrated nano-devices *will* lead to the emergence of small, swarmed and autonomous systems. The application of nanotechnologies, whether through materials or devices, *will* become pervasive and diverse, particularly in manufacturing (strong lightweight materials for transportation applications), synthetic reproduction, novel power (battery) sources and health care (targeted drug delivery and augmented medical treatments).

Risks and Benefits

Nanotechnology Side-Effects. Nanotechnology applications *will* raise concerns over potential health effects and environmental impact.[251] Subsequent action *may* lead to tracking and regulating the diversity of applications and products[252] as well as the impact on the dynamics of development, especially in the domain of life sciences. Developments in nano-scale delivery systems, capable of specific targeting and crossing biological barriers, *may* lead to an enhanced risk of misuse. Nanotechnology *may* also provide the physical and chemical means to produce or have ready access to miniaturised undetectable materials to conceal or protect the degradation of dangerous biological-chemical agents; this raises serious issues over proliferation and detection of these materials.

Autonomous Systems and Robotics. As the information revolution continues, there *will* be a pervasive and dramatic growth in the role of unmanned, autonomous and intelligent systems. These systems *will* range in size from meshes of small sensors and personalised robots, which replicate human behaviour and appearance, to a cooperative plethora of intelligent networks or swarms of environmental-based platforms, with the power to act without human authorisation and direction. Systems *will* exhibit a range of autonomy levels from fully autonomous to significantly automated and self-coordinating, while still under high-level human command. Systems *may* have human-like mobility and user interfaces to act as assistants, while other designs *may* consist of collaborative networks of smart sensors, weapon systems or transportation platforms, treated as smart tools. Developments *will* be enabled by advancements in: miniaturisation; low cost and high performance computation; novel and efficient power sources; sensors; sense-making and communications. As systems and platforms become smarter, the interaction between automated and human components within the wider system *will* pose significant challenges, bound only by legal and operating barriers. For example, humans *will* be increasingly challenged by the complexity of controlling multiple autonomous systems and interpretation of the associated information. As the pace of technological change increases and the difficulties of fusing several technologies are overcome, humans unable to cope *may* become redundant and be replaced by intelligent machines, or upgraded through technology augmentation.

Risks and Benefits

Public Perception. Continuing public aversion in the developed world to military casualties, *will* spur the further development of autonomous systems for a variety of dull, dirty and dangerous tasks. However, the perception that autonomous systems could cause harm to civilians and civilian property, as a result of system malfunction for instance, is *possible*.

---

[251] Massachusetts Institute of Technology (MIT) Review. Royal Commission on Environmental Pollution, *Novel Materials in the Environment: The Case of Nanotechnology*, November 2008.
[252] Congressional Research Service, *Nanotechnology and US Competitiveness*, 15 May 2008.

Societal Impact. Autonomous systems, in particular robots, *may* enable and support independent living for the ageing population, using machines to mitigate human weaknesses, particularly in rehabilitation, but also exploiting human strengths. Robots *will* provide increasing competitiveness in manufacturing, and are *likely* to play a key role in our homes and lives. Though quality of life *may* improve, reduced dependency on both large professional and low skilled human labour workforces *may* result in other societal pressures. Human-like sentient and servile companions *may* be more acceptable than conventional mechanical types that provide specific functions. Design *will* be further driven by the extension of human instincts, interests and skills. Humanoid robots *may* also carry out child-minding activities; studies have shown children to be highly responsive to robots, creating interest and curiosity, with close bonding and attachment, treating them as friends rather than as toys.[253,254] These robots *will* have enhanced human-machine interactions, controlled by remote care-givers. Reservation towards robots *may* be more easily overcome by the younger generation growing-up in a highly technological world and accustomed to such technologies.

Education and Training. Intelligent tutoring systems and avatars *may* be developed to interactively aid teaching students, particularly those with learning difficulties. They *may* have the ability to understand when pupils are confused, then focus and tailor material for personalised individual learning.

Ethical and Regulatory Practices. In the Laws of Armed Conflict (LOAC), the lawfulness of an attack on a military objective must be kept under review during the planning stage and execution phase; attacks are cancelled or suspended where it is realised that a target is not a military objective, or that disproportionate collateral damage will result. While the desire to minimise military casualties *will* spur the further development of autonomous systems for a variety of tasks, involving risk to human life, the extent to which autonomous systems can meet the requirements of the LOAC *will* determine how widespread their use would become. While technology matures quickly and brings innovation, LOAC principles and specific weapons' laws *will* evolve more slowly. However, certain established legal principles, such as the prohibition of weapons that cause superfluous injury or unnecessary suffering, *will* remain extant and are *likely* to influence their development.

At the tactical level, rules of engagement *will* adapt to take account of autonomous capabilities and, in some circumstances, are *likely* to limit their utilisation. However, the delivery of lethal effect by armed autonomous systems *will* raise ethical, as well as legal, difficulties, and a code of ethics is *likely* to develop.[255] While technology does not reduce accountability, proliferation *will* make autonomous systems available to various state and non-state actors who *will* resist, or ignore, legal or ethical restrictions, creating a multi-tier application of moral and regulatory practices.

[253] Sharkey N, *Ethical Frontiers of Robotics*, Science: Volume 322, no 5909, pages 1800-1801, 19 December 2008.
[254] Tanaka F, Cicourel A, Movellan J.R, *Socialization Between Toddlers and Robots at an Early Childhood Education Center, Proceedings of the National Academy of Science*, Volume ,194, number 46, 2007.
[255] More detail available at http://thics.calpoly.edu/ONR_report.pdf

Hot Topic – Cyberspace

From a national defence perspective, a number of underlying themes emerge. Offensive cyberspace capabilities *will* be used to penetrate and attack electronic-rich systems, networks and infrastructure. Recognition of malign intent and attribution *will* often be difficult. As civilian and military environments become increasingly dependent on integrated networks, and with space-based assets exclusively relying on the electromagnetic spectrum to receive or transmit data, the impact of cyber-attacks is *likely* to range from incremental to catastrophic.

Although people *will* remain the focus of the information domain, whether perception or reality, the degree of control *will* fluctuate. Central to the effective manipulation and management of the cyber domain *will* be control of the technological development and the mental capacity to understand how best to use the derived data. The complex interactions between cyberspace and ICT *will* be tightly coupled and vulnerable to attack. This *may* lead to cascading failure and emergent behaviours requiring mitigation through resilient design or the graceful degradation of systems when under stress or attack.

There *will* be novel threats. Some actors *will* identify the cyber vulnerability of potential adversaries and recognise that exploiting such vulnerabilities in times of conflict is less expensive than conventional warfare, and more difficult to detect, attribute and prove. Conversely, the technological leap made by developing states, for example moving to wireless networks, also renders them more vulnerable to cyber-attack than legacy fixed infrastructure. Examples of the use of cyber-technologies to influence strategic and tactical outcomes have been seen in Estonia and Georgia. Extensive 'denial of service' attacks contributed to both the military and economic pressures on the target government. While no state acknowledged itself as the perpetrator, such attacks as part of a unitary approach to conflict *will* become routine.

The incidents of cyber-espionage, cyber-terrorism and cyber-criminality *will* increase, especially across distributed virtual communities, raising ethical dilemmas. Protection of cyber assets *will* extend into active defence of civilian logistics and other supporting contractor organisations. Civilian and military information infrastructures, national and coalition, *will* co-exist and superimpose with ever-changing boundaries. This *will* require constant refreshing, posing major and novel problems for security. Defending and ensuring continuity of such interdependent systems *will* require trusted government and industrial partnerships, and the adoption of new approaches to ethical and technological cyber-management. Information infrastructure personnel *will* require a significantly different approach from physical infrastructure protection teams.

At the international level, the few existing laws concerning control of cyberspace *will* be reviewed, but national interests concerning the military use of cyberspace *will* delay progress towards agreement. The security and intelligence consequences *will* continue to be debated within the legal frameworks. However, their interpretations *will* often lag

behind technology uptake and emerging forms of social and criminal behaviour. Conversely, it is *likely* that the role of organisations such as the International Telecommunication Union and the UN Internet Governance Forum *will* increase in relation to policing standards, dealing with intellectual property rights issues, and imposing regulations.

In the military context, the vast quantities of sensor data (which such systems *will* be able to process at up to one billion MIPS)[256] have the potential to provide a more comprehensive view of the battlespace. Such processing power *may* also be deployed to provide a rapid and more extensively modelled set of alternative courses of action. These *will* be available on demand, in near-real-time, across a grid services architecture.[257] Core technologies that enable such architectures are *likely* to be widely available. Open source information and intelligence collection, coupled with increased capacity of commercial-off-the-shelf[258] technology and data-mining, *will* provide opportunities for global technological parity. Such parity *may* shift the balance of commercial advantage, raise the spectre of privacy concerns, and potentially aid targeting by terrorist groups and adversaries.

By 2040 the evolution of 'non-human like' intelligence[259] in cyber-technologies *will* introduce radically different computational processes. Coupled with convergence of potential breakthrough fields such as quantum-, nano-, bio- and human sciences, application of non-human-like Intelligence to the cyber battlespace *will* potentially result in disruptive technologies.

Civilian and military information infrastructures *will* co-exist and superimpose with ever changing boundaries

---

[256] MIPS: million instructions per second is a general measure of computing performance and, by implication, the amount of work a larger computer can do.
[257] The Open Grid Services Architecture describes an architecture for a service-oriented grid computing environment for business and scientific use, developed within the Global Grid Forum.
[258] Commercial off-the-shelf (COTS) is a term for software or hardware, generally technology or computer products, that are ready-made and available for sale, lease, or license to the general public.
[259] Non-human-like intelligence may be able to model complex systems such as climate in far greater detail than at present.

Hot Topic – Space

Space divides into 3 communities of users: civil space, commercial space and security space. Much of the hardware is shared and the space launch industry supports all sectors, often simultaneously. Civil space encompasses pure science, such as astronomy, scientific applications, such as climate monitoring, and most manned space flight. The majority of commercial users provide services to terrestrial consumers through Satellite Communications (SATCOM), including broadcasting and satellite-based information systems, predominantly Position, Navigation and Timing (PNT) information. Security space incorporates military uses of PNT and SATCOM, state surveillance capabilities and uniquely military applications, such as nuclear detonation detection and missile launch warning. Space Situational Awareness (SSA), once principally the concern of security space users, is gaining importance in commercial space, as orbits become crowded and debris threat levels increase.

Civil space activity is often a source of national prestige and is characterised by international cooperation. Both aspects *will* continue, though as ambitions increase in areas such as inter-planetary exploration, cooperation *will* probably intensify. Developing nations *will* continue to enter the civil space arena, with assistance from established players providing a conduit for major power influence. Manned exploration of the Moon is *likely* to resume and *may* extend to Mars. The space tourism sector is developing and *will* continue to do so. Any discovery of life beyond Earth would be a strategic shock with significant cultural repercussions.

The commercial space sector *will* continue to grow. Some players levy small charges on mass-market end-users, such as SATCOM customers and broadcast recipients, while others provide bespoke services, such as specialist imagery, to a much smaller number of users. There *will* be a growing awareness of the extent of dependency on space capability for daily existence, though the continuing incorporation of space-dependent components, and systems within consumer products *will* make dependency and resilience hard to characterise. Growing analysis by states to ascertain their dependence on space is *likely* to mitigate the more obvious vulnerabilities by, for example, insisting on back-up systems for critical utilities. Commercial pressures, from insurers and others directly exposed to risk, are *likely* to lead to increased commercial investment in SSA, *possibly* in conjunction with national and international authorities and agencies.

Emerging and rising powers *may* make their first foray into space in the commercial or civil sectors, but the attractions of exploiting security space *will* endure. Non-state and irregular actors *will* seek to emulate this by unconventional means, such as adapting commercial capability and seeking to mitigate the advantages conferred by security space on states. The emphasis on expeditionary capability *will* perpetuate dependence on space capability, particularly for surveillance and communication. Justifiable aversion to collateral effects *will* also underpin enduring emphasis on precision and discrimination, which is dependent on space-based PNT. By 2040 this area *may* be more amenable to non-space-based solutions.

More prolific use of orbital space *will* increase the density of uncontrolled material. Space debris *will* present an increased risk to the integrity of existing systems and services through collision or other forms of interference. Active management *will* be required to avoid collisions, as happened between US and Russian satellites in 2009. While a catastrophic 'domino effect', of successive collisions is *unlikely*, certain orbits *may* become unusable without significant levels of investment and international political and commercial collaboration.

Widespread weaponisation of space by 2040 is *possible*. Primitive systems such as high-altitude nuclear detonation to counter systems in low-earth orbit are already technically feasible, and more sophisticated systems are under development. The introduction of space-based weapons, capable of striking targets both in orbit and on the ground, *will* be technically feasible, although political and treaty constraints are *likely* to limit their deployment. The surveillance, intelligence and communication capabilities of space-based utilities are *likely* to represent a critical vulnerability for technologically advanced states and their militaries. Advances in novel weapons technology and the spread of conventional technologies *will* result in widespread capability to deny, disrupt and destroy satellites in low-earth orbit. However, for the majority of actors, relative fragility of other aspects of an integrated space capability, such as the ground segment and radio frequency communications with satellites, are *likely* to offer more attractive avenues to negate hostile space capability.

Exploitation of space for security purposes will endure

Hot Topic – Ballistic Missile Defence

Ballistic missiles have been a feature of combat since the closing days of World War II. Their rapidly improved range and accuracy were driven by the Cold War imperative to deliver strategic nuclear payloads, while robust, portable, shorter-range systems served to give commanders a range of tactical options. Early attempts to counter strategic missiles by developing credible ballistic missile defence (BMD) systems were seen as inherently destabilising, since an asymmetric, comprehensive system would have amounted to a second-strike capability. Consequently BMD systems were constrained by treaty arrangements.

Over 5,000 missiles with ranges from tens of kilometres to several thousand kilometres are now distributed across more than 20 countries. Concerns regarding missile proliferation have prompted a re-evaluation of treaty constraints. Ballistic missile proliferation is *likely* to continue through indigenous development of missile technology by technically adept emerging powers, and the import and local adaptation of systems procured through international markets. Although inter-continental systems *will* remain the preserve of states, short-range tactical systems are *likely* to be acquired by some irregular combatants. There is *likely* to be a correlation between inter-continental systems and possession of nuclear payloads, given the expense and complexity of such systems. Established nuclear powers *may* exploit the increasing accuracy of missile technology to adapt long-range nuclear systems to carry conventional payloads. In the tactical domain, however, similar systems *may* be employed to deliver conventional and a variety of CBRN payloads. The existence of indistinguishable nuclear and conventional variants is *likely* to cause misunderstandings.

Counters to tactical and theatre systems are based on development of legacy surface-to-air missiles (SAMs) designed to attack air breathing systems, for example, the use of the Patriot SAMs to counter SCUD missiles during the first Gulf War in 1991. These systems *will* be supplanted by dedicated missile defence variants fielded by major powers. The proliferation of modern SAMs, enhanced by indigenous modification, *may* yield a credible BMD capability for emerging powers. This *may* extend even to irregular combatants, though the level of protection offered is *unlikely* to be comprehensive.

Active BMD, the interception of missiles in flight, is one way in which the threat from ballistic missiles can be countered; however, others include: arms control treaties, embargos to prevent proliferation, deterrence, counterforce, passive defence and collective protection. Nonetheless, the development of strategic BMD systems is *likely* to continue along multiple technical tracks by the major powers. The various technical lines of development, such as airborne lasers, space-based DEW or developed SAM systems all have potential to succeed. International cooperation *may* allow deployment to contain emerging missile-capable states, *possibly* under some 'dual-key' or shared basis. Depending on the scale of the threat to be countered, it is *possible* that a combination of systems is required to achieve the required level of protection. An over-arching battle management, command, control, computing and intelligence infrastructure is essential to maximise the effectiveness of the BMD engagement; additionally, this will link early warning sensors and weapons systems together.

Hot Topic – Novel Weapons

Out to 2040, the development and deployment of novel weapons is *likely* to become widespread. There is *likely* to be continuing demand for weapon systems to be tailored and adaptable, offering variable yields, detonation characteristics, degrees of precision coverage and reduced logistic burden. They *will* need the ability to defeat national strategic assets, infrastructure and forces in well-prepared defensive positions. This *will* often be in difficult terrain, such as the urban environment.

Directed Energy Weapons (DEW) *will* be capable of discrete target discrimination, producing a strike beam or field of electromagnetic energy, acoustic energy or atomic scale particles to cause disruptive or damaging effects, at near instantaneous speeds, to equipment, infrastructure or personnel. They *will* have widespread employment including: hand emplaced 'suitcase' devices; and ground, sea and air-based systems, with applications that include engine disablement and infrastructure attack. Although most applications *will* be anti-materiel, and particularly effective against systems dependent on optics or electronics, there *will* be developments in anti-personnel concepts, using radiation to direct thermal energy to the skin of an adversary, or employ optical or acoustic effects to cause behavioural change. Anti-materiel DEW *will* have to be carefully evaluated at the early stages of procurement to ensure their effects are discriminate; they *will* need to be capable of being directed towards the chosen military objective without causing disproportionate collateral damage to civilians or civilian objects.

Radio Frequency DEW (RF-DEW) systems *will* be in general service across the battlespace. As this becomes increasingly 'digitised', the need to protect vulnerable electronic systems and networks *will* be important. Devices and platforms *will* need to be hardened against these DEW threats, as part of a suite of electromagnetic environment protection measures. RF-DEW systems *will* be designed to incapacitate and repel personnel, with a low probability of fatality and permanent injury. Alternatively, they could disable equipment, with minimal collateral damage. Systems *will* exploit the susceptibilities of electronic-rich targets to non-ionising radiation. This capability is *likely* to be delivered from stand-off platforms, with the effect ranging from temporary to persistent disruption, or even permanent damage. Expected advances by the civil sector *will* see a significant reduction in the size and weight of these systems. Furthermore, developments in solid-state switching technologies are *likely* to enable cooperative engagement by a swarm of small RF-DEW systems.

Laser DEW *will* also deliver a range of effects on sensors, including: electro-optical countermeasures, for example temporary dazzle or disruption; or permanent sensor damage, lethal effect or physical destruction. Initially the size, weight and cost of systems *will* increase with the power of the laser source. However, as the efficiency of high power lasers increase, reductions *will* be observed, allowing a wide range of delivery platforms exploiting such systems.

Novel energetic materials technology utilises high-energy density materials, such as molecular composites, nano-structured systems and meta-stable compounds such as poly-nitrogen, to deliver performances many times that of current high explosives. Enhanced blast weapons differ from traditional fragmenting munitions, in that they seek to

incapacitate through maximising blast performance with reduced fragment damage. Warheads will be able to deliver a range of attack modes. They will be capable of delivering improved performance in the warhead and propulsion system, at a smaller size, thereby reducing the overall logistics burden. Some nations already have the ability to field an array of enhanced blast weapons, ranging from hand-held systems through bespoke indirect fire platforms, to large air delivered munitions. As enhanced blast weapons become more prolific on the battlefield they will have significant implications for future tactical doctrine; their employment will need to remain within the confines of LOAC, and will lead to advances in the design and use of counter-protection.

Environmental warfare will be capable of exploiting the delivery and spread of plant and human pathogens through the release of remote controlled insect-machine hybrids or insects, in order to cause physical, and subsequently, financial damage. Such methods may be used as incapacitants or as lethal pathogens to attack humans. It will provide the means for states or their proxies and terrorist groups to exert power.

Weather modification will continue to be explored. The aims are to obtain more water, reduce hail damage, eliminate fog, or other similar practical result in response to a recognised need. Manipulation of the weather may affect changes in operating conditions, limit aviation flight envelopes, generate poor visibility while providing concealment and disrupt lines of communications. Weather modification may also affect morale. Analysis by the World Meteorological Organisation (WMO) has shown that, if successful, rainfall enhancement and hail suppression operations could have significant economic benefit. The WMO Atmospheric Research and Environment Programme notes that there are several operational programmes in fog dispersion, rain and snow enhancement, as well as hail suppression.

Glossary

ASEAN	Association of Southeast Asian Nations
BMD	Ballistic Missile Defence
BTC	Baku-Tbilisi-Ceyhan
BRICs	Brazil, Russia, India and China
CBRN	Chemical, Biological, Radiological, and Nuclear
CIA	Central Intelligence Agency
CIDCM	Centre for International Development and Conflict Management
COTS	Commercial Off The Shelf
CNO	Computer Network Operations
DEW	Directed Energy Weapons
DRC	Democratic Republic of Congo
EDSP	European Security and Defence Policy
EEZ	Exclusive Economic Zone
EMS	Electro-Magnetic Spectrum
EU	European Union
G7, G20, G8	Group of 7, (20), 8 Industrialised Nations
GDP	Gross Domestic Product
IAEA	International Atomic Energy Agency
IBSA	India-Brazil-South Africa
ICT	Information and Communications Technology
IDP	Internally Displaced Persons
IED	Improvised Explosive Device
IISS	International Institute of Strategic Studies
IMF	International Monetary Fund
IP	International Protocol
LOAC	Laws of Armed Conflict
MIPS	Million Instructions per Second
MNC	Multi-National Corporation
NATO	North Atlantic Treaty Organization
NEC	Network Enabled Capability
NGO	Non-Governmental Organisation
NOCs	National Oil Companies
OECD	Organisation for Economic Co-operation and Development
OPEC	Organisation of Petroleum Exporting Countries

PMSC	Private Military Security Company
PNT	Position, Navigation and Timing
R&D	Research and Development
RMA	Revolution in Military Affairs
SAM	Surface to Air Missile
SATCOM	Satellite Communications
SWF	Sovereign Wealth Fund
SSA	Space Situational Awareness
UNASUR	Union of South American Nations
UNCLOS	United Nations' Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNESCO	United Nations' Educational Social and Cultural Organisation
UNHCR	United Nations' High Commission for Refugees
UNSC	United Nations' Security Council
WEU	Western European Union
WHO	World Health Organisation
WMD	Weapons of Mass Destruction
WTO	World Trade Organisation

Index

Sources & Acknowledgements

Wide external consultation and review has been conducted to ensure Global Strategic Trends is both comprehensive and independent in its view of the future. In order to avoid analysing trends from a purely Western standpoint the judgments contained in Global Strategic Trends have been tested against international and non-Western perspectives; analysis and workshops have been conducted in the UK, South Africa, India and Japan. The extensive assistance and advice received in developing this edition is greatly appreciated. DCDC would like to acknowledge the following organisations for the support they have provided:

UK Government Departments

The Department for International Development, The Foreign and Commonwealth Office, The Home Office, The Cabinet Office, The Department of Energy and Climate Change, The Department for Business Innovation and Skills, The Office of Security and Counter Terrorism, Department of the Environment, Farming and Rural Affairs, The Foresight Horizon Scanning Centre, The Hadley Centre for Climate Prediction and Research, Defence Science & Technology Laboratory, Defence Scientific Advisory Council, Serious Organised Crime Agency, British High Commission New Delhi, British Embassy Pretoria, Wilton Park, FUSION, The Defence Academy, British Embassy Tokyo.

UK Research Organisations

Chatham House, RAND (Europe), Royal United Services Institute, International Institute for Strategic Studies, The Economic and Social Research Council, National Environmental Research Council, Shell International, British Geological Survey, EDF Energy, Goldman Sachs, Mackinder Forum, Policy Exchange, Centre for International Peace Building, International Association of Oil and Gas Producers, Wellcome Trust, Sanger Institute, CBI, Oxford Research Group.

UK Academic Institutions

Universities of: Cambridge, Oxford, West of England, Exeter, Aberystwyth, Lancaster, St Andrews, Reading, KCL, SOAS, Nottingham, Salford, Cardiff, East Anglia, Sussex, The Open University, Durham, Bristol, Queen Mary's London, Scottish Association for Marine Science, London Institute of Commonwealth Studies.

International Organisations

The Indian Institute for Defence and Security Analyses, Indian Peace and Conflict Studies, Indian United Services Institute, US Joint Forces Command Futures Group, National Intelligence Council, Defence Research and Development Canada, Norwegian Institute for Defence Studies, Asian Forum Japan, Hitachi, Netherlands Ministry of Foreign Affairs, Directorate of Strategic Affairs (Paris), South African Defence Forces, Japanese Ministry of Defence, Japanese National Institute for Defence Studies, Keio University (Japan), Jawaharlal Nehru University (India), Sea Power Centre (Australia), Office of National Assessments (Australia), SWP (Germany).

Global Strategic Trends Contact Details

The DCDC Global Strategic Trends Team can be contacted at:

DCDC, MOD, Shrivenham, SWINDON, Wiltshire, United Kingdom, SN6 8RF

Tel +44 (0)1793 314352

Or Via E-mail at:

dcdc-strategictrends@mod.uk

Alternatively, the publication is available on the MOD Internet site at:

http://www.mod.uk/defenceInternet/microsite/dcdc/

Notes:

Feedback for Global Strategic Trends – Out to 2040

This is the Fourth Edition of Global Strategic Trends and looks out to 2040. The trends and outcomes highlighted throughout the document are evidence based and are the result of discussion, analysis, assumptions and judgements. The team at DCDC would welcome your feedback on any of the judgements or evidence contained within the document. If you would like to comment please fill out the attached questionnaire and return it to the postal address provided on the Contact Details page. Alternatively you can fill in the form online at: www.mod.uk/defenceInternet/microsite/dcdc.

Your Details - (We are happy to receive anonymous responses; however, including your details will enable us to follow up on any further comments you may have).

Name		Surname	
Organisation		Country	
Telephone		E-Mail	

1. How do you or could you envisage using Global Strategic Trends?

☐ (a) To inform policy and/or strategy.
☐ (b) To provide analysis for scenarios or other futures work.
☐ (c) As a reference or background reading.
☐ (d) To stimulate debate.
☐ (e) Not used.

Comments

2. How valuable is GST4 to your work or the work that your organisation does?

☐ (a) Essential
☐ (b) Important
☐ (c) Useful
☐ (d) Of interest
☐ (e) Irrelevant

Comments

3. Are there any judgements that you feel should be given greater emphasis, if so which ones?

☐ (a) Yes
☐ (b) No

Comments

4. How do you rate the judgements contained with Global Strategic Trends?

   ☐ (a) I strongly agree with the vast majority of the judgements.
   ☐ (b) I agree with most of the judgements.
   ☐ (c) On balance I agree with some judgements and disagree with others.
   ☐ (d) I disagree with most of the judgements.
   ☐ (e) I strongly disagree with the majority of the document.

Comments

5. How familiar were you with the issues raised in Global Strategic Trends?

   ☐ (a) Most of the issues in the document were familiar to me.
   ☐ (b) I am aware of some of the issues in the document but not others.
   ☐ (c) Most of the issues raised in the document were new to me.
   ☐ (d) All of the issues raised in the document were new to me.

Comments

6. What is your assessment of the Strategic Trends methodology and process?

   ☐ (a) The probabilities are useful and make the judgements easier to understand.
   ☐ (b) I did not use the probabilities but the judgements and outcomes are useful.
   ☐ (c) The judgements and the process are hard to understand.
   ☐ (e) The process is limited and the document is flawed.

Comments

7. In terms of its total value in highlighting likely outcomes and long term trends what score would you give Global Strategic Trends out of 10?

Score   /10

8. If you would like to provide any additional comments or feedback please use the space below.