GLOBAL Strategic WAR PLANS . . .
WAR - DISEASE - CRIME and POVERTY

A Programme of Double-speak, False Science Based Policies and the Scarcity Myth for Depopulation Agenda's
(Note: We have replaced the maybe's with WILL)

The Development, Concepts and Doctrine Centre's Strategic Trends Programme is a 'continuous' programme of research that provides policy-makers with a context for long-term decision-making. This fifth edition of Global Strategic Trends, builds on previous editions and a respected body of work that benefits from continual engagement with a wide range of contributors from academia, business and government both domestically and internationally. The extent of across UK Government engagement – together with increased levels of international consultation and peer review – are particular strengths of this edition.

We recommend viewing the entire 202 page report - here:
http://www.ieee.es/Galerias/fichero/OtrasPublicaciones/Internacional/2014/Global_Strategic_Trends_-_Out_to_2045.pdf

The following notations are from the above link:

Refer to GST 5 regularly and draw your own conclusions from the information presented. This will be the most effective way of helping you think about the future and how to embrace it . . .
"Our lives and the world we live in will almost certainly change over the next 30 years, with the impacts felt by all".
As "the population tends to increase at a greater rate than its means of subsistence, resulting in the population checks of war, famine and epidemics".
People living longer, demand for resources - need more food, water and sanitation. Without successfully managing water stress, including more effective international cooperation, it is likely that 3.9 billion people will suffer water shortages.

Climate change, a rise in sea levels, desertification and reducing biodiversity are all issues - impacts on agricultural production and fishing,will exacerbate humanitarian crises.

Physical inactivity, unhealthy diets and increased life expectancy will lead to an obesity 'epidemic' as well as rises in non- communicable diseases such as dementia.

Technological progress will lead to dramatic increases in computing power that will enable us to predict

and monitor many aspects of our lives and surroundings.

Robots and ‘unmanned systems’ (able to carry out complex tasks without a human operator’s direct involvement) will be as ubiquitous as computers are today. Machines will become more sophisticated and lifelike. Robots will be used in areas of work and society, caring roles, customer-service, surgery and in combat. This will mean a period of adaption and change, as robots take on traditionally ‘human’ roles. There will be challenges to overcome, such as establishing whether we can learn to ‘trust’ robots. Unmanned systems will replace people in the workplace, carrying out tasks with increased effectiveness and efficiency, while reducing risk to humans. This will lead to mass unemployment and social unrest. As robots become more lifelike- capable of appearing to express emotion, interactions with people are likely to become more complicated. The increased capability of robots will change the face of warfare, some countries will replace potentially large numbers of soldiers, sailors and airmen with robots by 2045. Military decision-making is likelyto remain the remit of humans for ethical reasons, at least in western countries. Others countries may not be so willing to make the same trade- offs between speed and accountability.

Militaries and security forces may be asked to meet the challenges of more humanitarian disasters, and attacks by non- state actors and cyber-criminals may increase. As more people live in cities, it is likely that some future adversaries will be found in larger, more complex urban environments, possessing a greater level of information and better access to technology than they do today.As centres of population cluster in vulnerable areas such as

The Environment - -
As centres of population clusters in vulnerable areas i.e. coaster regions, the consequences of adverse weather will be be felt more keenly. By 2045, climate change is likely to have more noticeable effects. Without mitigation, rising sea levels will increase the risk of coastal flooding, particularly in regions affected by tropical cyclones. Droughts and heat waves will increase in intensity, duration and frequency. Some of these events
will precipitate natural disasters which, because of the interdependencies enabled by globalisation, will have consequences far beyond the site where the disaster occurs.
Extreme weather events - flooding and droughts will both increase in frequency and intensity in a number of regions. Extreme events will continue to cause widespread damage and loss of life,
Climate change will open up shipping routes during the summer months - new areas for extracting minerals and hydrocarbons in the Arctic. This will cause significant harm through heatwaves, droughts, and flooding across the region. Northern America’s 'economic' outlook is positive, boosted by newly accessible energy reserves, and it is expected to integrate ever-more closely with the global economy. (MARKETS)

Climate change is the principal driver of change in the Arctic and Antarctic, with increasing temperatures and precipitation. As Arctic and Antarctic sea ice retreats, many areas that are currently inaccessible will become open to commercial 'exploitation', particularly of oil and gas. The opening-up of the Arctic will focus attention on the region’s governance arrangements, and Large-scale military confrontation in either region is unlikely, but it is possible that some countries – depending on their internal politics – may seek to project power in the Arctic if they consider their interests in the region to be under threat.

The proportion of older workers in the global labour force will increase out to 2045, and a corresponding decrease in opportunities for younger people. People employed on shorter-term contracts and a growth in working remotely. Workers will probably have less predictable income and increasing economic insecurity. By 2045, there is likely to be greater equality between men and women in the jobs market, particularly in developed countries. In part, this may be driven by a global shift away from 'manual' labour, towards a more knowledge-based economy.

Sexual violence will continue to be a feature of conflict and state violence and, used as a weapon of war, has the potential to be a significant factor in instability.

Greater reliance on automated technologies could provide scope for terrorists and criminals to disrupt the transport system through cyber attacks.

Failed and failing cities, in both developed and developing countries, will pose major security challenges (such as social unrest and even insurgencies) with country-wide repercussions. With more people living in urban areas, security and armed forces will need to operate in this environment to a greater extent. Adversaries will range from government-controlled militaries to armed non-state groups with criminal or malign intent.

As more of our work and social activities depend on interconnected information and communications networks – which may, in places, be extremely vulnerable to attack – there could be more opportunities for criminals and terrorists to have a greater impact on our day-to-day lives.

Increasing numbers of devices collecting sensor data will intensify levels of surveillance. Stealth vehicles will find it more difficult to remain hidden and the ability to prosecute covert operations, especially in urban environments. This is particularly significant given the increase in the size of urban areas, along with the growing use of surveillance to prevent crime. (Double speak)

Augmentation of humans with embedded sensors and computing devices will occur. This may provide advantages such as improved situational awareness, health monitoring, and the ability to modify physiological and psychological states to increase performance and enhance resilience. Mind-controlled machinery will become much more sophisticated, using human brain-to-brain communication.

Imbalances across regions and countries are likely to exacerbate existing political and social tensions. The global median age is increasing with those aged 60
or over comprising the fastest growing
population age-group. Indeed, by 2045, 750
million people are likely to be over 65 years old.

Countries with increasingly elderly populations, requirements such as public pensions, health services and long- term care will be more pressing – priorities which could reduce defence spending in most affected countries. A declining working population coupled with increasing welfare costs will lead to the retirement age increasing (as has happened in some developed countries). A rising welfare burden will lead to governments re-evaluating how they provide social welfare. In societies with an ageing working population, older people are likely to hold an increased proportion of positions with authority and influence which, if not managed effectively, could disenfranchise the younger generation. Compounding this, young people may feel frustrated atSome Asian countries are likely to continuethe increasing cost of supporting a growing elderly population, particularly if they believe they have been disadvantaged by their elders.

Some Asian countries will experience an uneven male to female population balance out to 2045, due to sex- selective abortions, child abandonment and diseases which disproportionately affect girls. China may have 48 million more men than women by 2045, exacerbating gender imbalances in receiving countries if Chinese emigration increases. Increasing numbers of young men will be frustrated at being unable to find a wife and could lack the stability that a family life provides. Male- dominated societies also tend to

be more authoritarian and violent. Large youth populations, if not managed properly, will cause instability, unrest and conflict . .

Urbanization - 70% of the global population will be living in cities by 2045 and without mitigation measures including pressure on infrastructure (and the environment) which will contribute to social tensions within the urban population. Urbanisation and the effects of climate change will result in an increase in the magnitude of humanitarian crises, particularly since the majority of urban areas will almost certainly be either on, or near the coast, making these cities vulnerable to flooding. The greatest increases in urbanisation are likely to be in Asia, with between 250 and 300 million people moving from rural to urban areas over the next 15 years in China alone.Those
who remain in rural areas will experience increased isolation as rural populations decline.
By 2045, there are likely to be around 280 megacities (cities with more than 20 million inhabitants4). Many of these megacities will be agglomerations spanning administrative, and in some cases national, boundaries thereby driving integration and changing governance structures. Europe, for example, may have more than 20 major agglomerations by
2045 – the German Ruhr region, much of the Netherlands and Belgium could become a single gigantic urban area. The taxation rights of some major cities could make them major regional or international actors.

One billion people throughout the world already live in slums, lacking basic amenities, and there could be almost three billion people living in urban slum conditions by 2045. The urban poor are likely to become frustrated – and with increasing access to information, there is likely to be a growing awareness of inequality. If not dealt with effectively, this could lead to violent protest and possibly full-blown urban insurgencies. One billion people throughout the world already live in slums, lacking basic amenities.

Urbanization often results in increasing requirements for energy (particularly electricity), which could be a source of considerable tension unless it is provided in a sustainable way. Once people have access to energy, they are likely to always expect it. Some cities, in both developed anddeveloping countries could fail (for example, becoming bankrupt or seeing a breakdown in law and order) – potentially becoming security issues. Correctly managed, though, urban growth could generate greater prosperity and higher tax revenues, potentially offsetting some of these more negative aspects.

Because of concentrated populations, when disasters (whether natural or man-made) strike cities, large numbers of people are affected. Many of the biggest cities, a number of which are vital to the global economy, are situated in coastal regions which could face more extreme weather events and be vulnerable to rising sea-levels. Furthermore, because of inadequate sanitation, slums could be susceptible to communicable diseases – which could then spread globally because of increased connectivity between cities.

RESOURCES . . .

Demand for resources of all kinds is likely to increase out to 2045, as the world's population rises to around nine billion. While the demand for food will grow, some countries are likely to experience significant declines in agricultural productivity. Water shortages are likely to be particularly acute in many areas, exacerbated by increasing demand and climate change. In the 2045 timeframe, coal and hydrocarbons are likely to remain the most important sources of energy, with renewable and nuclear energy likely to make an increasing contribution.

Even at current population levels, supply of fresh water is, arguably, insufficient. Estimates of those suffering from water shortages today vary between 450 million4 and more than 1.3 billion people.5 Without

mitigation, by 2045 or sooner, around 3.9 billion people – over 40% of the world's population – are likely to be experiencing water stress.
Improvements in waste treatment and purification technologies offer hope that in the future more water could be reused or recycled. violent conflict over water will occur by 2045 or sooner. Global water demand will increase while supplies of fresh water dwindle, yet water management issues are likely to become increasingly complex. The effects of environmental and climate changes will also become more severe in many locations, outweighing any beneficial consequences.
If energy cost was no longer an object, desalinated water could be transported via pipelines to irrigate much of the Sahara, massively increasing the continent's arable land and potentially ending hunger. Similarly, desalinisation plants could resolve the probable crisis in water supply.

Food - food production is predicted to have increased by nearly 70%, to feed a larger and more demanding population – and it is possible that demand will outstrip supply. Pollution and soil erosion are likely to adversely affect agricultural land – some estimates assess that, globally, as much as 25% of agricultural land is already degraded. Warming, acidification and over- fishing also threaten to reduce the amount of food that can be harvested from the oceans.
Estimates of future food prices are highly varied and may be more volatile. Disruption, and possibly congestion, of global trade routes may lead to sharp increases in food prices – particularly in those countries dependent on food imports. When the effects of climate change are taken into account, the price increase above present levels could be as much as 100%. Climate change could contribute to increasing incidences of crop failure, potentially causing disruption to global food supplies.
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Demand for more food and water, increasing the strain on the environment

GMO - developing new measures to maximise yields will be important in ensuring productivity growth keeps pace with demand. Developments such as genetically modified crops, laboratory-cultured meat, improved agricultural techniques and recent developments in nitrogen fixing from the air, will also increase productivity while lowering the environmental impact of agriculture.

By 2045 food shortages will increase the number of children under the age of five who are undernourished by around 20-25 million, while the global malnourished population could increase by around 49 million.

NORE NUCLEAR POWER REACTORS . . There are currently 435 operable civil nuclear power reactors around the world, with a further 67 under construction. - See World Nuclear Association (undated), 'Number of Nuclear Reactors'.

US FRACKING - A key change to the global energy market by 2045 is likely to be growing US energy independence, driven by recently adopted novel oil and shale gas production techniques such as ‘fracking’. If the current increases
in production continue, the US looks set to become the world’s number one oil producer by around 2020 and a net exporter by 2030.

The discovery of alternative materials offering improved efficiency, reliability and longevity will reduce demand for some traditional materials (although it may lead to increases
in others). Some examples of these new materials and their potential applications are: DNA nanotechnology to fabricate nano-scale devices.
The self-assembly mechanism of DNA could be harnessed to fabricate mechanical, electrical and optical devices and circuits that may be ten times smaller than current technology allows. Graphene paper. Flexible and inexpensive to produce, and around ten times stronger than steel. Magnetic shape-memory alloys. Materials that change shape and mechanical properties when a magnetic field is applied. Self-repairing metal. Metal that responds to damage by ‘healing’ itself. Nanospheres.transparent material made of self- assembling nanospheres that is the stiffest organic material ever created, surpassing the properties of stainless steel and even Kevlar. Jelly-forming polymers so effective that a kilogramme of the compound could turn the water within an Olympic-sized swimming pool into jelly.

Programmable matter. Materials that can be programmed to alter themselves at the molecular level into various shapes and then disassemble to form entirely new ones. Compounds that can reform the shape of components in real-time, similar to holograms, could allow the remote projection of a replica of a person or object, or enable robots to change size (and perhaps even state of matter) to navigate narrow passages or around obstacles.

As centres of population cluster in vulnerable areas such as coastal regions, the consequences of adverse weather will to be felt more keenly. By 2045, climate change will have more noticeable effects. Without mitigation, rising sea levels will increase the risk of coastal flooding, particularly in regions affected by tropical cyclones. Droughts and heatwaves will increase in intensity, duration and frequency. Some of these events will precipitate natural disasters which, because of the interdependencies enabled by globalisation, will have consequences far beyond the site where the disaster occurs.

Reducing greenhouse gas emissions will be the most important means by which climate change is managed – although out to 2045 it appears likely that the drivers of
greenhouse gases will continue to increase. Inertia in the climate system means that warming will continue even if emissions were cut to zero tomorrow. Catching greenhouse gases before they are released into the atmosphere through techniques such as carbon capture and storage could play a vital role in reducing climate change – particularly while fossil fuels remain a major energy source. At a local level, constructing flood defences, altering agricultural practices in light of changing weather patterns and implementing water conservation measures will be the primary means of adapting to the effects of climate change.

Geoengineering - Theoretically plausible geoengineering methods (intentional, large-scale activities intended to counteract aspects of climate change) have been proposed for a number of years.

Detailed studies on the environmental implications of different geoengineering activities have recently begun to appear, but large-scale testing and implementation of such methods has not occurred – in some cases due to public opposition. Over-reliance on particular geoengineering technology to mitigate the effects of climate change could also render users vulnerable to catastrophic effects if equipment failed or was sabotaged. It is not clear therefore what, if any, role geoengineering will play by 2045 in countering the effects of climate change, and the extent to which it could heighten international tensions.

Extreme weather events, such as flooding and droughts, are likely to increase in both frequency and intensity in a number of regions. Extreme events will almost certainly continue to cause widespread damage and loss of life,

Degraded and threatened environments are likely to lead to affected communities migrating – with potentially destabilising consequences.

Armed and security forces, both at home and abroad, will be more frequently tasked with providing humanitarian assistance and disaster relief, supporting indigenous responders.

Without mitigation measures such as carbon capture and storage, continued reliance on coal and hydrocarbons for the majority of energy demand will exacerbate climate change and its knock-on effects = a chain reaction.

The ABOVE Segments from the Global Strategic Trends can be found in the first 39 pages of the programme.

Health - the most serious development in global health is the increase in the prevalence of non-communicable diseases (such as cardiovascular diseases, diabetes, cancers) have become the leading global causes of death.

Emerging infections and the risk of
pandemics
Up to 70% of recent emerging infections have originated in animals -
places where animals and humans interact are likely to be particularly problematic.

Climate change
Climate change is already affecting health, contributing to a decline in clean air, safe drinking water, sufficient food and secure shelter across the globe. Increased frequency and intensity of extreme weather events
and will affect physical health (such as heat-related illness) as well as mental health problems, such as increased stress due to the impact of flooding. Higher temperatures are also likely to raise the levels of ozone and other pollutants in the air that exacerbate cardiovascular and respiratory disease. Outdoor urban air pollution currently causes about 1.2 million deaths every year, and
this number will increase out to 2045. Climatic conditions strongly affect water- borne diseases and diseases transmitted through insects, snails or other cold-blooded animals. Lengthening transmission seasons of important vector-borne diseases, such as dengue fever, could also alter their geographic range. The loss or contamination of fresh water will lead to disease and crop destruction – food shortages, poor nutrition and malnutrition. Longer-term changes in weather patterns will

lead to significant decreases in fertility of farmland and water availability.

Obesity
An estimated 170 million children globally were also classified as overweight or obese.
Were obesity to be considered a disease, there would arguably already be a global obesity pandemic.

Ageing
Current estimates indicate 35.6 million people worldwide are living with dementia. This will double by 2030 and more than triple by 2050. Dementia is a costly condition:
socially, economically, and on the quality of life of those afflicted by it. Modern medical advances have also turned many life- threatening conditions such as some cancers and heart disease into long-term conditions, as more people survive acute episodes of illness and live for many years with their conditions. Living longer with disease - This helps to explain why the extra years of
life that people have gained are not always healthy or disability free.

Mental health
The global cost of mental health conditions in 2010 was estimated at US$ 2.5 trillion. This will more than double to US$ 6.0 trillion by 2030.Of these costs, 65% are incurred by developed countries and this is not expected to change over the next 20 years. By disease, mental illness accounted for the largest share of the global economic burden in 2010 and is likely to in 2030, just slightly more than cardiovascular diseases (followed by cancer, chronic respiratory disease and diabetes). Mental health conditions are the leading cause of healthy life years lost worldwide and account for 37% of the healthy life years lost from non-communicable diseases.Prevention, monitoring and diagnosis

Prevention, monitoring and diagnosis
Improved computing power, data collection and processing will make medical diagnosis quicker, cheaper and more accurate. Through implementing global standards, medical information such as patient records could be shared by clinicians in different countries. With a globalised medical information network interlinked with millions of sensors, advanced analytical systems
could identify, track and predict the spread of disease.Drug and treatment delivery

Drug and treatment delivery - the camera pill approved by the US Federal Drug Administration for diagnostic applications is capable of being electronically programmed to control medicine delivery according to a pre-defined drug release profile. Current advances have produced a pill which can monitor the patient, communicate with external diagnostic systems and respond to instruction for the targeted delivery of drugs within the digestive tract. As technology advances, the size of devices will be reduced small enough to travel in the bloodstream.

Regenerative medicine - DNA engineering will correct genetic defects and lead to a new kind of cell-based medicine that will be applied to every system in the human body, offering an alternative approach to treatment by medicines. Possibilities include: growing entire organs.

Advances that allow patients to interact with their prosthetics and other aids will lead to new ways to connect the able-bodied to machines and computers. Some countries (and individuals) will use advanced medical techniques, such as genetic modification, to gain a competitive advantage. Others will constrain their development for ethical reasons.

Rapid medical advancements - A game-changing medical breakthrough, similar in impact to the dis-

covery and mass-production of antibiotics, will significantly extend the human lifespan and dramatically reduce the incidence of non-communicable diseases such as cancers. The Breakthrough will probably ONLY be available to the very rich, causing social tensions. This would lead to increased populations and extended life span and subsequent unsustainable increase in demand for food, water and housing . .

Fertility and reproduction - human embryo to develop outside the body in an artificially created environment.

Transport - Driverless transport will be safer and more reliable – driverless vehicles would not be affected by human failings such as road rage, drink-driving or falling asleep at the wheel. Increasing automation will enable a far greater density of traffic to move at higher speeds and provide automatic routing to avoid congestion and hazards.
Mass transport
Future mass transport will provide faster and more closely-integrated transport using a variety of road, rail, sea and air systems. Future improvements are framed around the concept of 'seamless transport', (The Stated Goal) the idea that journeys could be taken without interruption. This would reduce waiting or travel time and there will be an ability to do other tasks while travelling. (People Are NOT Driving) To achieve this, there will be closer integration
and coordination across infrastructure and transport providers, as well as adopting automated systems. Unmanned systems will play a much greater role in the mass delivery of goods. For example, an urgent, high-value product could be quickly delivered. Amazon's recently proposed remotely piloted aerial delivery system is the future . Greater reliance on automated technologies could provide scope for terrorists and criminals to disrupt the transport system through cyber attacks.

The ABOVE Segments from the Global Strategic Trends can be found in the first 49 pages of the programme.

The 'Internet of Things'
The number of devices linked to the Internet is increasing rapidly, with everything from mobile phones to cars and even fridges having an Internet connection. This 'Internet of Things' is already a reality, with around 20 billion devices already connected, rising to an estimated 40 billion by 2020. The number of connected devices has increased by 4,000% between 2003 and today. The new IPv6 internet protocol allows for 340,282,366,920,938,463,463,374,607,431,768,211,456 connections which is believed to be sufficient for the foreseeable future.

'Big Data'
In 2000, 25% of the world's information was stored digitally: today it is more than 98%. On this trajectory, by 2045 there will be 20,000 times more digital information than there is today. The ability to collect and analyse this growing volume of information has been termed 'Big Data'. Such a large amount of data generates yet more information when appropriately analysed, allowing (us) to identify patterns which will help to counter the spread of disease, combat crime and even predict social and behavioral patterns.ABig Data is being used to predict consumer behaviours. Accountability and situational awareness will increase, as more aspects of life are quantified and analysed.

The uptake of social networking sites and even the use of supermarket loyalty cards shows that – for comparatively small rewards – people are readily persuaded to record their movements, financial transactions and buying habits. This behaviour is highly likely to continue out to 2045. Marketing campaigns

will portray the benefits of smart technology and machine- to-machine interaction, but the increased surveillance capability will make others fear an increase of state control. In turn, this is likely to drive the growth of the 'hactivist' community characterised by groups such as Anonymous.9 It will be increasingly difficult to avoid the sensors.me

EDUCATION - Global educational inequalities will persist, entrenching social discontentment and allowing youth disaffection to continue.-In the new education and training mix facilitated by employers, online and virtual blended learning will predominate, and formal face-to-face learning is unlikely to die out completely.chSome countries will begin to educate and train children assessed as having the potential to succeed in specific careers (including in the armed forces) from a very young age.

AUTOMATION and WORK - Robots or 'unmanned systems' – machines capable of carrying out complex tasks without directly involving a human operator – WILL be as ubiquitous in 2045 as computers are today. Unmanned systems are increasingly geared to replace people in the workplace, carrying out tasks with increased effectiveness and efficiency, while reducing risk to humans. This will ultimately lead to mass unemployment and social unrest. As robots become more lifelike, and capable of appearing to express emotion, interactions with people are likely to become more sophisticated. The increased capability of robots will change the face of warfare, andt some countries may replace large numbers of soldiers, sailors and airmen with robots by 2045. Military decision-making is likely to remain the remit of humans for ethical reasons, at least in western countries. Others may not be so willing to make the same trade-offs between speed and accountability.
The proportion of older workers in the global labour force will increase out to 2045, with corresponding decreases in opportunities for younger people. Flexible working practices will become more widespread, with people employed on shorter-term contracts and a growth in working remotely. Workers will have less predictable income and increasing economic insecurity. By 2045, there will be greater equality between men and women in the jobs market, particularly in the developed countries, and this will be driven by a global shift away from MANual labour, towards a more knowledge-based economy.c

Robots will replace people at work, which will ultimately lead to social unrest. Robots will continue to carry out tasks deemed too dirty, dull or dangerous for people, and will probably be used more extensively in such roles, as well as for more highly-skilled jobs. As robots will perform tasks that place people at risk, such as minefield clearance. By 2045, Robots will take on combat roles. Non-military jobs such as fire-fighting or construction will be carried out by machines in the future. In the same way that the widespread use of computers has made some professions (such as typists) almost redundant, we can expecterobot development to remove a number of types of job that are common today. While advancements in robotics will create new jobs that we have not yet envisaged (just as web designers were not imagined in the 1980s), adapting workers to a new set of roles may take considerable time, causing problems in the interim. While it is possible that governments will legislate to try to prevent the employment of robots in some areas, to safeguard human jobs, it is not clear how effective this would be in the face of "market forces". It is also unclear whether new jobs will be created at a rate sufficient to replace those that are lost, and automated processes will become cheaper than even the lowest-paid human worker.

Additive manufacturing - 3-D Printing for Food, Clothing and more . . .
Global manufacturing is evolving from a highly labour-intensive process towards more information technology- based processes, and driving a trend towards manufacturing processes relocating closer to their consumers, to avoid long supply chains. This will affect the balance of manufacturing in the developed and developing world, with less need for conventional manufacturing jobs in many regions. We can expect to see additive manufacturing (more commonly known as '3-D printing') also making a significant contribution. Additive manufacturing will transform the manufacturing industry. 3-D printing enables on-demand production, allowing items to be created quickly when an order is placed, rather than large amounts of costly stock having to be held in readiness for prolonged periods. With more decentralised production, products will be designed and printed for local consumption while requiring less industrial infrastructure than conventional manufacturing. The personal use of 3-D printers will increase rapidly, allowing for unprecedented levels of mass customization and even
the 'democratisation' of manufacturing, as consumers and entrepreneurs begin to print their own products. By 2045, additive manufacturing systems will be a common feature in the home and be capable of producing a wide range of outputs – food, clothing, and even complex devices with mechanical and electronic components.

More life-like machines ARTIFICIAL INTELLIGENCE - Pet robots
A growing number of customer-service roles will become automated and performed by robots. Over the last century, industrial processes have shown how automation can dramatically increase productivity, while lowering cost. This trend continue, with increasing automation of service roles, such as telephone or Internet-based customer support.

By 2045, advances in artificial intelligence will be enhanced to the point that a virtual telephone operator will be indistinguishable from
a human one, and an increasing shift towards mechanising caring roles. AI will take over in areas where there are few human candidates. Japan is developing robots that will provide care for the elderly, driven by its ageing population and shrinking workforce. Using robots as companions will increase. For example, Japan is using robot companions for its astronauts in space, and robotic pets and computer programmes with simulated personalities are growing in popularity.
Eventually, developments in robotics will mean that robots are physically indistinguishable from human beings, but it is hard to believe that by 2045 they will have achieved the degree of social acceptance or skills necessary for them to operate in all roles. Robots will demonstrate the appearance of realistic emotion which will endear more to humans, this will create its own problems, with people becoming emotionally attached to machines. Such a phenomenon has arguably already been experienced by
a small sub-set of computer-users' feelings towards virtual characters, and will be particularly problematic in the case of children forming emotional attachments to robot carers. The implications of human-machine relations are not yet known, and even by 2045, the long-term effects may not be clear. more robots that are able to perceive their environments will make limited decisions and take action for themselves. The level of responsibility given to such robots is likely to be determined by the importance of the roles they are intended to be used for and, more significantly, how willing we are to trust them. This trust is likely to largely depend on how well robots perform the tasks they are instructed to do, and how well they are able to learn.S

The US Government will lead on robotics for military usage, while Japanese companies are currently at the forefront of developing robots with commercial applications.

Robots will become more sophisticated and will take on a wider range of responsibilities. Legal questions

will emerge. For example, when robots malfunction, is it the owner, manufacturer or programmer who is responsible? Does a robot with biological components have rights? Changes to legislation will be required, but past experience suggests it is highly likely that legislation will fail to keep up with the speed of technological developments.

Robots will be able to respond to fast-moving or microscopic environments far better than humans, due to their faster information-processing times, enhanced precision and lack of susceptibility to human weaknesses, such as fatigue or hand-tremors. This will lead to new possibilities for medicine, such as eventually removing human surgeons from operating theatres, diagnoses performed by robots travelling along the bloodstream and operations performed at a cellular level. Some experts suggest that robots will eventually be small enough to fit inside a single living cell, capable of repairing damaged DNA or acting as antibodies against viruses/infections, although it is unclear whether or not such technology will be available by 2045.

A sophisticated robotic 'army' could theoretically be operated by a single individual, giving that person enormous power. Authoritarian regimes may therefore find it easier to stay in power, at least in the face of internal uprisings. Similarly, using robots could significantly amplify the capabilities of small groups of insurgents or terrorists, thereby increasing the threat that they present.m

Robots and automated systems will be capable of carrying out extremely complex tasks with no human involvement. Robots and machines will likely carry out all manufacturing and agricultural tasks; repair themselves; as well as clean, cook and tidy. Advances
in artificial intelligences will make machines so life-like that they are able to answer phones in call-centres, take care of children and even teach. Computers will diagnose and treat almost every medical condition. When progress on this scale is made in the future, it is likely that there would be very few jobs still carried out by human beings, who would be almost totally excluded from the workforce.
In richer countries, this large-scale automation of work would be likely to have a mostly positive effect, as governments would probably be able to provide their citizens with all the material comforts they need. However, many people may initially struggle to achieve a sense of purpose and social status without work, with increases in cases of depression. Education systems will need to be totally redesigned to enable people to self-motivate and to gain satisfaction from activities other than work. Over time, when populations have become more used to a life without work, they may fill their time playing sport, painting, reading and composing music.
In poorer countries, however, large-scale automation of work could stall economic development, perhaps even reversing it. For example, foreign companies would be far less likely to employ cheap labour, as machines would be so much more cost-effective and efficient. Some employment could initially remain, as poorer countries would be less likely
to afford to use machines to carry out roles in their internal labour markets. Eventually, though, automated equipment would probably become cheap enough for even these countries to afford.
Poorer governments will not be able to provide more than an extremely basic level of subsistence, meaning that people would have no way to improve their living conditions. This will lead them to become deeply frustrated and angry. Nevertheless, citizens would still receive some benefits from large-scale automation, such as charity-funded machines capable of providing very cheap diagnosis and treating disease. Some workers will welcome the increased freedom that more variable employment brings, others are likely to resent the insecurity caused by an unpredictable income.

Automated manufacturing techniques and practices will lead to economic destabilisation, as there is less need to use cheap labour. This will disproportionately affect emerging economies that would otherwise have benefited from out-sourced production arising from inexpensive labour.

Unmanned systems are likely to have an increasing role in combat, potentially transforming the way that wars are fought. Military decision-making is likely to remain a human preserve, at least in western countries, but it is possible that the actual fighting will no longer be a solely human endeavour.

The cost of unmanned systems will fall, while the ease of manufacturing complex items rises, making unmanned systems much more widespread and harder to regulate. Criminal and terrorist groups are likely to find it easier to gain, hold and use unmanned capabilities.

There is "unlikely" to be global legal and ethical agreement on the way in which military unmanned systems should be employed.

There may be public mistrust of, and resistance to, using unmanned systems (and robots in particular).

Mass protests and civil unrest could still develop, with ‘anti-robot’ movements becoming increasingly powerful.art slums: utopian or dystopian vision of the future? | Global Development Professionals Network | The pan dramatically increased. Without mitigating action, there could be a subsequent unsustainable increase in demand for food, water and housing.
The ABOVE Segments from the Global Strategic Trends can be found in pages 49 - 73 of the programme.
75
Corruption and money -
The potential for "corporate" corruption WILL increase as multinational corporations grow in prominence and economic reach.
Corruption will continue to exacerbate global inequality and conflict. By 2045, consistent attempts to curtail corrupt practices are likely to be made by national governments, international governing institutions, the private sector and non-state actors. Technology is highly likely to play a significant role in both enabling and combating corruption.
Responses to corruption - There is already an acceptance today that corruption needs to be addressed, but it is likely that by 2045 this will have become even more widespread.

Page 84 - UNSC Consensus - The DELPHI Technique using "consensus" will continue as the Tavistock Institute and Rand Cooperation's global meeting practices whereby trained and hired meeting facilitators will lead group think into predetermined outcomes and preplanned agendas will appear to have public buy-in - which they do not . . .

Digital anonymity will be difficult if not impossible to maintain - The longevity of data storage means that there is an ever-growing record of people’s activity, and attempts to avoid leaving a digital footprint will become increasingly difficult. The growth in the number of surveillance devices is increasing at a rapid rate and, unless individuals go to great lengths to avoid detection, it is likely that by 2045, a near-complete record of their movements could be built up by an interested party. Governments will increasingly exploit extensive databases and surveillance devices to monitor and curtail individuals’ activities.

Human Augmentation - HUMAN ENHANCEMENT . . . PAGE 89 - 90

External and internal electro- mechanical devices are likely to enhance human physical performance. Future technologies WILL make it possible for people to radically alter their identities by using a

range of physical and cognitive enhancements. The power and range of the five major senses will be significantly enhanced, often as a result of extending and applying developments made for medical reasons. Some developments are likely to require surgical implants, implying a degree of permanence – others will probably be temporary. However, it is difficult to speculate on the extent to which enhancing sensory perception will lead to improved interpretation of our surroundings. Some augmentations could provide signals from beyond our
normal sensory range. Despite its inherent adaptability, it is not clear how well the human brain will be able to process such data to produce useful information and analysis.
information to the brain, from external sensors such as cameras or sonar.20
New technologies will be able to extend our visual sense beyond the range of visible light into other parts of the spectrum. Implants designed to help restore sight provide an early indication of what will be achieved in allowing us to 'see' otherwise non-visible radiation. Our hearing will be significantly enhanced. Hearing aids are currently being developed that can choose and boost frequencies of interest which will enhance the ability to detect and understand speech in noisy environments. Similarly, improved understanding of how the brain can discriminate between individual smells in a mix of odours found in a typical room could provide the basis for developing future technology that will enhance our sense of smell. Even the tongue could be used as a novel pathway to conduct a range of sensory information to the brain, from external sensors such as cameras or sonar.
Advances in a range of disciplines, such as brain science and pharmacology, will increase our ability to influence emotional responses such as motivation, anxiety and fear – all of these affect individual performance in areas of considerable significance. Cognitive function may be enhanced either by machine interfaces or by using chemicals. Treatments, often developed to address mental health issues, will be widely used by healthy
people to augment or optimise cognitive performance, offering potential enhancement of many aspects of cognition, from learning and memory to wakefulness, attention and motivation.
External and internal electro-mechanical devices will enhance human physical performance. For example, powered exoskeletons already in development allow users to lift loads of up to 90kg without their performance being impaired, as well as reducing fatigue experienced when exercising. Prostheses are being developed that exceed the functionality of the limbs they replace and whose electronic control systems outperform the original. Brain- machine interfaces will allow direct control of prostheses, exoskeletons and systems remote from the body. Control of simple devices by thought is already a reality. (Note: Ted Talks)

Some Social and religious groups will not want to adopt to these new augmentations for ethical reasons. Equally, not all who wish to adopt these new technologies will be able to do so – the rich will almost inevitably have better access than the poor. Many of the technologies described above will almost certainly be expensive, leading to the prospect of poorer people being excluded from the benefits that technological enhancements may provide. Such inequality could lead to disaffection and instability when such groups perceive themselves as being marginalised.

Brain Computer Interface (BCI) -

Direct brain-to-brain communication will likely be achieved by 2045, transforming ways of working. The real- time transfer of behaviourally meaningful information between the brains of two rats has already been demonstrated, with rats successfully performing tasks that they had not previously attempted. Building on the progress that has been made with animals, the ability to move another's hand through non- invasive brain-to-brain interfaces has already been demonstrated. When extended to complex cognitive tasks, the approach of directly linking brains will be the basis for wholly new methods of decision-making, problem solving and planning. These methods will involve collaboration and using directly-shared knowledge and experience between humans (and potentially between humans and other species). OTHER SPECIES . .

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As well as potentially transforming both sensing and decision-making, direct brain linkage could have profound implications for social interaction and for the notion of what it means to be an individual human being. As seen with current interaction with virtual environments, where high-use levels sometimes lead
to addiction, there would be powerful behavioural effects. Notions of individuality would be challenged, leading to questioning of loyalties and allegiances to organisations, as individual and group identities merge. By 2045, it is even possible that the sharp distinctions between people and machine will disappear.
Mind-controlled machinery will become much more sophisticated, with human brain-to-brain communication possible before or by 2045.

Future weapons
Increased levels of defence spending and continuing advances in technology will lead to a variety of new weapons being available by 2045. For example, laser systems are maturing, with vehicle and sea-based platforms already at advanced stages of trial. Directed energy weapons, such as lasers, are currently capable of discrete target discrimination, producing a focussed beam (or wider field) of electromagnetic energy or atomic radiation to cause disruptive or damaging effects to equipment and infrastructure. Such weapons may also be capable of delivering "non-lethal" effect on human targets at considerable distances. Increases in the number and sophistication of sensors (civil and military) will increase the accuracy of targeting, as well as making it increasingly difficult to hide people, machines or equipment. As people use electronic devices more frequently, the ability to target an individual by their ‘digital signature’ will become easier. The cost of sequencing an individual’s DNA continues to fall, targeting an individual using their DNA will be possible before or by 2045. We could also see sophisticated environmental warfare, capable of spreading plant and human diseases by insects or insect-machine hybrids. Crops and cattle could be destroyed, as well as people being incapacitated or killed.
Globalisation, in particular the spread of technology, information and ideas, is likely to give an increasing number of people (both state and non-state actors) access to sophisticated and technologically advanced capabilities. This is likely to increase the opportunity for unconventional attacks on technologically sophisticated nations, including by terrorists.

The ABOVE Segments from the Global Strategic Trends can be found in pages 74 - 95 of the programme.
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Additional Notes from the Global Strategic Trends - Out to 2045
(These notations may repeat some of the notations above)

Corruption and money

If unchallenged, corruption is likely to continue to exacerbate global inequality and conflict. By 2045, consistent attempts to curtail corrupt practices are likely to be made by national governments, international governing institutions, the private sector and non-state actors. Technology is highly likely to play a significant role in both enabling and combating corruption.

Page 4-5
Age and gender imbalances (Young people disadvantaged by the elderly)

Imbalances across regions and countries are likely to exacerbate existing political and social tensions. The global median age is increasing (although the rate of increase is slower in developing countries) with those aged 60 or over comprising the fastest growing population age-group. Indeed, by 2045, 750 million people are likely to be over 65 years old. For those countries with increasingly elderly populations, requirements such as public pensions, health services and long- term care are likely to be ever-more pressing – priorities which could reduce defence spending in most affected countries. Some developing countries do not provide welfare and will not be directly affected by this trend. A declining working population coupled with increasing welfare costs are likely to lead to the retirement age increasing (as has happened in some developed countries). For some governments, a rising welfare burden is likely to lead to them re-evaluating how they provide social welfare.

In societies with an ageing working population, older people are likely to hold an increased proportion of positions with authority and influence which, if not managed effectively, could disenfranchise the younger generation. Compounding this, young people may feel frustrated at the increasing cost of supporting a growing elderly population, particularly if they believe they have been disadvantaged by their elders.

page 6
Migration

Migration is likely to increase or, at least, remain constant. In 2005, 191 million people lived outside their country of origin. Today there are 232 million (this figure already "exceeds" our earlier assessment in the 4th edition of Global Strategic Trends). Those countries attempting to limit immigration are likely to be only partially successful. In preceding decades, migration has been characterised by people moving from Asia and

Africa to Northern America and Europe.

During 2010-2050, the number of international migrants to developed countries is likely to be about 96 million, whereas the excess of deaths over births is projected to be 33 million, implying total net growth. The main estimated net receivers of migrants are likely to be the US, Canada, UK and Australia, while the main estimated senders are Bangladesh, China, India and Mexico. Without immigration, the population in most developed countries is highly likely to reduce. Those developed countries that do see population growth, therefore, will almost certainly see an increase in the size and importance of their ethnic minority communities.

Page 7

Climate change is likely to drive some people from areas that are particularly badly affected, although not everyone who wishes to leave is likely to be able to do so. Millions of people may be 'trapped' in vulnerable areas because of the high costs of migration, unable to raise the capital needed for moving away.

A growing consumer class

A rapidly growing consumer class (those who spend more than ten US dollars a day) will almost certainly be a key driver of the global economy. By 2030, this group is likely to grow to more than five billion from two billion today, while the proportion of consumers who are European and North American is likely to shrink from 50% today to just 22%. Rapid growth in many Asian countries, particularly China and India, is shifting the economic centre of gravity south and east.

Page 13
There could be an increase in trafficking and slavery by 2045, although the trend may be mitigated by improved surveillance technology and international cooperation.
Defence and security implications

■■ Many of the world's defence and security organisations are likely to incorporate specific gender equality targets.

■■ Increasing numbers of women are likely to have front-line combat roles in armed forces worldwide, mirrored by growing number of females participating in armed resistance movements and terrorist groups.

■■ Sexual violence will almost certainly continue to be a feature of conflict and state violence. Used as a weapon of war, sexual violence can be a significant factor in instability. However, countries and their armed forces are likely to face greater international

scrutiny and legislation against such activities.

Page 16

From rural to urban (Historic Buildings are Obsolete Infrastructure) . . .

By 2045, the proportion of people living in urban (city) areas is likely to have increased from a little over 50% to around 70% of the world's population. Urbanisation will probably increase most rapidly in the developing world. Of the 23 cities expected to have ten million or more inhabitants by 2015, are likely to be in developing countries. The greatest increases in urbanisation are likely to be in Asia, with between 250 and 300 million people likely to move from rural to urban areas over the next 15 years in China alone. Although those who remain in rural areas may experience "increased isolation" as rural populations decline, technological advancements are likely to enable better communication and remote working. Managed successfully, urbanisation could stimulate economic growth. In part, due to the exposure of new ideas and the accessibility of goods and services, it may also act as a spur for civil activism and improve the quality of life for many. While older cities are likely to have established links to resources, new cities may enjoy an infrastructural advantage – they will be able to build transport and communication networks suitable for modern vehicles and ways of working, without the constraints of historic buildings, narrow streets and obsolete infrastructure.

By 2045, there are likely to be around 280 megacities (cities with more than 20 million inhabitants4). Many of these could be agglomerations spanning administrative, and in some cases national, boundaries thereby driving integration and changing governance structures. Europe, for example, may have more than 20 major agglomerations by 2045 – the German Ruhr region, much of the Netherlands and Belgium could become a single gigantic urban area. The taxation rights of some major cities could make them major regional or international actors.

Urbanisation often results in increasing requirements for energy (particularly electricity), which could be a source of considerable tension unless it is provided in a sustainable way. Once people have access to energy, they are likely to always expect it. Some cities, in both developed and developing countries could fail (for example, becoming bankrupt or seeing a breakdown in law and order) – potentially becoming security issues. Correctly managed, though, urban growth could generate greater prosperity and higher tax revenues, potentially offsetting some of these more negative aspects.

Because of their concentrated populations, when disasters (whether natural or man-made) strike cities, large numbers of people are affected. Many of the biggest cities, a number of which are vital to the global economy, are situated in coastal regions which could face more extreme weather events and be vulnerable to rising sea-levels. Furthermore, because of inadequate sanitation, slums could be susceptible to communicable

diseases – which could then spread globally because of increased connectivity between cities.

Page 18
Water

Even at current population levels, supply of fresh water is, arguably, insufficient. Factors such as population growth, increasing demand from industry and agriculture, and reliance on unsustainable water sources (such as aquifers) are likely to mean that many people may not have reliable access to adequate supplies of water. By 2045, global agricultural water consumption could increase by 19%, with global fresh water demands likely to grow by 55% in the same period. Estimates of those suffering from water shortages today vary between 450 million and more than 1.3 billion people. Without mitigation, by 2045 or sooner, around 3.9 billion people – over 40% of the world's population – are likely to be experiencing water stress. This represents a significant increase on the estimated 2.6 billion people suffering water shortages in 2000.

The poorest people often have extremely limited access to fresh water. Someone living in a slum may only be able to access about five to ten litres daily, while a middle- or high- income individual living in the same city may use about 50-150 litres per day. An estimated 2.2 million people die every year from diseases that cause diarrhoea because of inadequate water and sanitation. This is still likely to be problematic by 2050, when 1.4 billion people (mainly living in developing countries) are unlikely to have basic sanitation. Efforts to improve safe water supply and health-care access have succeeded in reducing deaths from diarrhoea, but these gains may be thwarted as the number of people living in slums increases, while environmental change places further stress on fresh water availability. However, there continues to be advances in water desalinisation technology, as well as activity to reduce water waste and improve water utility. Improvements in waste treatment and purification technologies offer hope that in the future more water could be reused or recycled.

A shortage of water could lead to countries (and communities within them) diverting water for their benefit to the detriment of others. Many water resources are shared by more than one country – 263 river basins and 269 aquifers are shared by two or more countries, and 21 rivers and four aquifers cross the boundaries of more than five countries. As demand for water intensifies, it could lead to conflict. Some experts argue that water scarcity drives closer cooperation and, despite tensions, no modern state has ever declared war on another solely over water. But there are a number of reasons why violent conflict over water may occur by 2045 or sooner. For example, global demand is likely to increase while supplies of fresh water dwindle, yet water management issues are likely to become increasingly complex. The effects of environmental and climate changes will also probably become more severe in many locations, potentially out-

weighing any beneficial consequences.

Page 22
Food

By 2045, food production is predicted to have increased by nearly 70%, to feed a larger and more demanding population – and it is possible that demand could outstrip supply. Some types of consumption are likely to grow particularly strongly. As affluence grows in the developing world, the demand for more protein-rich diets is also likely to increase. China, for example, has seen meat consumption increase by 63% between 1985 and 2009, and this trend seems likely to continue. Pollution and soil erosion are likely to adversely affect agricultural land . . .

Growing use of nuclear energy raises the possibility of fissile material being obtained by non-state actors as well as states operating outside international laws, potentially causing security threats.

Page 23
Growing US energy independence

A key change to the global energy market by 2045 is likely to be growing US energy independence, driven by recently adopted novel oil and shale gas production techniques such as 'fracking'. If the current increases in production continue, the US looks set to become the world's number one oil producer by around 2020 and a net exporter by 2030,

Page 28
Resource protectionism

Increased demand for critical materials – which could include oil and water – has seen governments adopt protectionist measures to boost revenues and secure access to resources. These practices are likely to endure out to 2045. Anti-competitive behaviours such as expropriation of foreign companies, export restrictions, cartel-pricing behaviour, 'land acquisition' or high taxation are forms of resource nationalism designed to restrict international supply. For example, potash (used in agriculture) is increasingly subject to government-to-government trade deals rather than being traded on the open market. Rising demand for, and concerns over, access to rare earth elements could continue to motivate countries in trying to develop or secure their own sources of supply, bypassing international markets. While running out of these materials is unlikely within the 2045 timeframe, reliability of supply could be an issue because they are only mined in a very small number of countries (for example, China produces 86% of all rare earth elements). If one of those countries restricted supply, it would be likely to have a significant impact

on availability and price. However, such action is not without its costs. Unpredictable and retro-active policy changes to protect resources can, for example, lead to a drying up of foreign investment or customers.

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Defence and security implications

■■ Competition over some resources is likely to intensify and exacerbate existing political and security tensions, potentially acting as a catalyst for intra-and inter-state conflict.

■■ Demand for food may outstrip supply, leading to a rise in costs. Food shortages could lead to sharp price spikes, which could result in instability in those areas unable to absorb the increase.

■■ Climate change could contribute to increasing incidences of crop failure, potentially causing disruption to global food supplies.

■■ Growing use of nuclear energy raises the possibility of fissile material being obtained by non-state actors as well as countries operating outside international laws, potentially causing security threats.

■■ A reduced requirement for Middle Eastern oil by the US, coupled with a shift in the Middle Eastern markets toward Asia, could bring the US commitment to defence of Middle East export routes into question. However, US involvement in the Arabian Gulf is unlikely to alter significantly. But the US may look to other countries, including China and the EU, to play a greater role in security provision in the Middle East.

Page 30
A growing population will demand more food and water, increasing the strain on the environment out to 2045. As centres of population cluster in vulnerable areas such as coastal regions, the consequences of adverse weather are highly likely to be felt more keenly. By 2045, climate change is likely to have more noticeable effects. Without mitigation, rising sea levels will increase the risk of coastal flooding, particularly in regions affected by tropical cyclones. Droughts and heatwaves are also likely to increase in intensity, duration and frequency. Some of these events could precipitate natural disasters which, because of the interdependencies enabled by globalisation, may have consequences far beyond the site where the disaster occurs.

People and the environment

Human activities are likely to continue to have an impact on the environment. The proc-

esses of urbanisation, deforestation, industrialisation, agriculture and fishing have damaged the natural environment. By some estimates, pollution and soil erosion have led to as much as 25% of available land being degraded. Similarly, over-fishing and pollution have reduced the amount of food that can be harvested from the oceans. However, more sustainable farming and fishing methods and better industrial and urban practices could mitigate these adverse effects.

Climate change

Inertia in the climate system means that historic greenhouse gas emissions will almost certainly affect the climate for the next few decades, regardless of any mitigating action taken. By 2045, average global temperatures are likely to have increased by approximately 1.4°C above levels recorded at the end of the 20th century. Without concerted action, it is unlikely that it will be possible to prevent global average temperatures rising more than 2°C above pre-industrial levels. Although there may appear to have been no significant increase in temperatures over the last 10-15 years, periods of slow-down and speed-up in global temperature trends have occurred before, and are likely to occur again. Energy which would usually manifest as a rise in surface temperature is also being absorbed elsewhere in the Earth system, primarily in the oceans. Observations of ocean heat content and of sea-level rise re-enforce this conclusion.

Page 32
Without meaningful effort to secure global consensus on the scale of the problem and how it should be tackled, it will almost certainly be challenging to limit global temperature increases. By the end of the century, the Earth's climate is likely to be substantially warmer and different from today's. A large body of scientific evidence indicates that climate change is mostly being driven by human-caused greenhouse gas emissions particularly carbon dioxide (CO2) from generating poser. While the proportion of CO2 emitted by developing countries (particularly India and China) is likely to increase significantly out to 2045 without mitigating action, on a per capita basis, most developed countries' emissions are likely to remain higher than those of most developing countries.

Abrupt events (or tipping points) such as the failure of the Indian monsoon, changes in large-scale ocean circulation (for example a weakening of the Gulf-stream), substantial melting of the Greenland ice sheet and the release of large quantities of methane from the ocean floor are possible. All could cause major global disruption, although it is not possible to quantify the likelihood of these events occurring by 2045. Heat waves and extremely hot days are likely to become more frequent and intense, as are droughts, while instances of extreme cold are likely to reduce. It is also probable that instances of intense rainfall will increase and that extra-tropical storms move pole-ward.

Historically, the flooding in Pakistan in 2010 displaced an estimated 20 million people,

and damaged 1.6 million homes. Similarly, some experts believe that a 2.5cm rise in sea levels would displace 50 million people in the coastal regions of India. The economic impact of extreme events is uncertain, but losses per event from 1980-2010 ranged from a few billion US dollars (USD) to over US$ 250 billion in 2005 following Hurricane Katrina. It seems likely that developing countries will feel the economic impact of climate change particularly sharply, as they are unlikely to have the resources to mitigate its effects as successfully as more developed countries.

The Arctic is likely to see significant change with the melting of sea-ice opening up new routes across the Arctic Ocean during the summer months. Reduced summer sea-ice may present opportunities as new trade routes and areas rich in natural resources open up for exploitation. Thawing permafrost could make transportation to and from Arctic oil and gas facilities problematic as ice roads turn to marsh, particularly in Siberia. The softening of the ground is likely to make new areas suitable for agriculture.

Page 33
Rising sea levels

Global sea-levels are likely to rise by between 0.32–0.38 metres by 2050, although larger increases cannot be ruled out. The effects of sea level rise will not be uniform across the globe and there will be regional variations which affect the vulnerability of certain coastal regions. Currently, between 270 and 310 million people are believed to be at risk of coastal flooding. By 2045, a growing number of low-lying islands could be at risk of near total submersion – displacing entire communities. Without measures to mitigate and adapt to the effects of sea-level rises, by 2045 there could be between 80 and 130 million more people at risk from flooding, three-quarters of them in Asia.

Page 34

Around 20-30% of plant and animal species could be at high risk of extinction due to climate change . . .

Water

Future water stress is likely to be mainly driven by socio-economic factors. The frequency, intensity and duration of droughts in many parts of the world are likely to increase. Climate change is likely to contribute to longer-term changes in water availability, particularly in areas dependant on glacier melt-water. The continued melting of glaciers could increase freshwater availability out to 2045, but may bring with it an increased risk of localised flooding. In the longer term, as glaciers melt, the inter-annual reliability of the supply of water in glacial rivers will be affected. Changing rainfall patterns may mean declining water availability for some, and an excess for others.

Marine life

Marine ecosystems are expected to undergo substantial change by 2045. For example, numerous studies suggest that the increasing acidity of the ocean (due to greater absorption of carbon dioxide) will have harmful consequences for calcifying organisms such as coral reefs and many species of shellfish. Around inland and coastal areas, changing patterns of freshwater runoff, droughts, floods, increasing temperatures and rising sea levels could all have a significant negative effect on fisheries and aquaculture. Inland fisheries are particularly vulnerable to low water levels, changes in spawning grounds, water extraction and modifications to river courses (such as the construction of dams). Freshwater runoff could reduce the salinity of seawater, adversely affecting fishing grounds and coral reefs. Aquaculture depends heavily on adequate water exchange and is vulnerable to temperature extremes and storm damage, particularly in coastal areas.

Biodiversity

The impact of pollution, habitat destruction and climate change will almost certainly have a profound effect on wildlife. Some species are likely to adapt to the changes in their environment but many may not be able to. More species will almost inevitably become extinct, with the OECD's projections indicating that terrestrial biodiversity could decrease by up to 10% by 2050.20 The UN assesses that biodiversity loss has been more rapid in the last 50 years than in any other period in human history, a trend that some commentators suggest shows no sign of slowing. Around 20-30% of plant and animal species could be at high risk of extinction due to climate change. Reduction in biodiversity decreases the natural environment's resilience when adapting to change, since genetic diversity is the raw material for evolution.

A reduction in biodiversity could also lead to the loss of organisms that keep pest and disease species in check. There may also be significant economic consequences to biodiversity loss, with some suggestions that the annual cost to the global economy is between US$ 2bn and US$ 5bn. Reduction in biodiversity may also place food supplies at risk. At present, four crops (rice, wheat, maize and potato) provide more than 60% of global food energy. Relying so heavily on such a small number of crops means that, if growing conditions change (due to drought, increased temperatures or flooding, for example), we may not have sufficient genetic variety to be able to breed crops to cope with these environmental stresses.

Agriculture

The impact of climate change on agriculture is complex and region-dependent. Adverse

impacts (for example, heatwaves, droughts, storms and flooding) are expected across tropical regions and much of the Mediterranean basin. Higher latitudes are likely to experience a range of both positive and negative impacts (such as changes in water availability, heat stress , increased growing seasons and decreases in the occurrence of frost damage).

Indirect impacts of climate change – wildfires, land degradation, pests and diseases, extreme rainfall and sea- level rise – could have significant effects. For example, it is currently estimated that each year 10-16% of the total global harvest is lost to plant diseases, and climate change could increase this figure by 2045. Nevertheless, a great deal of the world's agricultural potential is unused or under-used. If this 'yield gap' could be closed, perhaps by technological improvements, GM crops and improved methods of agriculture and farming, the trend towards a decrease in food production could be slowed or reversed. Even using current technology, the potential exists to increase production by up to 40%.

About 60% of the workforce in developing countries (around 1.5 billion people) is employed in agriculture, livestock, fisheries and tourism. While the proportion of people working in these areas is expected to reduce (not least due to increased urbanisation), many are still likely to depend on the health of the natural environment for their livelihoods and may therefore be particularly vulnerable to the effects of climate change and environmental degradation. Degraded and threatened environments are likely to lead to affected communities migrating – with potentially destabilising consequences.

Page 38
Reducing greenhouse gas emissions is likely to be the most important means by which climate change is managed – although out to 2045 it appears likely that the drivers of greenhouse gases will continue to increase. Inertia in the climate system means that warming would continue even if emissions were cut to zero tomorrow. Catching greenhouse gases before they are released into the atmosphere through techniques such as carbon capture and storage could play a vital role in reducing climate change – particularly while fossil fuels remain a major energy source. Although at an early stage of development, and with questions remaining about whether they could operate on a large scale, more advanced carbon capture technologies have the potential to convert carbon into useful products such as plastics. At a local level, constructing flood defences, altering agricultural practices in light of changing weather patterns and implementing water conservation measures are likely to be the primary means of adapting to the effects of climate change.

Page 57
Alongside privacy issues, it is also likely to become harder to go 'off-line'. Those who do may even find that they have made themselves more conspicuous by their absence.

Page 54
Information
Revolutionary advances in how we acquire, store and analyse information, together with dramatic increases in computer processing power, are likely to give us the ability to predict accurately a wide range of phenomena, from crime hot-spots to the effects of climate change. As everyday objects are increasingly connected to the Internet, this vast network of sensors is likely to gather data on more aspects of our lives and the environment, making it hard for anyone to go 'off the grid'.

'Big Data'

In 2000, 25% of the world's information was stored digitally: today it is more than 98%. On this trajectory, by 2045 there will be 20,000 times more digital information than there is today. The ability to collect and analyse this growing volume of information has been termed 'Big Data'. Such a large amount of data generates yet more information when appropriately analysed, allowing us to identify patterns which may help to counter the spread of disease, combat crime and even predict social and behavioural patterns.

Access to information has until now only let us understand the past, leaving it to people to extrapolate and imagine what this may mean for the future. Big Data is increasingly allowing us to predict future behaviours accurately. Complex data sets which contain crime records, meteorological data, and behavioural heuristics are starting to be used to map probable crime locations3 – and in the future they are likely to deliver far more sophisticated forecasting tools. The advances in computation power mentioned previously are likely to enable further analytical processes development. This could provide the ability to model very large and complex systems more accurately to make predictions in areas such as climate change and population movements.

While Big Data could become important in helping solve some complex global issues, businesses may also become increasingly dependent on it – we are already seeing Big Data being used to predict consumer behaviours. Accountability and situational awareness are likely to increase too, as more aspects of life are quantified and analysed. (StopTheCrime.net - Note: BIG META-DATA - advancing to thought police, thought crimes - watch the movie Minority Report)

Page 55
The 'Internet of Things'

The number of devices linked to the Internet is increasing rapidly, with everything from mobile phones to cars and even fridges having an Internet connection. This 'Internet of Things' is already a reality, with around 20 billion devices already connected, rising to

an estimated 40 billion by 2020. If that trajectory were to continue, there would be around 100 billion devices connected to the internet by 2045. However, increasing availability (not least because they are becoming cheaper and smaller) is likely to lead to a sharp increase in the number of connected devices, so that by 2045 there could be around 50 trillion devices connected to the internet. These devices are likely to be producing and sharing vast amounts of data and information while connected to each other and to additional systems. Such a large number of devices connected across the world will almost certainly require a significant increase in communications infrastructure. The costs and technical challenges involved are likely to mean that there are some global disparities in access, at least in the short to medium term.

Page 56
People in many parts of the world are used to having mobile phones and computers with Internet connections, but by 2045, it is likely that numerous objects will contain some kind of sensor. There will probably be ubiquitous, tiny and cheap monitors reporting on the quality of drinking water, detecting structural damage in buildings and vehicles, and sensing and measuring pollution in the environment. Machinery and consumer products are likely to be monitored for the state of their components and materials, enabling them to report when repair or replacement is necessary. With progress in nanotechnology, vast networks of security sensors could provide continuous monitoring of critical infrastructure (such as buildings, bridges and pipelines), detecting chemical and biological attacks. The fusion of data from a range of sensors, combined with inputs from public sources such as social networking sites, will probably improve profiling and tracking capabilities. Stealth vehicles are likely to find it more difficult to remain hidden and the ability to prosecute covert operations, particularly in urban environments, is likely to become more technically challenging. As the number of connected public sensors increases, the information advantage currently enjoyed by countries' defence and security forces could be eroded or even reversed as adversaries, including non-state actors, attain similar levels of situational awareness.

Page 58
The uptake of social networking sites and even the use of supermarket loyalty cards shows that – for comparatively small rewards – people are readily persuaded to record their movements, financial transactions and buying habits. This behaviour is highly likely to continue out to 2045.

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National Authorities are almost certain to seek to use this potential mine of information – a development that is likely to raise major privacy concerns. Marketing campaigns are likely to portray the benefits of smart technology and machine- to-machine interaction, but the increased surveillance capability may make others fear an increase of state control. In turn, this is likely to drive the growth of the 'hactivist' community characterised

by groups such as Anonymous. However, it is likely to be increasingly difficult to avoid the sensor network of a future 'Internet of Things', since even remote environments are likely to contain some connected devices. A desire not to be part of the 'Internet of Things' may create new markets, for example a holiday resort advertising its facilities as literally 'getting away from it all' with a promise that you will be completely 'off-grid'. This could also lead to a drive to try to create spaces, both physical and virtual, which are unseen or ungoverned by state authorities around the world.

Defence and security implications

■■ Quantum computing could make all codes 'crackable' and genuine encryption impossible, as a quantum computer could theoretically try every possible combination of codes simultaneously to unlock a system. If this is the case, armed and security forces may have to physically separate their computer systems from the Internet, posing huge problems for networking and efficiency. Alternatively quantum cryptography could guarantee security of a message.

■■ Better gathering and analysis of data could vastly improve our understanding of physical and virtual environments. Predicting crime hotspots could enable more targeted deployment of police officers. Greater awareness of deficits and surpluses may make logistics more efficient. Similarly, detailed and rapid analysis of social networks could provide a deeper understanding of the local population, its culture and the environment.

■■ As more of our work and social activities depend on interconnected information and communications networks – which may, in places, be extremely vulnerable to attack – there could be more opportunities for criminals and terrorists to have a greater impact on our day-to-day lives. Similarly the ability to keep secrets is likely to become increasingly difficult.

■■ Connectivity of assets with strategic importance (such as those relating to national infrastructure) is likely to increase. Although this is likely to lead to gains in efficiency, it may also make such assets more vulnerable.

■■ An increasing number of devices capable of collecting sensor data could intensify levels of surveillance. Stealth vehicles may find it more difficult to remain hidden and the ability to prosecute covert operations, especially in urban environments, is likely to become more technically challenging. This is particularly significant given the probable increase in the size of urban areas, along with the growing use of surveillance to prevent crime.

■■ As the number of connected 'public' sensors increases, the information advantage currently enjoyed by countries' defence and security forces could be eroded or even reversed as adversaries, including non-state actors, attain similar levels of situational

awareness.

Education

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Institutions in Europe, Northern America and Australia may increasingly run their highest quality programmes from campuses in developing countries, as well as introducing more distance-learning courses. As more people learn outside their country of origin, and migrate to pursue careers, it is likely that there will be a drive to "standardise qualifications" at the global level. Even if a common global curriculum is not universally of a common global system. Across the developed world, many schools are likely to be increasingly run (or at least sponsored) by powerful corporate organisations.
Access to education could also become more polarised, depending on wealth or ability to pay. Students may be separated into vocational and academic streams from a young age. As corporate involvement in education grows it may encourage children's entry to one or other stream at even earlier ages, as corporations and organisations (including the armed forces) seek to identify – and train accordingly – the strongest future performers.

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Machines, jobs and education

Machines are likely to take over certain jobs from people, with developments in artificial intelligence ultimately meaning that education could focus on those (few) areas of human thought and activity that machines are unable to deliver efficiently. This means that education may play an important role in enhancing people's ability to develop new ideas, to interact empathetically with other people and to take responsibility – all things that it is difficult to envisage machines doing by 2045.

Defence and security implications

■■ Global education levels are likely to increase, but educational inequalities will probably persist, entrenching social discontentment and allowing youth disaffection to continue.

■■ In the new education and training mix facilitated by employers, online and virtual blended learning are likely to predominate, though formal face-to-face learning is unlikely to die out completely.

■■ Some countries may begin to educate and train children assessed as having the potential to succeed in specific careers (including in the armed forces) from a very young

age.t1

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Robots or ‘unmanned systems’ – machines capable of carrying out complex tasks without directly involving a human operator – are likely to be as ubiquitous in 2045 as computers are today. Unmanned systems are increasingly likely to replace people in the workplace, carrying out tasks with increased effectiveness and efficiency, while reducing risk to humans. This could ultimately lead to mass unemployment and social unrest. As robots become more lifelike, perhaps capable of appearing to express emotion, interactions with people are likely to become more sophisticated. The increased capability of robots is likely to change the face of warfare, with the possibility that some countries may replace potentially large numbers of soldiers, sailors and airmen with robots by 2045. However, military decision-making is likely to remain the remit of humans for ethical reasons, at least in western countries. Others may not be so willing to make the same trade-offs between speed and accountability.

The proportion of older workers in the global labour force is likely to increase out to 2045, with a possible corresponding "decrease" in opportunities for younger people. Flexible working practices are likely to become more widespread, with people employed on shorter-term contracts and a growth in working remotely. Workers will probably have less predictable income and increasing economic insecurity. By 2045, there is likely to be greater equality between men and women in the jobs market, particularly in the developed countries. In part, this may be driven by a global shift away from manual labour, towards a more knowledge-based economy.

By 2045, it is even possible that robots will take on combat roles.

Automation and Work
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Development in robotics may mean that robots are almost physically indistinguishable from human beings . . .
Global manufacturing is currently evolving from a highly labour-intensive process towards more information technology- based processes. This is, in places, driving a trend towards manufacturing processes relocating closer to their consumers, to avoid long supply chains. This could affect the balance of manufacturing in the developed and developing world, with less need for conventional manufacturing jobs in many regions. Automation already facilitates this trend, and we expect to see additive manufacturing (more commonly known as ‘3-D printing’) also making a significant contribution. Additive manufacturing has the potential to transform the manufacturing industry, with performance and cost- effectiveness rapidly improving to the point where large-scale adop-

tion for manufacturers is plausible well within the 2045 timeframe. 3-D printing enables on-demand production, allowing items to be created quickly when an order is placed, rather than large amounts of costly stock having to be held in readiness for prolonged periods. With more decentralised production, products could be designed and printed for local consumption, potentially reducing reliance on expensive imports and requiring less industrial infrastructure than conventional manufacturing. It is also likely that personal use of 3-D printers will increase rapidly, allowing for unprecedented levels of mass customisation and even the 'democratisation' of manufacturing, as consumers and entrepreneurs begin to print their own products. By 2045, additive manufacturing systems could be a common feature in the home and be capable of producing a wide range of outputs – food, clothing, and even complex devices with mechanical and electronic components.

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As robots become more sophisticated, taking on a wider range of responsibilities, novel legal questions will almost certainly emerge. For example, when robots malfunction, is it the owner, manufacturer or programmer who is responsible? Does a robot with biological components have rights? Changes to legislation will almost certainly be required, but past experience suggests it is highly likely that legislation will fail to keep up with the speed of technological developments.

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Maritime choke point

By 2045, sea lanes are likely to continue to play a major role in the global economy, despite probable advances in additive manufacturing and improvements to air and land based transport. On current forecasts, the tonnage of goods transported by sea is likely to double within the next 30 years. Anticipated growth in computing power, situational awareness and automation could mean that the shipping of goods will be quicker, cheaper and more reliable. Shipping is also likely to be safer than ever before, driven by more accurate long-range weather forecasts and improved ship construction and operating procedures. As such, a significant amount of the world's economy would depend upon maritime trade - some countries could face major financial crises if sea transport became significantly disrupted.

If tensions rose between countries near to a vital maritime choke point, particularly if threats to block the sea lane were made, the international community would almost certainly act. Countries that are likely to be highly internationally active by 2045 (such as Brazil, China and the US) could be expected to work together to try and find a resolution. Should diplomatic efforts fail to reduce tensions, the international community could approve the deployment of an international naval task force to ensure that key sea lanes were kept open. Land-based international observers could be deployed to those

countries bordering the choke point and air, cyber and space surveillance of the region is likely to be intensified.

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Defence and security implications

■■ Antimicrobial-resistant infection could significantly increase medical risk on military operations.

■■ Novel medical and surgical interventions will almost certainly improve casualties' survival, and recovery rates.

■■ Advances that allow patients to interact with their prosthetics and other aids are likely to lead to new ways to connect the able-bodied to machines and computers.

■■ Some countries (and individuals) are likely to use advanced medical techniques, such as genetic modification, to gain a competitive advantage. Others will probably constrain their development for ethical reasons.

Drug and treatment delivery

In 2001, the first camera pill was approved by the US Federal Drug Administration for diagnostic applications. Seven years later, a pill capable of being electronically programmed to control medicine delivery according to a pre-defined drug release profile was ready for serial manufacturing, and being used as a research and development tool. Current advances have produced a pill which can monitor the patient, communicate with external diagnostic systems and respond to instruction for the targeted delivery of drugs within the digestive tract. The next evolution will probably see further integration of monitoring and drug delivery, with automated diagnostic and response systems. As technology advances, the size of devices is likely to be reduced while retaining the same capability. It seems probable, therefore, that there will be future medical devices small enough to travel in the bloodstream.

Page 43
As we live longer, different types of diseases, such as dementia, are likely to become more prevalent. Current estimates indicate 35.6 million people worldwide are living with dementia. This is likely to double by 2030 and more than triple by 2050 if no treatment is found. Dementia is a costly condition.

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Mental health conditions are the leading cause of healthy years lost worldwide.
Mental health

The global cost of mental health conditions in 2010 was estimated at US$ 2.5 trillion. This is likely to more than double to US$ 6.0 trillion by 2030. Of these costs, 65% are incurred by developed countries and this is not expected to change over the next 20 years. By disease, mental illness accounted for the largest share of the global economic burden in 2010 and is likely to in 2030, just slightly more than cardiovascular diseases (followed by cancer, chronic respiratory disease and diabetes). Mental health conditions are the leading cause of healthy life years lost worldwide and account for 37% of the healthy life years lost from non-communicable diseases.

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Obesity
Were obesity to be considered a disease, there would arguably already be a global obesity pandemic. By 2008, an estimated 1.5 billion adults globally were overweight and 500 million adults were obese. An estimated 170 million children globally were also classified as overweight or obese. This includes more than 25% of all children in some countries – more than double the proportions from the start of the global rise in obesity in the 1970s. Unlike other major causes of preventable death and disability, such as tobacco use, injuries and infectious diseases, there are no examples of populations in which rising obesity has been reversed by public health measures.

The increases in obesity in adults are widely projected to continue to rise in the next 10 to 20 years. PageDevelopments in technology are likely to lead to significant improvements in medicine and health, such as the potential fordeveloping cures for

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GEOENGINEERING

Theoretically plausible geoengineering methods (intentional, large-scale activities intended to counteract aspects of climate change) have been proposed for a number of years. Detailed studies on the environmental implications of different geoengineering activities have recently begun to appear, but large-scale testing and implementation of such methods has not occurred - in some cases due to public opposition. One theoretical "solar" not occurred – in some cases due to pub radiation management’ technique would aim to disperse sulphates into the upper atmosphere, reflecting the sun’s rays back out to space, producing a cooling effect. However, as with most geoengineering techniques, there are questions about how to maintain the intervention, and minimise the potentially

harmful side-effects. For example, it is not known what the long- term effects of dispersing large quantities of sulphates into the atmosphere would be. Over-reliance on particular geoengineering technology to mitigate the effects of climate change could also render users vulnerable radiation management' technique would aim to disperse sulphates into the upper atmosphere, reflecting the sun's rays back out to space, producing a cooling effect. However, as with most geoengineering techniques, there are questions about how to maintain the intervention, and minimise the potentially harmful side-effects. For example, it is not known what the long- term effects of dispersing large quantities of sulphates into the atmosphere would be. Over-reliance on particular geoengineering technology to mitigate the effects of climate change could also render users vulnerable to catastrophic effects if equipment failed or was sabotaged. It is not clear therefore what, if any, role geoengineering will play by 2045 in countering the effects of climate change, and the extent to which it could heighten international tensions.

Defence and security implications

■■ Extreme weather events, such as flooding and droughts, are likely to increase in both frequency and intensity in a number of regions. Extreme events will almost certainly continue to cause widespread damage and loss of life, although our warning mechanisms, defences and ability to respond may also improve in the same timeframe.

■■ Reductions in the extent of summer Arctic sea-ice could open up new shipping routes during the summer months and boost economic growth in the region – increasing its strategic significance for many countries.

■■ Degraded and threatened environments are likely to lead to affected communities migrating – with potentially destabilising consequences.

■■ Armed and security forces, both at home and abroad, are likely to be more frequently tasked with providing humanitarian assistance and disaster relief, perhaps supporting indigenous responders.

■■ Without mitigation measures such as carbon capture and storage, continued reliance on coal and hydrocarbons for the majority of energy demand may exacerbate climate change and its knock-on effects.

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Material

Potential applications

Miniaturisation

DNA nanotechnology to fabricate nano-scale devices.

The self-assembly mechanism of DNA could be harnessed to fabricate mechanical, electrical and optical devices
and circuits that may be ten times smaller than current technology allows.

Significant expansion of the capabilities of computers, such as improved processing power; better ability to synthesise materials by design; the development of advanced therapeutic and drug delivery systems; and ultimately, the development of nanobots.

New developments in piezoelectric materials (materials that turn kinetic energy into electrical energy) could allow devices without batteries to run on power harvested from vibrations and operate at more extreme temperatures.

Constructing devices able to operate in normally unreachable or unsafe locations, such as the monitoring environmental conditions in places too dangerous for humans.

Replacements for traditional materials -

Micro-alloys such as palladium-based metallic glass with a strength and toughness greater than any known material.

May be used in small-scale components, leading to better- constructed aircraft and spacecraft.

Graphene paper. Flexible and inexpensive to produce, and around ten times stronger than steel.

Replacements for a range of conventional and existing composite structural materials, far stronger than those available today. Could also support miniaturisation and sensors with greater sensitivity and accuracy.

Responsive materials - Magnetic shape-memory alloys. Materials that change shape and mechanical properties when a magnetic field is applied.

Ultra-efficient engine valves that open and close automatically; positioning tools for microsurgical procedures; sensors for detecting environmental contaminants; and less toxic batteries. Applications likely to be limited to a small scale, due to the challenge of integrating the required high magnetic field actuation system.

Self-repairing metal. Metal that responds to damage by ‘healing’ itself, such as nickel super-alloys with designed- in defects that allow cracks to repair themselves under normal loading conditions.

Better structural materials that could be used in turbine blades, giving better resistance to fatigue.

Information-providing protective coatings. Chemical reactions that are triggered by various failure mechanisms, resulting in a change of visual appearance to indicate when maintenance or repair is required.

Active corrosion protection systems; coatings which indicate exposure to chemical or biological agents; coatings which indicate aging.

Metamaterials

Artificial materials engineered to exhibit properties that only rarely occur naturally

Nanospheres. A transparent material made of self- assembling nanospheres that is the stiffest organic material ever created, surpassing the properties of stainless steel and even Kevlar.

Revolutionary improvements in body armour, with the potential for new ways to customise products, such as printed body armour. A component for strengthening existing metals and composites; creating medical implants.

Ultra-lightweight and ultra-absorbent materials such as highly-porous carbon constructs one-sixth the density of air and highly absorbent.

Current materials used for cleaning up oil spills absorb around ten times their weight in oil, but new materials show potential to handle 900 times their weight in oil with very high rates of absorption. Capture and transport aerosols such as pollutants and water vapour.

Jelly-forming polymers so effective that a kilogramme of the compound could turn the water within an Olympic-sized swimming pool into jelly.

Treating wounds; altering or denying access to waterways.

Programmable matter. Materials that can be programmed to alter themselves at the molecular level into various shapes and then disassemble to form entirely new ones.

Compounds that can reform the shape of components
in real-time, similar to holograms, could allow the remote projection of a replica of a person or object, or enable robots to change size (and perhaps even state of matter) to navigate narrow passages or around obstacles.

We have inserted the Conflict MAP below from an earlier edition of the Global Strategic Trends Program 2007 - 2035 . .
GLOBAL STRATEGIC TRENDS PROGRAMME: 2007-2036 . . .

http://www.cuttingthroughthematrix.com/articles/strat_trends_23jan07.pdf

Strategic Trends is an independent view of the future produced by the Development, Concepts and Doctrine Centre (DCDC), a Directorate General within the UK's Ministry of Defence (MOD). It is a source document for the development of UK Defence Policy.

This edition of Strategic Trends is benchmarked at December 2006. It is a live document and will be updated regularly on our website as new thinking emerges and trends develop.

'I have but one lamp by which my feet are guided, and that is the lamp of experience. I know no way of judging the future, but by the past'.

'People who worry about problems that others are not worrying about are irritating and are disparaged after the event. People who were right when others were wrong are even more irritating'.

We believe that the future will happen as a result of long-wave themes and developments that unite the past, the present and the future.

Rapid medical advancements
A game-changing medical breakthrough, similar in impact to
the discovery and mass-production
of antibiotics, could significantly
extend the human lifespan and dramatically reduce the incidence of non-communicable diseases such as cancers. Initially, this breakthrough would probably only be available to the very rich, exacerbating social tensions. As the treatment became accessible to everyone, there would be a significant impact on populations, as life span dramatically in-

creased. Without mitigating action, there could be a subsequent unsustainable increase in demand for food, water and housing.

Shock:

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We recommend viewing the entire 202 page report - here:

http://www.ieee.es/Galerias/fichero/OtrasPublicaciones/Internacional/2014/Global_Strategic_Trends_-_Out_to_2045.pdf

NASA PAGE
http://www.StopTheCrime.net/nasa.html

Global Strategic War Plans Page
http://www.StopTheCrime.net/globalwar.html