



EU research and innovation policy and the future of the Common Foreign Security Policy

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Disclaimer

The views expressed within this Report represent those of the authors alone and should not be construed as representing the position of the European Commission.

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Genesis

In 2004 ISIS Europe was awarded a tender under the Sixth Framework Programme for RTD to conduct a study into 'EU research and innovation policy and the future of the Common Foreign Security Policy'. The main objective of the study was to analyse the future challenges for CFSP, to provide the European Commission with scenarios related to a European Foreign and Security Policy, and to examine their implications for EU research and innovation policy. In addition to issues relating to crisis management, the European Commission wanted a long-term view on the future of CFSP that could shed light on key issues that the EU will have to face on the international scene until 2015 and on research needs in relation to such issues.

This is the Report that resulted from that study. It is divided into three parts: Part A identifies the 10 most important threats and challenges confronting the EU up to 2015; Part B refines these findings into a more precise analytical framework through the construction of five scenarios relating to the future European security environment; and Part C identifies the major implications of the scenarios for future developments in EU research and innovation policies – in particular its external dimension

Introduction

This Report analyses the future challenges for the European Union's (EU's) Common Foreign and Security Policy (CFSP) and assesses their implications for EU research, technology and innovation policy. In doing so it attempts to look over the horizon, beyond immediate security threats, to give a longer-term perspective (up to 2015) that will help to shape the future direction of EU policy in these areas.

The Report first identifies and examines the most important policy issues relevant to EU security over the next ten years. It then develops and refines that analysis through the use of five carefully defined scenarios. The major implications of those scenarios for the future of EU research, technology and innovation policy in relation to supporting CFSP are then explored. The Report concludes with a number of recommendations for particular research priorities, instruments and policies.

The Report aims to supplement the conclusions of the European Commission Report 'Security Research: the Next Steps', but does not address questions related to priorities for the Community-funded European Security Research Programme (ESRP) that will be launched by 2007 as part of the next Financial Perspective (FP7) 2007-13.

The Report is not tied to any particular research programme: rather, the aim is to inform overall research agendas in support of European security. The Report supports the recommendations contained in the Report of the European Parliament's Foreign Affairs Committee 'Security Research: the Next Steps' – produced in response to the Commission's Report – which call for a

more balanced interaction between research in the natural sciences and technology and other sciences, in particular political, social and human sciences.¹ The main recommendations of this Report address topics in social and human sciences.

This Report does not dispute the importance of research into technology to provide more security for the community's citizens. However, the Report also recognises the importance of understanding complex socio-technical systems requiring a more comprehensive approach to understanding the role of science and technology in both threatening and promoting security. Furthermore, the authors of this Report saw a particular need to take a comprehensive and forward-oriented look at security challenges, strongly endorsing the Commission's desire that any European initiative on security research should respect individual rights, democratic values, ethics and liberties. Security research should also work to promote social justice and cohesion, equality of opportunity, environmental quality, public health and human dignity. In a post-national world, the design of research and innovation policy should also take into account the other - potentially detrimental - effects that a predominantly military or technological orientation may incur.

¹ *Security Research – the Next Steps*, Report of the Foreign Affairs Committee, A6-0103/2005, para.15, p.6.

A. Meeting the key threats and challenges to 2015

The purpose of Part A of the study was to identify the 10 most important threats and challenges confronting the EU – drawing on the in-depth analysis of 15 leading experts (from various disciplines: social sciences, physical sciences; and institutions: universities, research institutes, NGOs, and think tanks), each of whom wrote a paper that was presented to, and discussed with members of the European Commission at a workshop in Brussels in 2004.² These threats and challenges were divided according to regional, horizontal and technological trends. A particular emphasis was given to identifying issues that were relevant to DG Research’s considerations for FP 2007-2013.

Introduction

Global insecurity is now brought about primarily by various impacts of the networked political economy and the ‘clash of civilisations’ in a world of borders that are highly permeable to flows of information, finance, goods and people. It arises from societal changes related to scientific and technological developments as much as from new types of vulnerabilities to human aggression and unanticipated byproducts of various types of human activity.

In the 21st century, the EU has turned its attention to how best to preserve and enhance its long-term security interests. A major step in this direction, in addition to practical activities within the European Security and Defence Policy, was the adoption of the European Security Strategy (ESS) in December 2003, by the European Council.³ The ESS provides, on the basis of a broad perception of security, a list of major threats to European security, political principles on how best to respond to them, and an outline of instruments already available to - or in need of development by - the EU.

Part of the challenge of how to achieve sustainable security in an increasingly interdependent world, is to add security concerns to the community’s research, science and technology agenda. This requires a review of research priorities, instruments and policies, a job partly already done within the framework of the Preparatory Action on ‘Enhancement of the European industrial potential in the field of Security Research 2004-2006’ and the European Security Research Programme foreseen for FP7.

Several key tasks remain to be done, however. One is to improve the dialogue between those conducting ‘peace and security’ research and those researching ‘science and technology’. Although there is an appreciation in both ‘camps’ that the work of the other is important to their own field, to date there has been comparatively little interaction between them. Another task is to mainstream within EU policy a common, but much wider definition of security.

² This Report contains a synopsis of the findings produced by these 15 papers. The full text of each paper from Part A can be found in the Annex attached to this Report.

³ *A secure Europe in a Better World*, Report drafted under the responsibility of EU High Representative Javier Solana, Brussels, 12 December 2003.

As the ESS clearly acknowledges, we need to move beyond relying solely on military means and develop a spectrum of policy instruments. These instruments should range from civilian ones - employed in conflict prevention, peacebuilding and in neutralising terrorism - to those intended to tackle the root causes of insecurity and conflict.

Understanding the socio-economic and cultural dimension of geo-strategic threats is often under-rated, and certainly under-funded, compared to simply seeking technological ‘solutions’ to the various manifestations of threats. By that time, it may be too late to prevent threats from becoming conflicts and materialising into seriously damaging situations. Investing in science, social and natural, and technology to forestall threats *before* they become critical is clearly a more cost-effective application of scarce resources than pouring money into coping with the *consequences* of them once they have become ‘live’.

Social sciences and humanities can offer no foolproof ‘solutions’ about how to bring about peace and security any more than “magic bullets” can be developed to perfectly safeguard European security. Consequently, it will remain important to continue to invest in applications of emerging technology to deal with the manifestations of threats as well as seeking their eradication at source. Moreover, it is important to develop greater understanding of the complex nature of socio-technical systems as related to security, an area that is under-researched at present.

This Report identifies the ten most important security challenges facing the EU until 2015 drawing upon the findings of 15 leading experts (from various disciplines: social, physical and engineering sciences; and institutions: universities, research institutes, NGOs, and think tanks). These are defined under three thematic headings namely, regional security trends, horizontal security trends and technological security trends. For the purpose of clarity and focus, the findings outlined below follow a designed template, which indicate recommendations respectively for FP 2007-2013 and for DG Research until 2015. These recommendations are based on future-orientated analysis structured under three sub-sections, namely: threats, challenges and opportunities. The main conclusions and recommendations are presented at the end of the Report, and set out a conceptual framework for the design of research and innovation policy to promote European security for the long term.

A.1 Regional Security Trends

A.1.1 Russia and Eastern Neighbours

Threats

Any serious deterioration in the relationship between Russia and the EU - very difficult to envisage at present – would raise once again the risk of the possible use of Weapons of Mass Destruction (WMD) in Europe. . The illegal export of nuclear material, as well as expertise, to countries of concern will continue to be a major worry over the next ten years at least. Organized crime and terrorism will also become more of a danger, partly because of the inability of some Eastern European neighbours adequately to enforce the rule of law and control their frontiers. While conventional military capabilities will decrease in the long term, some groups could acquire

advanced systems in the next decade (Global Positioning System jammers; rudimentary Unmanned Aerial Combat Vehicles etc.) that would improve their ability to conduct asymmetric attacks.

Challenges

The possibility of a further deterioration of civilian control over national territories, due to the collapse of legal systems, organized crime or the outbreak of civil wars, could require European intervention – perhaps even military intervention. The need to respond early and timely to secure materials and weapons of mass destruction as well as civilian research institutions would be necessary.

Opportunities

Between now and 2015 it seems preferable and possible to improve and develop those conflict-prevention and crisis management tools that are capable of containing local or regional conflicts.

Research recommendations

- Enhancing research-based knowledge of internal, national and transnational political and security developments in the region, including technological developments and capacities, in the context of the role of European security policy looking to 2015.
- In the long run, the aim of a European research plan for improved security responses should be to understand and influence the information flow in the conflict region. Thus, all the technologies for information gathering and assessment as well as social science-based analysis that is useful for understanding events should be developed.
- European security policy needs to start developing the capabilities necessary to negate the exploitation of networked systems by adversaries (media; C3 systems; dispersed weapon systems).

A. 1.2 Mediterranean Neighbours

Threats

By 2015 there could be a growing feeling of resentment towards the EU in the Mediterranean region, both in Northern Africa and in the Middle East, due to EU-imposed reforms (conditionality) and to a growing perception that the EU is not living up to its side of the bargain. Poor governance may also contribute to a possibly worsening economic situation in the South. The Israel/Palestine conflict could also flare up again, possibly leading to a wider regional military conflict. Although the conflict will not pose a direct security threat to the EU, it could have important negative consequences for EU interests. For instance, it is already an important cause of the stagnation of cooperation in the Euro-Mediterranean Partnership (EMP), and still feeds terrorism.

Challenges

Many existing regimes to the South do not have good records vis-à-vis democratization and the rule of law, nor do they inspire confidence for the future. The incomplete application of human rights clauses in the framework of the EMP has certainly not contributed in a positive way. As a result, the EU is often perceived as favouring stability over democratization. Given the gravity of the security environment, the future challenge for the EU is not only to focus on stability, but also to focus on representative grassroots democratisation processes.

Opportunities

There is a need to develop a new type of policy dialogue that includes security cooperation between the EU and Southern partners. This holds true especially in the field of the European Security and Defence Policy (ESDP), where the appointment of liaison officers to the EU Military Staff and, eventually, participation in ESDP manoeuvres and operations could be pursued.

Research Recommendations

- How to successfully build institutions in weak and/or undemocratic states that contribute to knowledge creation and to political, social and economic development.
- How to achieve accountability and benchmarking - with a sense of ownership - in the framework of 'positive conditionality'.
- Understanding the interaction between state and non-state actors and external partners in the framework of 'positive conditionality'.
- How to reform the security sector in authoritarian states.
- Development of communications policy and improving the perception of the EU.

A.1.3 Transatlantic relations

Threats

Although US unilateralism, especially in respect of a number of security-related issues, risks a strategic rift opening up with the EU, it is hard to imagine this developing to the extent that the US becomes a direct threat to the EU.

Challenges

In the short/medium-term, ideological shifts in the White House may reinvigorate a differentiated bilateralist US approach towards European states rather than a more symmetric US-EU partnership. This could be exacerbated if the differences in security perspectives are amplified by economic differences, possibly resulting in 'trade wars' that would affect the EU as a whole. Despite the solid foundation of common values, the fact that the US and the EU are the two most capable power blocs in the world, could lead to destabilising forms of competition and conflict.

Opportunities

Under Javier Solana's guidance, the EU has chosen to stick very closely to US initiatives, by developing its own strategy on WMD (despite disagreements about threat assessment), by writing together the 'roadmap' for peace in the Middle East (despite skepticism about the US's pro-Israel bias), and by using a very similar style of vocabulary and structure in the ESS to that used in the US National Security Strategy. Because of converging structural interests and because the US Administration will face difficult consequences of its policies (especially in the Middle East) there is room for a transatlantic rapprochement.

Research Recommendations

- Develop EU-US co-operation in major science and technology programmes and investments (ITER, through organisations such as the European Space Agency (ESA) and CERN, and joint research programmes in areas such as energy, environment and climate change, and on social science research related to security).
- Upgrade Science and Technology co-operation with other regional frameworks like the Southern Common Market (MERCOSUR), South African Development Community (SADC) and the Association of South East Asian Nations (ASEAN);
- Reinforce multilateral research cooperation between NATO countries, and involving North and South America and the EU.
- Conduct research on the EU-US *New Transatlantic Agenda* and *Joint Action Plan*, not only at the level of ministerial meetings and senior officials, but also medium and lower levels.
- Maintain investment to enable strategic autonomy from the US when necessary.
- Establish an EU Think Tank in Washington to conduct security analysis and to engage US decision makers and opinion formers in debates on transatlantic relations from a European perspective.

A.1.4 China and South and East Asia

Threats

The coming decade will witness a significant shift in the ‘balances of power’ associated with the growing wealth and power of China, which will raise inevitable security concerns. Risks of inter-state war and conflict will tend to pre-occupy Asian states, and this is a region where war between the major powers, including nuclear powers, may occur. US military power will continue to loom large for virtually every state in the region, either as a potential threat, ally or welcome outside ‘balancer’. Many states in the region will invest heavily in accumulating major conventional arms. A particular risk is the further nuclearization of Asia beyond the Indian subcontinent, including South Korea, Japan and Iran. Some states are at risk, in particular Indonesia, which could have major regional ramifications. Currently, the EU’s engagement with China is generally weak on key political and security issues. This situation needs to be rectified.

Challenges

There are several weak or failing states, raising associated concerns about transnational crime, terrorism, piracy, and complex internal or transnational violence. Numerous conflicts are ongoing, including in Nepal, Sri Lanka, Kashmir and Irian Jaya. India and Pakistan both possess nuclear arsenals, and North Korea poses direct challenges both to the Non-Proliferation Treaty (NPT) and to its North East Asian neighbours. Democratisation processes are powerful across much of these regions - including fragile states like Indonesia - which are welcome but will continue to instil tension and unpredictability.

Opportunities

External actors will have an important contribution to make to conflict prevention and reduction efforts in Asia. Appropriate wider international assistance from international organisations, the EU and ‘donor’ states such as the UK, France, US, Canada and Australia is vital (especially in the wake

of the 2004 Tsunami). A particularly important issue is to engage with actual or possible new nuclear states.

Research Recommendations

- More comprehensive research is required on the nature of inter and intra-state disputes, including economic, religious and cultural factors, and on cross-national institution building that could promote stabilisation and reduction of conflict.
- A greater research focus is required on the nature of failing states and how the phenomenon can be redressed.
- More expertise on Chinese International Political Economy is required.

A.2 Horizontal Security Trends

A.2.1 Trends in internal warfare - particularly in Africa

Threats

Sub-Saharan Africa is in particular danger of remaining within the conflict trap in the next decade. Political institutions and economies will continue to remain weak in most African countries. GDP per head is the lowest of all major regions of the world; economic growth is slack, economic diversification limited, and population growth high. HIV/AIDS will dramatically worsen the situation, because it predominantly disables and kills people in their most productive years and burdens social systems. Low economic growth is a major cause of civil wars.

Challenges

One future challenge is to find and promote technologies that support income generation in situations marked by political instability. Civil wars in Africa have potential spillover, particularly through increased refugee flows, health crises (HIV/AIDS) and inflow of illegal drugs. Media coverage - the 'CNN effect' - also may lead to stronger public calls for Europe to intervene in Africa, although the transience of media attention makes it difficult to sustain support for assistance over time. Other challenges include implementing effective development strategies, persuading African governments to accept institutional reforms, and the preparedness of EU Member States to invest in peace support operations.

Opportunities

There is a need and opportunity to increase our knowledge of particular conflicts and wars – requiring regional expertise on political institutions, social structures and conflict formations. Developing the New Economic Pact for African Development (NEPAD), African Union would be a good start.

Research Recommendations

- Social science research: regional expertise, research into the causes of internal wars and conflict resolution. Regional security analysis, effectiveness of development assistance, including the generation, uptake and application of knowledge to indigenous problems.
- Research on developing cheaper airlift capacity, as this would lower costs of military and humanitarian intervention.

- Peace support operations should become a particular focus of attention in military research.
- An important field of research involves exploring the conditions for re-establishing safe and stable post-conflict environments, for instance, security sector reform, turning war economies into peace economies and restarting devastated economies.
- Developing tagging techniques for small arms, ammunition, and equipment used in illegal exploitation of natural resources, to make it easier to disrupt illegal trade routes.
- Surveillance: sensors on various platforms, including satellites, are needed for better control over the flow of many types of goods (and people) traded illegally.

A.2.2 Trends in International Terrorism

Threats

The primary terrorist threat is likely to come from fundamentalist Islamists and their development of new methods - perhaps deploying chemical, biological, radiological, or even nuclear (CBRN) devices - as part of suicide attacks upon civilian targets. They will also deploy psychology and cyber-warfare techniques and continue to use the media. They will exploit failing states (sometimes in conjunction with organized crime) arising from empires disintegrating, under-development, and regional conflict.

Challenges

Counter-terrorist activities need to be applied in ways that are not counter-productive, resulting in the alienation of extremist communities. There is also a danger that a failure to provide proper and transparent risk assessments to populations will result in confusion and unrealistic expectations, a draining of support, and a backlash against political establishments. We need to be able to track, arrest and prosecute terrorists before they strike. The protection of key strategic assets can best be achieved through an integrated Homeland Security strategy. It is important to address the 'supply side' of CBRN by tightening controls, and the 'demand side' by influencing state behaviour using a variety of instruments (diplomacy, deterrence, protection). Regional diplomatic initiatives e.g. in the Middle East, are required, as well as educational programmes for allies (Saudi Arabia, Pakistan), spreading good governance, supporting social and political reform, dealing with corruption and the abuse of power, establishing the rule of law and protecting human rights.

Opportunities

Terrorism can be tackled by addressing some of its root causes, including political repression, regional conflicts, poverty etc. Improved homeland defence will raise the cost of terrorism. However, we should avoid the temptation of attempting to deploy technological countermeasures to meet every conceivable threat scenario. It is unrealistic to defend every public building and every airport and highway. There will continue to be a need for states to protect key strategic assets, but overall efforts should be concentrated on trying to mitigate the generic threat. Homeland security and foreign policy need to be integrated into a coherent and genuine Common Foreign and Security Policy (CFSP) which includes positive measures to stabilise civil conflict and overcome polarisation, ghettoisation and discrimination. The EU should recognise the strengths and limitations of technology and not to divert scarce resources into wasteful technological 'fixes'.

Research Recommendations

- Application and further refinement of biometric technology to prevent identity theft and identity forgery.

- Investment in financial tracking technologies.
- Development of enhanced verification technologies, especially in relation to biological weapons and radiological materials.
- Cross-cultural research on conflict reduction strategies, including legal, educational and financial instruments, and on institution building.
- There is an urgent need to educate a new generation of arms controllers that understand the scientific and technological application of CBRN weapons and that can help devise effective means to control them through multilateral mechanisms.

A.2.3 Trends in nuclear proliferation

Threats

The ESS identifies WMD proliferation as potentially the greatest threat to the EU's security. It also links the issues of proliferation and terrorism that would allow a small group to inflict damage on a scale previously possible only for states and military organisations. In the near term, the main state-based proliferation concern is and will continue to be the risk that states remain within the Nuclear Non-Proliferation Treaty (NPT) but these states could go on to covertly develop the elements of a nuclear weapon. On a number of occasions non-state groups have shown an interest in using nuclear materials to commit a mass impact terrorist attack. An expanded role for nuclear - as part of a balanced energy strategy - will increase the number of nuclear facilities around the world and the volume of trade in proliferation-sensitive materials and items. To avoid vulnerabilities that could be exploited by terrorist groups it is of great importance to locate and safeguard fissile material and contain the spread of relevant knowledge.

Challenges

We need a deep and wide understanding and shared diagnosis of the problem that would provide the platform for EU policies that can be sustained over an indefinite period.

Opportunities

An analysis of nuclear proliferation trends demonstrates the inter-woven political, strategic, economic and technological dimensions of the issue. Therefore, when tackling the nuclear proliferation question, the EU must keep in mind that approaches to energy strategy, sustainable development, the willingness to strengthen governments in failing states and the preparedness to invest in peace support operations could all impinge on the likelihood of nuclear proliferation in specific states.

Research Recommendations

- Research on how arms control doctrine can respond to a possible 'second nuclear age' in light of the expiration of existing bilateral strategic arms control agreements and including exploration of the potential of regional mechanisms.
- Research future energy policies to explore the relationship between economic competitiveness, secure energy supply, environmental sustainability and regional and global security.
- Research into the future of the international nuclear safeguards system along two axes: legal/political and technical. Examine enhanced nuclear safeguard technology and analytical techniques that could facilitate the IAEA's ability to verify a states' compliance with its safeguards obligations (e.g., by improving nuclear material accountancy at bulk handling

facilities) and be applied by international organizations and bodies other than the IAEA to detect clandestine activities, including trafficking in nuclear weapon-related technologies and expertise..

- Studies of the research establishments in countries of potential proliferation concern, including the identification of facilities (such as specialized research institutes) where nuclear-related knowledge and materials are located, and how the proliferation relevance of R&D at such locations may be evaluated.

A.2.4 Trends in poverty

Threats

Poverty can fuel internal instability, with all that entails for local and regional security. It can also lead to voluntary migration, which not only robs developing countries of dynamic and valuable human resources, but also can cause problems in host societies. It is particularly in the EU's interest that countries on its borders are well governed and that violent or frozen conflicts are resolved. Combating poverty, inequality and marginalization both inside and outside of the EU's immediate neighbourhood will also continue to be relevant for European security. The concern is that development should not become an objective *only* in a security context, but should remain a goal in its own right.

Challenges

Ongoing poor governance often lies at the heart of these problems. Corruption, inefficiency and a lack of commitment to undertake policy and institutional reforms due to lack of internal social cohesion are inimical to reducing poverty. The post-Cold War period has additionally seen state failure characterized by weak (and in some cases collapsed) state institutions, abuse of power, corruption and lack of accountability. This situation compounds regional instability, while providing opportunities for organized crime, which thrives on the opportunities for illicit profits presented by conflict.

Opportunities

Trends in poverty reduction and the key resulting impediments all have important implications for future EU strategy, including in terms of science and technology policy. While progress towards the Millennium Development Goals (MDGs) rests on the combination of a large number of factors, the EU, with the Community and its Member States has a vital role to play – especially given that it provides some 55 per cent of global Overseas Development Assistance (ODA), is the world's largest multilateral grant provider (at 63 per cent), the world's largest single market and the main trading partner of most developing countries.

Research Recommendations

- In order to enable swift, effective and useful EU intervention in pursuit of poverty reduction, EU research funding should aim to ensure a multi-faceted character, with the cooperation of partner countries that are the most seriously affected. DG Research should aim to ensure that the results and recommendations resulting from such research are fed into the appropriate Directorates.
- Research into the effectiveness of the use of resources under various constraints (land, people, capital)

- Technologies for more efficient use of resources (agriculture, industry) and research into reliable distribution mechanisms for food, equipment and information.
- Social science research into the links between poverty and governance.

A.2.5 Trends in organized crime

Threats

Organized crime was one of the five ‘key threats’ identified in the ESS: principally involving drugs, small arms, trafficking (people, money, arms). Ethnic distinctions that define most organized crime groups are now beginning to erode. In the years ahead organized crime is likely to adopt a more ethnologically pragmatic, network-based approach. This makes sound business sense in a globalised world and amongst actors unfettered by political constraints. It will, however, make the roots and dynamics of organized crime more difficult to analyse, comprehend and counter.

Challenges

The virtue and efficacy of biometric passports and associated identification in tackling organized crime is highly controversial. Some view such ‘technical fixes’ with great suspicion, and the majority of developing countries will certainly take many years longer to introduce their biometric equivalents.

Opportunities

There is a growing political will at EU level to tackle organized crime e.g. EU support programmes in third countries now specifically demand its suppression.

Research Recommendations

- Given the link between organized crime, terrorism and failing states, DG Research programmes should aim to coherently research the three dimensions collectively, while acknowledging the demarcation lines between them.
- An audit should be conducted in order to gauge the extent to which Security Sector Reform (SSR) is capable of eroding organized crime, based on research into appropriate indicators.
- Social science research on preventing dangerous technology falling into the hands of criminals (dual-use problematic).
- Technologies for crime prevention and fighting.

A.3 Trends in Technological Security

A.3.1 Trends in nanotechnology

Threats

In the longer term, certain applications of nanotechnology will pose risks that will need regulation. Future military R&D in several countries could lead to nanotechnology proliferation that endangers international peace and security. In general, the nearly complete lack of resources for military-

technology assessment and preventive-arms-control research should be corrected. In the near future, specific studies should be devoted to the prevention of new chemical and biological weapons and appropriate transparency and compliance measures, and the limitation of autonomous fighting systems.

Challenges

The EU should co-ordinate nanotechnology restraint among its Member States active in military high technology. On the international stage, the EU should promote discussions at various levels with a view to agreed nanotechnology limitations, preferably by global treaties, alternatively by export control measures. Politically, one of the most important tasks should be to engage the US - as well as its potential opponents - in talks about preventive limits. Adherence to ethical and specific procedural rules should be demanded from R&D contractors.

Opportunities

Ethical rules for dealing with nanotechnology dual-use should be developed. Such rules can build on the regulations currently in force in the areas of human experimentation. Questions relating to the proliferation of knowledge about nanotechnology should be assessed. Exploratory studies should be conducted on the potential of nanotechnology in the verification of compliance with national and international rules and agreements.

Research Recommendations

- The EU should support R&D in the areas of better protection against terrorist attacks using chemical or biological agents. This type of research concerns mainly sensors as well as neutralisation and decontamination substances and devices.
- Research required regarding the question of dual use, given the ethical, legal and societal implications.
- Research on how co-operative international limitation of dangerous technologies can be implemented in the EU's best interest.
- The development of civil society participation in the international system that would allow the control of nanotechnology and other potentially dangerous new technologies.

A.3.2 Trends in Biotechnology

Threats

The future threat posed by the hostile use of disease will manifest itself on three levels. First, state programmes will continue to remain a serious cause of concern. Second, non-state entities appear to have an ever-growing interest in non-conventional weapons, including biological agents. Third, a significant segment of the biological weapons (BW) threat lies in the future as developments in science and technology may enable states, or even individuals, to develop stable and controllable agents to cause widespread and indiscriminate harm.

Challenges

At the core of the biotechnological revolution is information: data collection and processing, knowledge, techniques and skills. With today's globalization and growing interdependence this knowledge and the capacity to use it inevitably diffuses across national borders. While lateral proliferation processes are undeniably taking place, the greatest challenge to the future Biological

and Toxin Weapons Convention (BTWC) regime may actually come from a sudden massive application of civilian biotechnology for the purpose of acquiring a biological warfare capability by a state party facing a security threat. There is a need to strengthen the BTWC and the Chemical Weapons Convention (CWC). Generic countermeasures are possible, cost-effective, and necessary, however such measures must be undertaken long before an incident.

Opportunities

If a future BTWC verification regime is to remain relevant for many decades, it will require mechanisms to deal with the possibility of instant realization of the dual-use potential of biotechnology. In addition to the traditional verification and monitoring of the destruction and non-production of BW, it will have to incorporate an understanding of biotechnology and technology transfer processes that go beyond mere products (agents, production equipment, etc.). The aim of this new set of tools is to render transparent technology transfers between economic units (e.g. individuals, laboratories, companies, etc.) within a state and between economic units across national boundaries (including states and transnational companies and organizations).

Research Recommendations

- Research is required on how governments and public authorities can take wide-ranging preventive measures against biological terrorism without resorting to mass mobilization of national resources. Such measures must be generic and cost-effective, and benefit society as a whole through, for example, improvements in health and emergency infrastructure.
- Need to develop detection technology, and innovative means for engaging with research communities who may be involved with potentially dangerous developments in biotechnology, including the development of ethical rules within research and professional institutions.

A.3.3 Trends in Info-technology and cognitive sciences

Threats

Some information-technology (IT)-based military applications, in particular autonomous fighting systems and preparations for net/cyber war, could bring dangers for international peace and security, the security of citizens and even for democratic society itself. If preventive/limitation of the most dangerous military IT applications are not successful, serious and previously unrecognised threats to European security are likely to materialise.

Challenges

There is a need to reconcile or balance contradictory goals in IT R&D, to monitor and assess the potential adverse impacts of new developments, and to support technology for crisis-intervention capabilities, monitoring and verification.

Opportunities

IT provides options for monitoring and verification of compliance with rules and agreements. With its dominant political, multilateral approach to the resolution of conflicts the EU may be in a good position to affect the worldwide climate towards co-operative limitation of dangerous technologies including military applications.

Research Recommendations

- Research is required on how cognitive science can be more relevant to security or defence research and policy, including human-computer interaction, and monitoring activities such as computer simulation of weapons testing through community building in the appropriate scientific and technological professions.
- Research on how to contain information warfare.
- An overview study should be devoted to the potential of IT to monitor events and information with a view to verify compliance with rules and agreements. Specifically, automatic tools to find indications of illegal or unethical R&D or other activities – specifically in scientific literature, in the public media and on the Internet.
- Interdisciplinary research should study how to balance the increasing need for transparency with the right to privacy.

A.3.4 Trends in Military technology

Threats

There should be a distinction made between *immediate* threats *directed at the EU*, demanding direct EU science and technology/research and development (S&T/R&D) responses, and *potential* as well as *indirect* threats. What are not risks today may be risks tomorrow if the right actions are not performed. The problem of conventional weapons proliferation needs to regain political saliency as an issue. We need to understand better how the arms trade operates and what the consequences of proliferation of all types of conventional military technology are; how proliferation is likely to occur in the future and what the security consequences could be. There is a danger that EU-US disagreements on civilian aerospace subsidy will spill over into the defence field, and that the perceived need to compete with the US could draw the EU into an economically destructive ‘arms race’. However, ensuring that needs are defined by users rather than industry should help to limit this threat.

Challenges

The security sector needs to better understand how civilian technological advances can be altered in order to meet internal and external security needs, as defined by user groups. There should be funds made available for the evaluation, testing and demonstration of the potential of these technologies for security use. A particular aspect of western societies is the quick spread of IT and related goods and services. This is also reflected in the S&T/R&D military planning for network-centric warfare. This creates a particularly high degree of societal risk given the vulnerability of the structures/networks themselves; while making such structures/networks secure is costly. Sweden currently seems to be managing this successfully in the field of network centric warfare, and their system should be investigated.

Opportunities

- It should be possible for the EU to formulate a long-term ‘baseline’ for an EU Science and Technology-based innovation system: one in which societal/individual security and military security-related threats as well as creative perceptions, aims and ambitions are presented in a strong policy and institutional framework. That baseline should directly relate S&T/R&D disciplines or activities to the ESS. This baseline needs to be discussed and revised at regular intervals, especially in light of changing EU policy aims. In order to avoid

duplication, ways of encouraging national defence research organisations to put in joint bids for funds should be investigated. Could a special scheme, including all the necessary security provisions, similar to that currently operated by the European Science Foundation be put into place? Also, a focus on the specific needs articulated by the European Defence Agency (EDA) should help funding to be targeted in a way that moves ESDP further down the path of being able to fulfill all Petersberg tasks (humanitarian, peacekeeping and crisis management) as quickly as possible. It will be necessary to develop new types of arms control strategies to deal with new types of actors and technologies.

Research Recommendations

- Ensure that the money available for testing, evaluating and demonstrating the potential of civilian technology for internal and external security purposes is both open to small, niche firms or research programmes.
- Develop research links between the EDA and European defence research agencies and the European Commission.
- Science and Technology-based military innovation skills, competences and potential in smaller EU members including new members.
- Developments in and potential (deliberate preparations) for military use of commercially available technologies and equipment.
- The importance of military S&T/R&D skills for the creation and use of asymmetric force. Such a study could be combined with studies of conflict developments in general and in EU neighbouring countries or regions, particularly the Middle East.

A.3.5 Trends in Space Technology

Threats

The informal US policy of refraining from putting weapons in space seems increasingly in question as perceived risks to US space assets from a variety of sources grow. The capacities and intentions of the North Korean regime remain unclear, and the US suspects China of developing lasers designed to destroy satellites in orbit. Moreover, the very dynamic of modern warfare threatens to blur the line between militarization and weaponization of space, increasing the likelihood of conflict in outer space. An attack on Western space assets could be a ‘grand equalizer’, denying the most developed countries the ability to use their most lethal and sophisticated weapons which are dependent upon space-based Command, Control, Communication and Intelligence systems. European militaries are a part of this dynamic as well, as they are increasingly dependent on space assets.

Challenges

The increasing proliferation of ballistic missile technology is another element driving the militarization, and possibly weaponization, of space. Faced with the challenge of shooting down a missile in flight, the US is looking to space both as a platform for detection sensors and a potential launch point for anti-missile munitions to strike enemy missiles upon launch or mid-flight. This would be a destabilising development, as it could be perceived as developing a first-strike capability, or encourage other states to develop and deploy space-based military platforms.

Opportunities

Confidence-building steps between the EU and US hold the promise of reducing the likelihood of space warfare. Both the US and Europe will need to gain mutual assurances that they will continue to enjoy access to and use of their space assets. A more ‘water-tight’ regulatory regime for the Global Monitoring for Environment and Security (GMES) and Galileo satellite systems, for example, could significantly lessen US fears of a potential breach of the systems’ neutrality – thus reducing one incentive for putting arms in orbit.

Research Recommendations

- Research required in ballistic missile development and WMD developments in countries of concern and ability to weaponize missile, i.e. make delivery vehicles with warheads.
- Non-missile strike capabilities: laser, other forms of energy
- Research into the use of space-based remote sensing for verifying compliance with international agreements on arms control and the environment, and for monitoring industrial accidents and natural disasters.
- Vulnerability of current and future EU space assets.

The 10 most important policy issues for EU security until 2015:

1. The EU needs to mainstream a strong conflict prevention mechanism horizontally across all major foreign policy fields, including international cooperation in science and technology. This mechanism requires substantive analytical capacity and the technical backup in order to pursue upstream conflict prevention.
2. The EU Homeland Security agenda needs to be coherent with its foreign policy agenda. The technical capacity of both Homeland Security and foreign policy also needs to be augmented, specifically regarding intelligence sharing and retrieval. EU military capacity also needs to specialise (demarcation of tasks) and streamline (battlegroups concept), while airlift capacity needs to strengthen dramatically.
3. Technology should become a centrepiece of EU foreign policy in the future. However, there is a need for a clear technological code of ethics governing dual-use, which safeguards individual privacy and increases necessary transparency. Also, there is a need to ensure that potentially harmful technology is kept out of the hands of terrorists and organized crime, while stabilising technologies are shared as widely as possible.
4. Arms Control: there is an urgent need to invest in a new generation of arms control, non-proliferation and technology experts able to understand the new scientific challenges posed by existing and emerging technological breakthroughs (across Nanotechnology, Information Technology, and CBRN technologies) and the means for their regulation and constraint through multilateral and regional frameworks.
5. There is a need for a renewed emphasis upon area studies combined with security studies/conflict studies in the social sciences to investigate the regional contextual sources of contemporary security concerns (regional security complexes, terrorism, failed states, “risk society”, poverty, organized crime etc)
6. There is a need to understand further the importance for EU Co-operation with neighbouring countries and key partners such as China and the US as well as the need for strategic autonomy in responding to contemporary and future security threats, as well as opportunities for the future evolution of the ESS. A co-operative and synergistic approach needs to be balanced with the ability to go it alone if needed, in terms of research, technology and action.
7. There is a need to further our understanding, as the basis for developing a European strategic culture on security matters, on what a common European security and threat assessment includes and continually revisit this analysis in the face of a changing security environment and in order to deepen further our understanding of threats, risks, opportunities and common (foreign and security) policy responses. Similarly, greater understanding is needed of the causes of insecurity in Europe and about strategies for security building.
8. State failure and disintegration, internal conflict and organized crime, could trigger major threats to European security. This is most likely to happen in the poorest area of the World, particularly in Africa and on Europe’s eastern and southern borders – but also in pockets of deprivation within Europe. Despite a recent surge in analysis, there remains a great need for further study of the causes and consequences of civil wars on the African continent. Fighting poverty and improving governance throughout the world is a major security challenge for Europe.
9. It is important for the governments and public authorities to realize that counter and preventive measures must be taken long before a terrorist incident, in particular using the technologies surveyed above, occurs.
10. The security sector needs to better understand how civilian technological advances can be altered in order to meet internal and external security needs. The potential contributions of other sectors, both public and private, need to be recognised and supported as well.

B. Responding to specific security scenarios

The analysis in Part A was refined into a more precise analytical framework through the construction of five scenarios relating to the future European security environment. These served to illustrate how the key threats and challenges identified earlier might manifest themselves in particular contexts.

It should be understood that the scenarios are not predictions, nor are they even considered probable developments. They are just useful as instruments for organizing thinking and helping to prepare for future developments in light of uncertainties. The scenarios were able to provide more precise ideas about geo-strategic regional issues, horizontal security trends internationally and on technological security trends.

These scenarios were presented to the European Commission at a workshop attended by the authors, project partners and Commission officials in June 2005.

B.1 Geo-strategic scenario: *Nuclear device detonated in Europe*⁴

B.1.1. Context in 2015

Europe remains a potential target for mass impact terrorist attacks. There are significant geographical areas not far from the borders of the European Union, outside government control, that could provide armed groups with places to train and accumulate materials and weapon-relevant items. Large stockpiles of fissile material stockpiles remain in Russia, the security of which continues to be a cause for concern.

Terrorist groups may further develop their links to organized crime and to individuals working inside nuclear establishments. When combined with weak international nuclear safeguards, there is a risk that the thefts of small quantities of materials will go undetected. These thefts may be undertaken for financial and not political or ideological reasons but the internal network between terrorists and organized crime provide a pathway to extremist groups.

The amount of nuclear material in Russia is not known and no official figures on Russian stocks exist. While estimates involve large uncertainties, varying by several hundreds of tons, the upper limit of the current estimates of HEU held in Russia is 1,400 tons, enough for some 30,000 crude nuclear explosives. These stocks are managed with very little transparency and are not subject to

⁴ This scenario is not a prediction, nor even a probable development. It is a useful instrument for organizing thinking and helping to prepare for future developments in light of uncertainties.

any international safeguards. Confidence that they are safe and secure rests entirely in the level of faith we have in the Russian authorities.

For the purposes of the scenario it is assumed that security upgrades continue to be implemented in Russian facilities, but that these are given a relatively low priority.

B.1.2 The Scenario

In this scenario, the main uncertainties (and uncertainties are inevitable in judgments about the future) relate to the developments in the political sphere. There are fewer uncertainties in the technology sphere because the properties of nuclear explosive devices are reasonably well understood and possible to predict based on information in the public domain.

Having spent ten years accumulating highly enriched uranium (HEU) in small quantities, a terrorist group has sufficient material to construct a simple gun-type nuclear explosive device. The material is used to assemble a device, which is then detonated in a city of a country bordering the EU. Between 40,000 and 100,000 people are killed. Understandably, the capacity of the targeted state to respond to the immediate consequences of the attack is quickly overwhelmed. The scenario is only driven by technology to a limited degree, and preventive approaches and humanitarian responses are equally if not more relevant to consider here.

Trigger: The event that is the trigger for the scenario is clearly hypothetical. Efforts have been made to ensure that the projections that set the initial conditions for the event are credible and plausible. Each of the background conditions is considered likely, given what we currently know. Therefore, while it is not suggested that the event at the centre of this scenario is probable (let alone likely) it is argued here that there is a clear possibility of such an event.

The risk of a nuclear terrorist attack taking place in future is significant given the identified trends amongst mass impact terrorist groups combined with the availability of fissile material, the questionable quality of nuclear security and the relative ease with which a functioning device could be constructed once adequate quantities of suitable material had been acquired. However, such an event is almost certainly not imminent, given that very considerable quantities of fissile material would need to be accumulated to compensate for the lack of sophistication in weapon design that a terrorist group would be likely to use. Therefore, a systematic preventive programme would have a very high probability of succeeding and forms the main part of a credible positive outcome to the scenario described below.

The design for a nuclear explosive device is different from that likely to be used to build a nuclear weapon as traditionally understood in state arsenals. However, there are continued refinements in the technology of nuclear material protection, control and accountancy and in the EU (including in fact inside the European Commission) there is a very great deal of technical expertise that can be applied in understanding and addressing the technology issues raised in this scenario.

The security of Europeans is affected in several ways by such an event. First, a successful terrorist attack on the borders of the EU would have a serious impact on the domestic politics of the targeted country. Second, the demonstration effect of such an attack would have an impact on the wider

effort to fight global mass impact terrorism. Third, the quantity of material available to the group that carried out the attack would be unknown along with its location and their intentions concerning further attacks. Fourth, the nature of the international response, and in particular by the US, would be difficult to predict.

The terrorist group issues a statement that it has in its possession sufficient material for a second device and states that unless its political demands are met this device will be used to attack a second major city. Large numbers of people spontaneously begin to evacuate major cities in the country in question. Many of the evacuees travel to the borders of the EU.

If the negative outcome to the scenario actually came about, there could be a technological component to the response where it could be necessary to manage large numbers of people assembled at the borders of the EU, including the delivery of medical and other humanitarian assistance on the other side of the border. In this case there would be a need to respond at the border of the EU in conditions where a significant number of sick and wounded people are trying to enter the Union. The technological implications of responding to this credible negative outcome of the scenario would include understanding what kinds of medical and humanitarian treatment would be required, where this treatment would be delivered and by whom.

B.1.3 EU preventive measures

An expanded nuclear security programme

There is a strong case for Europe to support increased efforts to secure and, where possible, reduce the stockpiles of fissile material that could be used to make nuclear explosive devices, in particular those stocks of materials that could be used to make a device without the need for additional processing. HEU and plutonium stockpiles should be consolidated in fewer locations, which are easier to protect. The process of consolidation could also take into account the possibilities for decommissioning research reactors that are no longer needed for the purpose of separating isotopes for experimentation.

Expanded capacity to respond at the borders of the EU

The EU has established mechanisms to combat terrorism, organized crime, environmental threats and threats to public health and safety within its border. Many initiatives exist to develop integrated border management at the EU's external borders. However, these efforts do not always connect together in all of the fields that would be required to ensure security within the EU. In particular, existing programmes for cooperation with countries that share borders with the EU lack cross-border dimensions in WMD-related areas.

An enhanced programme on counter-terrorism cooperation with Russia

The common interest in combating terrorism has been a key theme in recent political statements from the EU and Russia. The documents agreed at the recent EU–Russia summit included the desirability of exchanging ideas and models for combating terrorism as one among many suggestions for enhanced cooperation in this area. This could increase the degree of commonality in the approaches taken towards counter-terrorism operations in the EU and in Russia. Moreover, at the declaratory level the question of how to develop an effective counter-terrorism programme that remains proportionate and respects democratic values, protecting individuals while upholding human rights, is one of shared interest.

Relations to EU science and technology policy

There is a strong case for the development of further knowledge and intelligence related to the security situation in Russia, including the questions of the future developments in the security sector (including a better understanding of the scale of financing that is being directed to security-related activities and the wider economic impact of such financing), in civil-military relations, and in relations between the centre and the regions in Russia (in light of the wider political development within the country).

There is a strong case to continue to investigate the approaches to preventive action in the field of nuclear security. These investigations should include a natural and applied science element focused on issues related to nuclear material control and accountancy. These types of investigations should engage the nuclear pole of DGs Transport and Energy as well as the Joint Research Centre.

There is still a need for a systematic and dedicated programme to build a nuclear security culture in Russia and in other countries. This is a programme that should engage the scientific and the industrial communities from the EU and from Russia in multi-disciplinary projects in the nuclear, biological and chemical functional areas.

The development of a mobile capability able to respond to CBRN terrorist events could assist the delivery of post-event humanitarian and emergency assistance either within the EU, at its borders or to populations within the affected country. The feasibility of including this capability as one element in programmes to manage the borders of the enlarged EU could be one area of further investigation. The response in case of a request for assistance would depend partly on the capacities that exist and partly on the effectiveness of a deployment of those capacities. Forward planning and exercises in which participants from both EU countries and countries adjacent to the EU think through how responses could be organized in different scenarios would be potentially useful areas for further attention.

The organisation of an integrated border security management system around the periphery of the enlarged Union could aid border control. The inclusion of a WMD-related component into the integrated border security management system of an enlarged EU should be investigated, taking into account both preventive aspects of border management and crisis responses.

B.1.4 Recommendations

From the brief outline above a number of areas emerge in which scientific- and technological research could make a valuable contribution to gaining a better understanding of future problems and fashioning responses. Our analysis concludes that a systematic preventive programme would have a very high probability of succeeding. This should focus on:

- Research focused on assessing the risk of nuclear terrorism in countries close to the enlarged EU should be given a high priority as part of EU WMD non-proliferation effort. The research should also focus on identifying responses to identified risks.

- In a similar vein, focus should be placed on coordination and cooperation with the countries around the periphery of the enlarged EU to take preventive actions and to prepare responses to a nuclear terrorist event or other act of catastrophic terrorism.
- It is crucial to identify and support the nuclear security measures that can safeguard and control all relevant materials that a terrorist could use (over and above current efforts in Russia and Ukraine). Equally, the EU should help to develop a programme for building a ‘nuclear security culture’ to be introduced as part of the curriculum in scientific and technical training programmes within the nuclear establishment of Russia and other countries.
- In designing such a research programme, representatives of the relevant internal actors (such as the Joint Research Centre, other nuclear safeguards specialists, border management and security specialists as well as relevant country and regional desk officers) should be engaged. Experts from Member States, the Council and other competent partners could also form part of an advisory body.
- Any EU sponsored and managed research programme in this area should draw on the knowledge of, and be conducted in, cooperation with international organisations with relevant expertise. Special reference is made here to the International Atomic Energy Agency, the International Science and Technology Centre (ISTC) in Moscow and the Science and Technology Centre of the Ukraine (STCU) in Kiev.
- Another research focus should be on the linkages between the domestic economic, political, social, ethnic and demographic development of countries around the periphery of the enlarged EU and tendencies in the development of international, mass impact terrorism.

B.2 Homeland security scenario: ***Biological incident in Europe***⁵

B.2.1 Context in 2015

The reality of the threat posed by bio-terrorism can no longer be denied. Today the nature of this threat lacks specificity. Terrorist organizations may be more likely candidates for large-scale bio-terrorist attacks than criminal organizations, although the latter might be involved in extortion schemes involving the threat of poisoning with toxins (poisonous substances derived from living organisms). Criminal acts involving biological agents (mostly toxins) are in the overwhelming number of cases committed by individuals as an act of revenge or out of a grudge against another individual or company.

There are many types of agents. Biological agents differ in infectivity and pathogenicity, and therefore pose different levels of threat. However, while certain agents primarily affect human

⁵ This scenario is not a prediction, nor even a probable development. It is a useful instrument for organizing thinking and helping to prepare for future developments in light of uncertainties.

health, other ones target animals or plants, and may consequently be used for economic terrorism while they would pose less of a danger to the perpetrator. These types of threats might escape from common EU policies as a consequence of the human health approach to bioterrorism. Targets can be humans, animals or plants and the purpose of bioterrorism may be societal or economic disruption rather than mass casualties.

The present scenario assumes that by 2015 the EU has adopted a counter-bioterrorism policy focusing on particular threat agents. These agents are being researched for the development of effective prophylaxis, medication and vaccines. In addition many research programmes funded by the EU and individual member states address the growing concern about emerging and re-emerging diseases, which are responsible for a large number of outbreaks inside Europe and in the continent's periphery.

In several EU member states high-containment laboratories have been set up in which researchers are looking into genetically modified pathogens in order to determine to what extent existing medication and vaccines might be overwhelmed. As part of the efforts to reduce the risk of disaffected scientists and laboratory workers in neighbouring countries (Russia, Ukraine, as well as Middle Eastern and North African countries) being involved in illegal weapon programmes, the EU has set up several collaborative programmes promoting peaceful uses of biology and biotechnology.

In addition, individual EU member states are promoting extensive scientific and technology exchanges with some of the neighbouring countries to counter the threat of newly emerging diseases plaguing different parts of the world. They invite foreign scientists to participate in research programmes inside the EU. In comparison to ten years earlier, the overall fear of biological warfare has receded as a result of more peaceful security interactions in Europe's periphery. Nonetheless, some societies remain unstable as a consequence of unequal distribution of wealth and religious rivalry.

B.2.2 The Scenario

On 31 June 2015 some vague reports appear in the national press of an EU Member State about several people having come down with a mysterious illness. It emerges that whatever is causing the disease, the symptoms progress fast and it has a high fatality rate. Although initial symptoms are flu-like, specialists in infectious diseases are baffled because of the lack of response to available medicines. By mid-July the first cases emerge in two other Member States, and the disease spreads further thereafter. There is the suggestion that truckers driving across Europe may have carried the disease, as the initial local cases in the other countries appear to have their presence in petrol stations along motorways or motels in common. It is soon clear that the picture about the epidemic health officials have is hours, if not days behind the actual situation.

Governments close borders, and attempts are being made to quarantine infected people. However, at the same time, economic activity grinds to a halt as supplies no longer come through and people refuse to go to work. Soon this turns into social unrest as a consequence of the lack of food supplies and other essentials, on the one hand, and the rapidly dropping confidence in the ability of the authorities to handle the crisis.

Preoccupied with the unfolding crisis, nobody links the disease outbreak to a news story that had appeared on 4 June about the murder of the wife and three children of a microbiologist working in the EU and his disappearance. These events were then widely viewed as a family drama. In fact, a criminal syndicate had held them hostage while he was forced to smuggle genetically modified pathogens out of the high-containment laboratory.

Trigger: *The trigger for this event was a criminal syndicate using extortion to gain access to genetically modified pathogens out of a high-contamination laboratory. The lessons learned, however, are applicable to whether the disease results from deliberate, accidental or natural causes. While the revolution in biotechnology will bring numerous new nefarious applications of disease, it will also - if applied appropriately - create many new opportunities to deal with health threats from benign/natural or accidental causes as well as from hostile sources. In other words, some of the policy development should be geared towards harnessing biology and biotechnology for peaceful purposes.*

B.2.3 EU Preventive Measures

The goals of biological terrorism may be diverse. Not only is it possible for terrorists or criminals to select biological agents with effects ranging from incapacitation to a high risk of lethality, they can also target agriculture or infrastructure to cause economic damage. No government can prepare to deal with all contingencies. The measures to be taken in order to prevent acts of terrorism, protect the population and infrastructure, and deal with the consequences of a terrorist event must be designed and executed in such a way that they cause the least disruption to economic and social activities and do not diminish the fundamental organizing principles of a society. While it is necessary for policy makers to sufficiently prioritize the threats posed by biological terrorism, it is equally important not to excessively dramatize the threat and especially the consequences of hypothetical events.

Development of health infrastructure

The basic options with regard to countering the dangers of deliberate disease or poisoning with biological agents (toxins) are the development of (1) a nation's general health infrastructure with some supplementary measures that target some specific risks, or (2) countermeasures against specific threat agents. The first option is the preferred one. A range of generic measures that bolster the existing health and emergency infrastructure and procedures may go a long way in dealing with such threats. Rather than disrupting a society, they may actually be beneficial to the population in ordinary as well as extraordinary circumstances. As governments and public health officials are increasingly confronted with threats posed by emerging and re-emerging diseases (e.g. Severe Acute Respiratory Syndrome (SARS), polio, Marburg virus, influenza, etc.), the generic measures would also help to build the necessary capacity to deal with naturally occurring emergencies. Some of the generic measures are set out below.

Of particular importance is that there is a good regional distribution of emergency wards (including staff) and a spare capacity of beds. In the case of an emergency following the release of a biological agent against humans, there is an immediate need for a surge capacity to deal with the emergency.

Many other measures will lose much of their effectiveness if the ability to deal with a sudden massive influx of patients is non-existent or inadequate.

Rapid detection and identification of an outbreak is of critical importance to take the correct emergency measures. This is crucial, as with certain diseases (e.g. anthrax) it is still possible to administer vaccines or medication immediately after the infection has occurred. Highly contagious diseases may have spread much farther than the latest intelligence would indicate to decision makers. The longer the delays in identification, the greater the emergency they would have to confront. Early and up-to-date intelligence on the progress of the epidemic is critical for early decisions on containment and quarantine strategies. It will be important to mobilize distribution channels and production capacity of vaccines or medication, as well as to mobilize international assistance.

Many of today's physicians will not be familiar with some of the diseases that are of the greatest concern for use in warfare or by terrorists. Such refresher courses would improve their ability for rapid and accurate diagnoses (a doctor who had taken an emergency course quickly suspected anthrax in the first victim of the letters with anthrax spores in the US in October 2001). Furthermore, regular training would be a very cost-effective contribution to the need for early and reliable intelligence about an outbreak. Often civil emergency services are well equipped to deal with industrial disasters. Their equipment should be complemented to deal with cases of deliberate outbreaks, and the staff should be trained in how to deal with suspicious outbreaks.

The size and nature of stockpiles of vaccines, antibiotics and antidotes are a function of the emergency plans the public health authorities develop. In the case of the anthrax letters in the US in 2001, there was a rapid shortage of adequate antibiotics and the dependence on a single (foreign) supplier exacerbated the situation. Also, the recent failure of influenza vaccines in the US because of the forced halt in production in the UK demonstrates the need for adequate stockpiles until such time that the distribution channels become operational or the production can be increased.

Communication equipment should be adapted or developed to common standards. These standards must be applied not only to emergency services on the territory of a single EU member state, but also among member states, neighbouring states and more widely as disease will not stop at borders. In addition, common protocols must be designed and adopted in order to address the issue of the many languages within the EU.

Development and adoption of crisis communication strategies

Crisis communication strategies are designed to be able to inform the public in a responsible way. Among the measures to be considered are the identification of authoritative sources of information for the public at both national and EU level and the establishment of procedures to maintain communication even under the gravest of circumstances. Both the national and EU authorities should conclude agreements with different sectors of the press in order to prevent – as far as possible - sensationalist reporting that might contribute to panic with attendant pressures on stockpiles of antibiotics and social disturbances. In addition, political authorities and key personnel should receive training in crisis communication. The communication strategies at high-risk industrial facilities and industrial evacuation procedures probably offer a good starting point.

Training and simulation

Simulation exercises and training of crisis response and management are required at all levels of decision-making and across the multiple agencies that would be involved in a large-scale emergency. They must involve local, regional and national politicians, the people responsible for managing and overseeing emergency responses, and the press. Tabletop exercises for the highest levels of decision makers would focus on overall coordination and communication strategies with the different services and commanders on the scene of the incident. While single-day exercises are sufficient to test certain components of the emergency procedures, it is also necessary to plan occasional simulations that may last several days, in order to examine the overall integration of these components. The tabletop exercises are complemented by realistic field exercises simulating the exercise on the ground. It is imperative that the simulations are concluded, even if situations emerge that are unpalatable to democracies (e.g. quarantine measures for humans for highly contagious diseases, and their enforcement by means of lethal force if necessary).

EU members are already conducting such simulations with regard to incidents at nuclear or industrial facilities or major accidents, and the exercises for biological and chemical terrorism can build on these experiences. However, industrial disasters like the ones in Seweso (1976) or Bhopal (1984) or the recent outbreak of SARS suggest the need to develop and test the emergency procedures at all levels. Many lessons in this respect can also be learned from the terrorist strikes against the Twin Towers in New York and the Pentagon in Washington, DC on 11 September 2001.

In Europe, with its many small countries, a need exists to run cross-border training exercises whereby the organization of emergency response procedures among EU members is tested and improved (e.g. by discovering and resolving legal and bureaucratic obstacles preventing emergency and law enforcement or specialized military units to operate on the territory of another EU member). Similarly, EU-wide technical assistance programmes must be tested in practice. The important point to bear in mind is that the preparation and fine-tuning of procedures takes many years, and these activities should be undertaken soon.

Specific measures for countering CBW threat

The generic measures described above (which probably make up 80–85 per cent of the preparedness against a biological attack) should be supplemented by some specific measures. They include the stockpiling of vaccines and medication against low-probability, but high-consequence biological agents for both military and civilian use. Before there is a serious incident - especially with a highly contagious pathogen -government authorities should identify the priority services and personnel who should have access to pre-treatments and medication. These groups of people extend beyond the obvious categories of first responders, medical staff, and police forces. In the economies of advanced industrialized states, personnel responsible for the energy supply, food distribution, and so on, are equally vital to prevent the collapse of a functioning society. Such an assessment should be based on the careful analysis of the functioning of critical infrastructure and integration of services in the EU member states.

For the civilian authorities it is equally important to realize that the military standards for chemical and biological decontamination differ fundamentally from those required in a civilian setting. Military standards for decontamination are governed by operational necessity on the battlefield and under certain circumstances military commanders have to accept chemical or biological casualties. There is no such tolerance for casualties in civil society. However, if the civilian standards are set at unnecessarily low levels or, worse, no commonly accepted levels have been adopted, then the

normalization of activities will be considerably delayed and this could cause considerably more social disruption and economic losses than the actual terrorist attack.

B.2.4 Recommendations

To conclude, since it is impossible for any policy maker or health official to predict what a biological attack might involve, it is important not to become fixated on certain types of biological threats that *might* be used, as this would only drain resources from the public health infrastructure and divert much of the research, vaccine and medicinal development away from *naturally* occurring disease outbreaks. The response, therefore, should be driven by generic considerations, such as:

- Investments in health infrastructure should ensure that there is a good regional distribution of emergency wards and a spare capacity of beds, with some supplementary measures that target certain specific risks. Establishment of specialized, well-equipped laboratories for rapid identification of pathogens; enhanced production capacity of vaccines or medication; familiarizing all health ‘first responders’ with unusual diseases; investments in communication technologies for emergency services etc.
- The EU should continue to engage in international programmes to employ scientists, technicians and other professionals who were formerly involved in offensive BW programmes, both within Europe and in partner countries as appropriate.
- It is imperative that the EU develops its independent intelligence capabilities and interprets the data in accordance with European security needs. Moreover, it needs to adopt common standards and criteria for interpreting risk and threat data so that the analyses are acceptable to all member states.
- The EU should develop a new generation of vaccines and medication. This would not only deal with emerging and re-emerging diseases, but also be prudent vis-à-vis ‘traditional’ diseases.
- The EU should develop early warning and detection technologies. At present detectors exist for specific agents. However, considering that many different types of pathogens could be used in a biological attack there is a need to develop early warning and detection systems that are more generic. Investment in leading edge technologies is needed, which may require public funds to stimulate industry interest.
- There needs to be improved mental adaptation to risk. Proper information provision from the authorities, along with familiarization with the emergency procedures, help to alleviate people’s fears.
- It is important to strengthen the disease surveillance infrastructure and procedures in the 2005 accession states and in current EU candidate states – especially in the transitory period just after they accede – as these are currently seen as an Achilles’ heel to current EU bio-security policies.
- The EU needs to monitor and develop a response capability with regard to non-human pathogens too. Although the EU can deal with the terrorist BW threat as a consequence of its competences in the field of human health, attacks against plants and animals (agriculture) or against the economy in general are outside its remit.

B.3 Regional security: *Turmoil and Crisis in North East Asia*⁶

B.3.1 Context in 2015

The selected geographical focus here is North East Asia: a region of major geo-strategic importance to the EU and to the wider international community. It is also important for many other reasons as well (technology, economy, regional security, transnational issues). There are secondary but important transnational dimensions to the scenario, including issues of poverty and development, financial risk, migration and refugees, ideology, internal turmoil and transition from entrenched authoritarian government.

From the perspective of 2015, a number of factors have accumulated in recent years that undermine North East Asian States' continued capacity to manage and avoid key domestic and regional conflicts. China, after several decades of rapid economic growth (of 8 – 10 per cent per year), has entered a period of relatively slow growth (4 – 5 per cent) and uncertainty.

Meanwhile, the regime in North Korea (DPRK) has successfully retained power, but on the basis of strict authoritarian control rather than reform. The international community has long become accustomed to this, though security anxieties associated with the development of a modest DPRK nuclear arsenal had gradually legitimised the development of a more 'normal', i.e. robust, Japanese defence policy, and reinforced US military alliances with South Korea (RoK) and Japan.

B.3.2 The Scenario

The Trigger: In late 2014, centralized state control within North Korea collapses, and fractures within the ruling elite in DPRK open up. South Korean troops (but not those of the US or Japan) are invited in to assist with restoring order. The outcome of the increasingly violent struggle for power in North Korea is not clear.

The location of the DPRK's nuclear weapons remains unclear, but fears of a launch against South Korea and Japan are high. China, the US and Japan are on high military alert, amid intensified mistrust. In the Taiwan Straits, Taiwanese authorities also go onto high military alert. The risks of further escalation, and widening military conflict appear high. The EU and the rest of the international community struggle to prevent and defuse the conflicts.

The scenario is designed to clarify and illustrate the challenges and priorities for the EU and its partners in addressing factors and trends relating to possible major geo-strategic security issues. It also contributes to appreciating issues relating to regional security and the interaction between domestic, international and transnational processes.

⁶ This scenario is not a prediction, nor even a probable development. It is a useful instrument for organizing thinking and helping to prepare for future developments in light of uncertainties.

North East Asia continues to be a region of immense strategic importance, with relationships between China, Japan, US, Russia, Taiwan and the Koreas – all strong or medium military powers – continuing to exhibit a complex mixture of tension, suspicion and co-operation. Difficult disputes between these states/entities remain unresolved, as policy-elites from these states hope and assume that economic and other self-interested considerations will continue to prevent crisis or war. Even in relation to North Korea, the status quo appears to many to be better than the collapse of the regime, with resultant upheaval, migration and uncertainty. However, there is a real risk that the region will enter a period of turmoil and crisis by 2015, threatening devastating war. In this context, this scenario is well adapted to highlight the significance and need for effective measures to prevent, reduce and manage conflicts in this region by the EU and its partners.

B.3.3 EU Preventive Measures

The EU needs to consider various confidence-building and conflict prevention, management and reduction policies and programmes relating to North East Asia, including a broad range of security co-operation mechanisms. It should advance policies and programmes that promote domestic reform (good governance, rule of law, democratic institution building, tolerance, restraint, etc) in China, DPRK and other relevant countries. Capacity building in relation to the UN and other international regimes is important to develop the capability to respond to crises and aid stability and security. Partnerships and common approaches need to be forged between the US, Russia, Japan, China and others to engage constructively with conflict prevention and management in East Asia, along with the promotion of civil trade and economic development.

There is a range of credible variants relating to the outline scenario described above. A relatively benign and a relatively malign scenario are possible, both of which have the same essential factors: slowing economic growth rates, crisis in North Korea, and unresolved issues over the Taiwan Straits leading to a regional crisis.

Within this framework, the relatively benign scenario is one in which policies, programmes, reform processes and regional/international security-building processes help to limit and contain the intensity of the crisis and facilitate relatively successful responses to it. The EU and other OECD countries become increasingly engaged with the challenges of promoting security and co-operation in North East Asia. Having long stood on the sidelines of US military and political engagement with China and DPRK, and North-East Asia more generally, the EU decides to add an important politico-military dimension to its economic, trade and cultural relations with the countries in the region. This comes at some cost, since it raises difficult issues that some EU member states would prefer to defer. But, perhaps stimulated by the need to address DPRK nuclear weapons programmes, EU Member States join Japan and the US in mounting concerted pressure on China to take stronger action to pressure DPRK in relation to its nuclear weapons programme.

As the scenario proceeds, the EU and its allies review overall policy towards the region, strengthen political and security relations with Japan, South Korea and ASEAN countries. The EU's military presence in the region remains low, certainly compared to that of the US. However, conflict management and prevention is given a higher priority in EU policy and programme engagement. A decision is taken to ensure that EU and other, non-European states play an active, multilateral role in promoting co-operative security and defending non-proliferation regimes, rather than leaving the US to act largely independently. This is manifest in several areas. One is to engage more forcefully

in supporting efforts by ASEAN states and by Japan to establish military confidence-building measures and other co-operative security frameworks in East Asia, to facilitate conflict prevention and conflict management capacity. Although EU influence is limited, this has the impact of clarifying global multilateral interest in these issues.

The relatively malign scenario is more in line with ‘business as usual’ trends, in which pressures to tackle the factors underlying the crisis have been modest, and the crisis catches the international community relatively unprepared, without the capacities, shared confidence and understandings to respond in a co-ordinated and co-operative manner.

B.3.4 Recommendations

This scenario highlights a wide range of issues specifically relating to EU and its partners’ engagement with North East Asia and also other key geo-strategic regions far from Europe. Following the specific scenario, there are many issues for scientific and technological research raised. However, there are also generic issues that would be raised also in relation to possible crises in other regions. A key point to notice in relation to this scenario is that understandings and enhanced EU policies, programmes and technology transfer regulations over a period of time can contribute to relatively modest incremental steps toward stabilisation over the next decade in geo-strategic areas that can nevertheless make all of the difference when/if a crisis occurs.

The outcome depends on a combination of prior development of frameworks for security co-operation and availability of instruments for crisis management. Considerations here include the degree to which political/security networks are created, developed and sustained in North East Asia over the coming period. Within that broad framework, will be the extent to which transfers of military (including actual weaponry) and dual-use technologies (including civil nuclear technologies) can be controlled. It will be important to build confidence-building mechanisms, including the development and applications of verification and intelligence technologies.

In many key respects the North East Asia scenario demonstrates the need for a number of enhancements to current research that have generic applications. For instance, in order to help us to prevent such a scenario requires:

- Social science research into: the key political and security developments and trends in the region, and of the countries that comprise it; the relationships between economic, societal and political processes (including democratization) and security issues; lessons learned from crisis response and conflict prevention missions, and humanitarian/peace-support interventions;
- Enhanced research into conflict prevention, management, reduction and resolution, and development of the institutional and technical instruments available to the EU and its partners to pursue these;
- More research of strategic/security linkages between science and technology, especially dual-use technology transfers from the EU and its partners to East Asian states - particularly China - and the political/security implications;
- Relevance of transnational science and technology communities to regional conflict prevention, management and reduction;

- Enhanced understanding about the use, and limits of use, of EU instruments (aid, trade, preventive diplomacy etc.) to exert pressure on states for internal reform and regional confidence and security building processes.

In other words, social science research is needed to help European and regional policy makers to improve the conditions for regional stability, confidence and security building, crisis management and reduction, good governance, and the legitimacy and stability of governments. The scenario also highlights a number of natural and engineering science and technology priorities, including:

- Enhanced technology assessments relating to dual-use and military transfers;
- Improved capacities to detect, monitor and verify the presence or movements of sensitive WMD technologies and materials;
- Enhanced EU capacity to monitor and assess developments (including population and military movements) in areas such as North East Asia.

B.4 Regional security scenario: *Turmoil in Gulf of Guinea*⁷

B.4.1 Context in 2015

In addition to the colonial history and political, economic and personal ties that grew out of it, the Gulf of Guinea has become one of the major oil-producing regions in the world. While most of the oil produced in the sub-region will likely go to the US in the future, it is also likely to become an increasingly important supplier to some countries in Europe. The countries in the sub-region as well as the US will look to Europe to contribute to securing the flow of oil.

Most of the states in the sub-region are very poor. The legitimacy of governments is low. Parts of the territory in the region are currently out of reach of government control. In the Niger Delta violent clashes between various armed groups and government forces take place from time to time while in the Angolan enclave of Cabinda the militant Front of Liberation of the State of Cabinda (FLEC) continues to operate.

All of the states in the region maintain strong ties to Europe, all having been European colonies (of the UK, France, Spain). Elites in these countries continue to be oriented towards Europe. Children are primarily sent to France and the UK for education. Migration to Europe is a common and desirable ambition. Family ties between migrants and relatives at home are strong. However, economic relations between the sub-region and Europe are unbalanced. Europe is important as a trading partner and source of investment for the countries, while the countries are economically of minor importance for Europe. Some countries, such as Cameroon and Republic of Congo in the region continue to be major recipients of economic assistance from Europe.

⁷ This scenario is not a prediction, nor even a probable development. It is a useful instrument for organizing thinking and helping to prepare for future developments in light of uncertainties.

The Gulf of Guinea region hosts a number of major oil producing states, particularly Nigeria and Angola (Cabinda). Oil from the region already constitutes a major share of oil imports of some European states, and, even more so, the US. Oil, and also gas, production in the region will grow as new production comes on stream (because its oil needs to be transported through the Gulf of Guinea, Chad, a coming major producer, often is seen as being part of the region). The US is not only the leading importer of oil from the region; US companies are also dominating the oil business. In the US, the Gulf of Guinea is often seen as strategically important. Estimates from various sources, including the US National Intelligence Council put the share of oil coming from Sub-Saharan Africa, with more than half of it coming from the Gulf of Guinea, at up to 25 per cent of US imports by the year 2015. As the share of the region in US imports is likely to grow, the strategic importance of the region for the US will also increase.

People in the region are overwhelmingly poor, and are likely to remain so by 2015. Income per head is very low in Nigeria, with more than half of the population living on incomes below the internationally defined poverty line of US \$1 per day. Incomes in other oil producing countries are higher, but only Gabon can be considered a (lower) middle-income country. Income distribution is highly skewed in all countries. Even in the relatively better off countries, some areas are very poor. This includes some of the oil-producing regions, such as the Niger Delta region in Nigeria. Migration is high, with Europe and the US as preferred destinations. Levels and quality of education are low. Qualified students strive to attend quality tertiary education institutions in Europe and the US, contributing to major 'brain drain'. Increasing oil production may raise income per head in some countries, including Equatorial Guinea, Sao Tome and Principe, and Chad. However, theory indicates and history demonstrates that this may not necessarily be the case.

While it is difficult to make any prediction about the political systems prevailing in 2015 in the relevant countries, it is fairly easy to predict that the level of legitimacy of the state, whoever rules, will be low unless there are major improvements in economic well-being and internal conflict between social groups. Research-rich countries are surprisingly often afflicted by bad governments – in the sense of not delivering public services to citizens, including security and welfare. Corruption is often rampant and governments rule autocratically in the majority of states in the Gulf of Guinea region. In a number of these states, the combination of poverty and incapable government has weakened already weak state institutions, reduced people's confidence in politicians and officials and led to civil unrest. As a result, all states in the Gulf of Guinea region are widely regarded as being 'fragile states'.

B.4.2 The Scenario

***Trigger:** Massive parallel demonstrations, acts of sabotage and shutdowns of oil and gas installations in oil producing regions of Western Africa are escalating into widespread violence. The objectives of the uprising are unclear (unfriendly regional governments? independence? ethnic tensions?). Some groups with possible connection to international terrorism may be behind the acts of sabotage. One African government reacts by sending troops into the region, which further intensifies the conflict and it spreads to other countries in the region. Massive population movements result, including increased refugee flows within Africa and to Europe. The US government, which draws 25 per cent of its oil from the wider sub-region, is extremely worried about the situation and calls for European intervention.*

With violence growing and oil production stopped, one African government decides to act with military force. Some groups with possible connections to international terrorism are conducting acts of sabotage on offshore oil installations and attacking pipelines and tankers. Other governments in the region remain silent, even though violence has spread to their territories. It is not clear whether they support the violence, which now spreads further and government forces cannot quell the unrest. Instead, large parts of the region become unstable and the situation degenerates into civil war. Fighting is increasingly brutal with atrocities committed on all sides. Massive population movements result, including increased refugee flows to Europe but primarily to other parts of the region.

The US government is very worried about the situation. US warships are engaged in patrolling offshore operations. While this results in fewer attacks of offshore installations, warships themselves become targets of sea-mines and crude missiles. Pressure on the US government to also protect installations on shore grows. In turn, the US government calls on Europeans, with their historical ties and their own oil interests in the region to joint action to stabilize the situation.

The lives and livelihoods of Europeans are not directly threatened by the events described in this scenario. However, with major disruption in oil imports, oil prices are rising. European oil companies are losing income and assets. With continued fighting, immigration levels may become so high that they present a burden to economies and societies in Europe. If acts of sabotage are really committed by terrorists, than these groups may also extend their activities to Europe, presenting a threat to the lives of European citizens. Clashes among militant groups and between these and government forces lead to significant battlefield deaths. However, much worse is the situation of civilians, particularly the refugees, in affected African countries. Humanitarian organizations cannot work properly because of the ongoing fighting and the general chaos on the ground.

While not a security threat in itself, the strong stand of the US government is a major security concern for European political decision-makers. An unwillingness to help the US would contribute to a deterioration of the relationship between the US and Europe. Whilst no direct threat to the security of European, the unfolding humanitarian catastrophe, the level of oil imports, migration flows and US interests will put pressure on European policy makers to take steps to contain, possibly help to solve, the crisis.

If things go well

The members of the EU increase humanitarian aid, promise additional development aid to the countries, focusing on particularly poor regions. At the same time, the EU offers its good services to help facilitate the settlement of the conflict. Mediation by the EU Foreign Minister and EU Special Representatives is successful. Officials benefit from the advice of social scientists with regional expertise and a good grasp of the situation in the region. Part of the success lies in their ability to offer packages of development assistance and trade measures to improve the economic situation in the respective countries, utilising the expertise and connections of the expatriate communities based in Europe.

In the affected African countries, the EU uses a number of instruments for short-term stabilization of the situation. After further assessment of the situation, which again benefits from the input of academic country and regional expertise, teams of policemen and administrators are dispatched. This provides the foundation for a more long-term engagement in economic and political

reconstruction. Refugee flows to the Southern borders of the EU are at a manageable level. Refugees are properly screened at entry points and brought to pre-established refugee camps for later temporary settlement in communities all over Europe. The US is content with the European stand, and is also following a policy of constraint. After some further bloodshed, and death from starvation and diseases, parties to the conflict establish a truce. The uprising ends, and production and export of oil and gas resume.

If they don't

Fighting and humanitarian crises in those African countries affected reach levels that neither the US government nor European governments and public are willing to tolerate. Open war between these African countries seems imminent. Refugees increasingly move to other countries in the region, in the wake also spreading turmoil and chaos to other states in the region. The sinking of a patrolling US warship by a missile triggers a US decision to send troops to the region. The UN Security Council sanctions military action on humanitarian grounds. European decision-makers decide to participate with forces in a US led military action to occupy the Niger Delta. Refugee flows to the Southern periphery of Europe are growing. Screening of refugees becomes a problem. It cannot be excluded that militants from the region now see Europe as an enemy and plan to conduct acts of terrorism in Europe.

B.4.3 EU preventive measures

European science and technology policies with effects on situation factors

The appropriateness of European reactions to the unfolding crisis is contingent on understanding it properly. Two factors seem of particular importance for such understanding: a) a solid knowledge base about the conflict formations in the relevant region (see above, structural factors) and b) intelligence on leadership, actions and plans of militant groups, as well as governments and political opposition groups in the region. While government authorities will likely have to primarily rely on intelligence service with appropriate means (signal intelligence, informants, photo-intelligence), knowledge resources are best built in academic institutions. (These will also be an important recruiting ground for intelligence services.)

The probability of a reasonably good outcome is increased with the availability of, and experience with, a wide range of instrument for conflict resolution. Research is needed to support the development and use of appropriate instruments for conflict prevention, resolution and management, including topics such as how to deal with states in various forms of decay or decline, how to mix instruments of development, diplomacy and coercion (sanctions), and on priorities for external aid in crisis situations.

If the situation deteriorates, the members of the EU will need to decide about sending troops. If troops are sent, they should obviously be sent with the best possible technology for logistics, intelligence, reconnaissance and, ultimately, fighting. As this is a vast field of technologies, this will not be deepened here.

Refugees from West Africa will reach Europe primarily by boat over the Mediterranean. In addition, some entries via commercial airliners (with false passports and visas) can be expected. Prevention of refugee flows to Europe has many facets. From the point of view of science and technology policies, border patrol technologies are particularly pertinent. Screening of refugees will

require, in addition to physical searches, interviews and other techniques for checking of identities. Again, this is not the place to expand on an area that recently has received much attention in Europe.

How well the countries in and around the Gulf of Guinea could be doing by 2015 will largely depend on whether they have democratic, open governments, reduced poverty and economies that are growing even outside the oil and gas sector. Economic dependence on oil and gas production may well still be high, but efforts can be made to reduce it through investment in other economic sectors. One of the forms of investment is into education, where Europe has a major role by accepting students to European schools and universities and providing support to educational and training institutions in the sub-region, with the aim of building indigenous capacity rather than succumbing to the temptation to recruit “drained brains” into European employment. One approach could involve support for European/African partnerships, whereby franchising, distance learning and other arrangements would benefit educational establishments both in Europe and in the region.

European science and technology policies

It is assumed that the level of attention given to the sub-region remains fairly constant between 2005 and 2015. The discussion on how European S&T influences the trajectories of the major factors identified above focuses on scientific exchange and other forms of training, reductions of dependence on oil and gas, research on the improvement of livelihoods outside the oil and gas sector, and the promotion of social science for good governance.

S&T for improvements outside the oil and gas sector

Improvements in agricultural production, as well as in a broad range of manufacturing activities are crucial to improve living conditions in the countries concerned. Oil and gas income provide the opportunities to invest in the diversification of production and exports, in agriculture, industry and services. S&T can help leverage such investments. Without further detailed analysis of bottlenecks and opportunities for economic improvement, it is not possible to prioritize S&T fields. However, in view of the continuing importance of agriculture in the countries concerned, improvement in agricultural production would be an obvious candidate. Other research priorities would be in public health and the delivery of online education to rural communities. A related issue is that of conflict-effects of economic growth and development. A number of strategies and instruments have been developed under the heading of conflict-sensitive development; however more research is needed to improve their practical application in various circumstances.

Reductions of dependence on oil and gas

This has been and continues to be a major field for S&T in Europe. Obviously it is important quite apart from the topic discussed here, but the security dimension adds to its weight. Achieving a reduction in the dependency on oil and gas will depend on the success of diversification. Investment in immediate down-stream activities can assist here, supported by research on which sectors are of particularly good development potential for each of the countries in the region.

Scientific exchange, training

The application of modern technology in the oil and gas sector, including in down-stream activities as well as improvements in other income earning activities, will yield increasingly better results with growing numbers of high class researchers, engineers, technicians, and educators from the relevant countries. The basis for scientific work in these countries is very weak. Until 2015 it will,

at best, be possible to lay some of the foundations by increased training of students from these countries in Europe and support for educational institutions in the sub-regions.

Social science for good governance

Another area with potential to have some influence on the trajectory of major variables until 2015 is social science research that helps policy makers in Europe and the sub-region to improve the conditions for good governance, focusing on the legitimacy and stability of governments, and better mechanisms for the delivery of public services. Relevant areas of social science research include research into the functioning of the control of small arms and light weapons, conflict formations and resolutions, constitutions and other institutional arrangements.

B.4.4 Recommendations

This scenario predominantly covers issues of regional security in a region of some political and economic interest for Europe, arising from poverty and government failure made worse by resource scarcity. Recommendations for S&T policies illustrated in this scenario are primarily in the fields of social science, particularly area research, development research and research on good governance and technologies relevant for conflict prevention and crisis management, particularly intelligence and military capabilities. Other S&T policies with relevance for the scenario include energy conservation and border control. Prevention strategies that Europe could consider include:

- Improvements in agricultural production are crucial to improving living conditions in the countries concerned. Oil and gas income provide the opportunities to invest in the diversification of production and exports, and S&T can help leverage such investments.
- Although a number of conflict sensitive development strategies and instruments have been developed, more research is needed to improve their practical application and effective integration into the productive economy.
- The application of modern technology in the oil and gas sector, including in down-stream activities as well as improvements in other income earning activities, will yield increasingly better results with growing numbers of high class researchers, engineers, technicians, and educators from the relevant countries. Institutions are needed that are capable of educating, training and sustaining their work in the region.
- Effective, humanitarian immigration control needs to be able to distinguish between legitimate and illegitimate refugees. Technology for identification of documents and persons, as well as for information collection and storage can be useful in this respect.
- Research to support the development and use of appropriate instruments for conflict prevention, resolution and management includes topics such as how to deal with states in various forms of decay or decline, how to mix instruments of development, diplomacy and coercion (sanctions), and on priorities for mobilising external aid in crisis situations.
- Social science research is needed to help policy makers in Europe and the sub-region to improve the conditions for good governance, the legitimacy and stability of governments.

Area studies to enable European reactions to the unfolding crises being based on solid knowledge about the region and the causes of potential conflict (as in previous scenario).

B.5 Technology driven scenario: *Cyber Warfare and New Weapons*⁸

B.5.1 Context in 2015

The use of new weapons - based on information technology, nanotechnology and biotechnology - provide a potential for much more clandestine and unexpected types of attack, and the ability to destabilise the military situation. Counter-technologies, such as software agents, are deployed to help to find the violators of limitation treaties or sensors to detect explosives or chemical/biological warfare agents.

Since most of the dangerous new weapon technologies are still under research and development, there is an opportunity for preventive limitation: prevention being much more effective than “therapy”. New technologies can be used to monitor for dangers (at borders, important traffic centres, government buildings), contain the consequences of incidents (protection) and help in overcoming them (decontamination).

Clouded in secrecy, most countries with strong armed forces have prepared for information warfare. Cyber attacks would use secret `backdoors` in widespread operating systems. Co-ordinated action by thousands of network computers, in part using sleeper agents, both of the electronic and the human variety, would be augmented by physical destruction of central communication trunk lines and nodes, and possibly satellite communications infrastructure, both earth-based and in space.

Following the US introduction of unmanned combat aircraft, other leading producers develop them too and some export them with few restrictions. Lightweight carbon-nanotube (CNT) composites, very powerful computers and small sensors and actuators are used widely in civilian industry so that imports of hardware components are easy to arrange without arousing suspicion. Flight-control, target-recognition and other algorithms for (semi-) autonomous movement and action can be developed based on publicly available information; there is suspicion that specific algorithms and programmes have been sold illegally or stolen.

Technology for weaving/spinning carbon-nanotube-based fibres into arbitrary forms and forming strong, lightweight composites is used in many countries. One large country that produces small arms develops all-plastic small arms with CNT-composite barrels and (maybe recoilless) metal-free ammunition and exports them in large numbers. Via civil wars in Africa they spread to criminals all over the world. Security equipment for their detection is being developed, but has not yet been deployed at many locations.

⁸ This scenario is not a prediction, nor even a probable development. It is a useful instrument for organizing thinking and helping to prepare for future developments in light of uncertainties.

Based on the same principle, and using more powerful nano-particle-based propellant, smaller missiles are developed. Using small sensors, actuators and guidance computers `child-portable` air defence systems are developed (30cm long and 2kg mass) that are capable of reliably shooting down civilian aircraft. Rockets just 2m long are routinely used to launch miniature satellites of below 1kg mass. Even though docking on, or hitting, another satellite is extremely difficult, suspicion about the intention to do so are high. There is also an increasing fear that very small ballistic missiles (of 2-5m length) may be used to hit strategic nuclear targets with high-precision, small, non-nuclear warheads (maybe using target-seeking sub-munitions).

Suspicion grows that new biological or chemical weapons against organisms - based on advances in biotechnology, pharmacology, nanotechnology, genomics and proteomics - are being researched and developed in many countries. In Europe, in order to deter a threat, calls grow for the pursuit of an offensive research and development programme for biological weapons.

The consecutive steps set out below address different technologies in isolation, whereas, in reality, a number of events would take place in rapid succession or simultaneously involving a mix of technologies. The intent is to emphasise systemic thinking (in terms of the international security systems) and to stress the high leverage that prevention provides. If prevention is unsuccessful, once certain thresholds are crossed, action-reaction cycles are likely to occur that will be very difficult to stop until the system arrives at a new - perhaps uncertain - stability. One present example of such a threshold would be the introduction of space weapons. A near-future threshold would be the introduction of autonomous combat systems (aircraft at first).

B.5.2 The Scenario

It is difficult to devise a realistic purely technology-driven scenario. In reality, aspects of technology would enter other conflict scenarios in various forms and to various degrees. In order to demonstrate the technological aspects, this scenario is an artificial, condensed combination of events tied to information technology, nanotechnology and biotechnology. It is intended to highlight the importance of preventive limitation of cyber warfare and new weapons based on information technology, nanotechnology and biotechnology. Recommendations for science and technology policy follow from that.

***Trigger:** civil war breaks out in a state adjoining the EU - in a situation similar to former Yugoslavia in the early 1990s. Among immigrants from A and B, there is strong support for the respective causes with money being collected and volunteer fighters being recruited. Apart from the warring factions other non-state actors get involved (terrorists, supporters, unknown); this spills over into EU territory and leads to attacks on the communication infrastructure (with resultant breakdown) leading to severe economic consequences; terrorist attacks on decision-makers; escalation to large-scale armed conflict involving the EU.*

Bad Case Scenario

In response to the EU intervention, terrorists linked to side A attack buildings of the European Commission and of national governments with small missiles programmed to deliver an explosive payload through the windows of particular rooms. Because new, expensive detection equipment has not yet been set up at many airports, hijackers from side B are successfully smuggle all-plastic firearms onto several aircraft, take them over, and crash them into government buildings. Unknown

actors launch a large-scale, software-virus attack on European computer/communication networks. Communication is severely hampered, damaging mostly the civilian economy. The computers used in the attack are based in a country outside Europe – country C - and make it appear that it was this government that conducted the attack.

While the EU and member states ponder retaliation, after a few days side A exploits the opportunity and launches a cyber attack against country C, making it appear to come from the EU. Except for independent military lines, communication in country C collapses for several weeks. Fearing that country C – in the belief that the cyber attack has come from the EU and no longer able to react in kind – would attack Europe, EU member states have autonomous mechanised combat aerial vehicles (UACV) patrol along its eastern borders. They repeatedly pass country C's combat aircraft at short distance. At one encounter, the control computer of one EU UACV mistakenly thinks a country C aircraft is attacking it. Due to the programmed short reaction time, it shoots the aircraft down. As a consequence of communication to the other UACV and programmed fast reaction, aircraft of both sides go into firing mode and armed conflict starts.

The bad-case outcome is extremely negative. There is no doubt however that it is possible. The very knowledge about this possibility will instil considerable caution in rational decision-makers; they would only escalate to the point of attacking an opponent if under extreme pressure. However, there is a risk that such perceived pressure could be the result of false information. Another possibility could be that one party gambles with a show of force that does not go as expected. And one should not discount the possibility of less rational decision-making, mistakes in the interpretation of information and accidents. Finally, there are many possibilities for systemic human and technical errors, or for human insubordination.

Good Case Scenario

Terrorists linked to A, while trying to smuggle mortars for attacks against government buildings, are interdicted at a European border. Intensified police checks find a van transporting artillery rockets. One car bomb explodes in front of a government building, but roadblocks with portable explosive-detection equipment prevent three others from coming close enough to injure a high-ranking decision-maker.

Sympathisers of B are caught when they attempt to smuggle pistols into the airports of Country C. No aircraft are hijacked. Unknown actors launch a large-scale, software-virus attack on the European computer/communication network. Communication is severely hampered, damaging mostly the civilian economy. They use computers in Country C and make it appear that the its Government conducted the attack.

EU and member states have doubts if the attack was indeed carried out by Country C. Side A has not prepared a large-scale cyber attack and does not act against Country C. As a precaution, EU member states have piloted combat aircraft patrol along the EU's eastern borders. They repeatedly pass Country C's combat aircraft at short distance. At one encounter, one EU pilot has the impression that a Country C aircraft prepares an attack, but waits to be certain. Recognising that he was wrong, he does not shoot at this aircraft. In another instance, a missile is actually fired and an aircraft downed, but because there is no automated fast transmission and reaction of the full squadron, the incident remains isolated and does not trigger general shooting.

A terrorist group spreads anthrax spores in several metro stations, but due to small, relatively cheap BW-agent sensors mounted in most stations, the consequences remain limited. Using new nanoporous decontamination agents, the stations are cleaned in a few weeks.

Preventive arms control is not a new concept. It is not about outlawing whole areas of technology. Instead it focuses on specific applications or, in a few cases, on military/hostile uses of generic technologies. The arguments and criteria derive from considerations of ethics, security, health, democracy etc. – similar to the usual technology assessment in the civilian sphere, but here applied to the tools of large-scale security activities of states. Examples of preventive arms control are the Protocol banning blinding laser weapons of 1995 and the BTWC of 1972 (that already prohibits development of biological weapons).

Except for cyber warfare and some aspects of precision weapons, all other new technologies mentioned below will probably only start to arrive by 2015. Thus, they may be more relevant at a later period of time; nevertheless they should be included because they would be based on tendencies starting much earlier.

Under more benevolent scenarios, international negotiations have led to agreements limiting armaments and to new humanitarian-law protocols, and this approach could be applied to this scenario. For example, there should be a new rule in humanitarian law forbidding cyber attacks against computer networks, and a treaty that bans unmanned combat aircraft (and similar vehicles for land combat). Further agreements rule out small arms and ammunition that contain no metal, and small missiles altogether. The BTWC remains in force and has been augmented by a compliance and verification protocol. Pharmaceutical and biochemical companies are inspected randomly. Software agents scan the scientific - including `grey` - literature, the Internet and public media for indications of illegal behaviour in all areas. Challenge inspections investigate the suspicious cases.

B.5.3 Recommendations

International preventive arms control is the central means of dealing with cyber, nanotechnology and biotechnological threats. Counter-technologies, such as software agents, are deployed to help find indications of non-compliance and sensors to detect explosives or chemical/biological warfare agents.

The main findings from the scenario suggest that in order to counter threats from nefarious applications of emerging technologies, EU research policy should be oriented towards:

- Interdisciplinary research on the design of preventive limits of dangerous new technologies or new military options, including consideration of the verification of compliance.
- Interdisciplinary (at least natural and social science) research on the risks of misuse of new technologies and consequences for international security, explicitly including military applications and civil-military interactions/exchanges, considering also the capabilities of small groups and second-level arms-producing countries.

- Social- and cultural-science research on the conditions necessary for agreeing to preventive limitation. Among the specific priority topics should be cyber warfare, autonomous combat vehicles, small robots, small missiles, new chemical agents, new biological agents, space weapons. Generic areas to be studied should include information technology, molecular biology and nanotechnology.
- RTD: of sensors for chemical and biological agents, radioactive, explosive and other dangerous material (smaller, cheaper, more sensitive – to be carried by security personnel), and of filtering, neutralising and decontaminating material; of co-operative technical means of verification (close-range sensors, remote sensing, tags/seals, inspection equipment, methods to find preparations for cyber attacks); of software agents that evaluate the scientific literature, public media, the Internet for indications of illegal or unethical R&D or other activities: complemented with broadened science ethics and community-building within scientific and technological communities across borders, particularly where active research with dangerous potential is known to be undertaken.
- Research on: how to set up an international high-level scientific committee on developments in science and technology that are relevant for security, to conduct observation, analysis and advice; systematic inclusion of the potential for misuse into the research and development process, incorporating consequences of military applications of technology and possibilities for internationally agreed limitations; the possible roles of professional societies and codes of conduct in such a process.
- Improved monitoring of compliance and early warning of potential problems.

C. Implications for EU Research and Innovation Policy

Part C of the project sought to identify the major implications of the scenarios for future developments in EU research and innovation policies – in particular its external dimension.

Introduction

Reflecting a wider shift in the EU's development,⁹ European research and innovation policy is in transition. In future, rather than being tied to industrial competitiveness - the *raison d'être* of the Framework Programme in the past - policy will increasingly have to include a stronger focus on other public policy objectives, including security. This is because, to date, European foreign and security policy has outpaced the modification of research and innovation policy. Consequently, there is not a Europe-wide basis for establishing a good understanding of issues that underpin security policy choices. Europe as a whole lacks expertise in some functional and geographical areas, whilst in other areas expertise is highly concentrated in certain countries. Those who might wish to make use of research findings do not have a wider European research community at their disposal.

Promoting a European Research and Innovation Area that includes a security component is crucial, therefore - regardless of CFSP-related developments in the EU Treaty provisions. National programmes, especially in smaller countries with insufficient resources, are unable to address the problem across a spectrum of different research areas. If the EU wants to continue to expand its role in the world it will require a research community of sufficient capacity, quality and breadth to sustain it.

An effective security research programme needs to be based on the best possible understanding of anticipated trends and developments across a wide spectrum of different functional areas and in different parts of the world. It also needs to encompass areas of research, particularly in the social sciences, that may not previously have been considered relevant to security building. In the next budget cycle, therefore, it would be unwise to allow concerns over the limits of Commission competence artificially to restrict areas where research is sponsored. In respect of innovation, insofar as this refers to the development of specific technologies through applied science and engineering, the situation is different. The use of Community resources would probably not be appropriate where there was a risk of duplicating the efforts of Member States.

The scenarios examined earlier suggest that developments in 'hard science' are more predictable than those in social science. Overall, the EU needs a better understanding of social, political and demographic developments in different parts of the world. Specifically, it needs to incorporate that information into better security assessments, to understand both the origins of threats, whether hostile or as by-products of other natural or human causes, and the efficacy of measures designed to

⁹ As noted earlier, with the publication of *The international dimension of the European Research Area* (EC, 2001), EU research and technology policy became linked with foreign policy objectives for the first time. This development is described and elaborated in the Commission Report entitled *Security Research: The Next Steps*, published in September 2004, found at: http://europa.eu.int/eur-lex/en/com/cnc/2004/com2004_0590en01.pdf.

mitigate or to prevent conflict. This requires research programmes and projects to be structured in ways that facilitate both international and cross-disciplinary studies and analyses.

So what are the wider implications for the EU's overall research and innovation policy? Drawing on the findings above, the aim should be to develop a vision for research and technology that enhances European security over the next ten years. Accepting the reality of globalisation and increased interdependency, the premise is that European security now depends upon extending to others the power sharing and cooperative regime it has itself so effectively applied internally. And that this include forms of cooperation in research and innovation, science and technology similar to those that helped to pave the way for the accession of ten new Member States in 2004.

Through the Framework Programme and the European Research Area in particular, the EU has already developed a wide range of instruments for international cooperation, and refined associated concepts and approaches. For example, it has successfully designed pragmatic and effective policies for intellectual property rights and for balancing cooperation in research and technology development with fostering industrial competitiveness.

C.1 Implications for conflict prevention and crisis management

The above clearly points towards a greater emphasis being placed on conflict prevention and crisis management capacities. Research is needed to generate knowledge that can guide various investments in security building measures. A renewed emphasis in bolstering the social sciences - including Area Studies – would help us to better understand the causes of conflict and hence help us to prevent future ones. The causes and consequences of state weakness and failure, the changing nature of weapons proliferation, and the consequences of mass impact terrorism all require deeper analysis and comprehension. This could be followed by an investigation into the effectiveness of the application of existing policy instruments relating to development, diplomacy and coercion (sanctions). This is needed because although the ESS recognises the need to apply a broad spectrum of instruments it has yet to fully understand the implications of doing in particular combinations and in specific locations and contexts. There is also a need for the exploration of alternative mechanisms for security building associated with the re-conceptualisation of economic and social development in these terms. This could apply to consumer movements and corporate ethics development, for example, or research initiatives in agriculture, information infrastructure and animal health, by international charities, and their inter-linkages with more conventional “security research”.

Another recurring theme has been the importance of providing ‘enabling’ skills - practical and technological assistance - to potential accession states and neighbours, and in regions affected by possible or actual conflict. The EU has an obvious vested interest in ensuring that these countries can properly enforce their border and export controls. It should also expand those programmes that employ scientists, technicians and other professionals who were formerly involved in WMD programmes or where there is a risk that scientific knowledge will be misapplied. New cooperative threat reduction programmes should be developed in countries wherever appropriate, and should involve biological, as well as nuclear and chemical weapons. Developing joint science and technology projects that engage the relevant scientific community in peaceful research and development activities would have multiple and tangible security benefits to the EU, in addition to economic, environmental and other benefits in an interdependent world.

Successful conflict prevention and crisis management also still requires enhancements to existing - and the development of new – technologies (for example, transport capacity, communications capability and quality of intelligence). In respect of controlling the illegal trade in weapons, tagging technologies need to be developed, along with sensors to improve monitoring and tracking the flow of goods.

When considering how to expand and improve information/intelligence requirements, again it is the quantity, quality and analysis of such information that will make Europe more secure, rather than technology *per se*. In confronting terrorists who rely on minimal technological support and who are linked through familial bonds, technology serves to generate, intercept, and translate actionable intelligence - as the use of closed circuit television images and mobile telephone intercepts has recently demonstrated in respect of identifying and arresting suspects in the London terrorist bombings. However, technology is not sufficient; trained interpreters and analysts also need to engage with increasingly sophisticated technologies and networks of agents, which requires research into knowledge management to improve recognition, evaluation and rapid, appropriate response to threats.

Promoting cross-cultural understanding and dialogue among and within different ethnic and religious groups - especially in relation to young people and in areas of high unemployment - is vital in combating terrorism. The engagement of research and educational institutions in Islamic countries, in partnership with their counterparts in the EU, should be made a priority here. Developing innovative ways of conducting research using new media and information technologies – such as the Internet and satellite television - should be supported.

C.2 Structural versus thematic elements in EU policy

A mixture of thematic, horizontal and structural elements, and approaches which combine these elements, is needed in any successful EU research, technology and innovation policy. Themes that emerge include crisis prevention and management, and understanding the sources of conflict and terrorism. New structural elements would include incorporating security assessments into technology development policies. The need to strengthen particular research fields, such as increasing the funding of area studies, could constitute a key horizontal element across all thematic areas.

In a rapidly changing security environment it is important to anticipate the types of research that are orientated towards societal - rather than traditional military - security. A redefinition of security to encompass economic, social cohesion, environmental and other issues, requires new research into how best to build and sustain that security. For instance, research is needed into how to stabilise international financial markets, develop industrial ecology, control greenhouse gas emissions, construct social capital, enable endogenous innovation and economic development, and so on.

As internal borders in Europe have dissolved, so too will the dissolving boundaries of the European Union make territorial defence of the EU as a whole increasingly less relevant. The armaments industry is not irrelevant to defence against contemporary threats, but much of it will need to be re-oriented to deal with the very different nature of those threats, some of which have become more internalised. So, military technology will continue to make a contribution to future security, and will find limited derivative application, for instance via the control of smuggling of illegal goods, drugs and immigrants.

But the growth area for technological applications to security challenges is likely to be in the implementation of internal surveillance systems such as the introduction of biometric identification cards, and data mining activities, ostensibly as measures against terrorism, but also in relation to combating crime and preventing social security fraud. Nevertheless, serious questions remain as to whether such increased surveillance methods will in effect improve security. The deleterious impact on privacy and civil liberties that would result from this state-sponsored surveillance could - by undermining the trust of those sections of society whose cooperation is essential in combating terrorism - actually *decrease* security. It is essential therefore that 'security impact assessments' are applied before any decisions are made to apply new technologies in this way.

Although technological trajectories can be extremely complex to identify - and the link between military and civilian technologies difficult to decouple - certain patterns have emerged. Aerospace technologies, for instance, are generally highly transferable between military and civil applications in either direction. Electronics are more complicated. In the US, for instance, electronic-based inventions developed by civilian industry were 'captured' early on by military sponsorship. But subsequently, civilian markets overtook military contracts in commercial value, and innovation in non-military electronics made more rapid progress, with the ironic consequence that a significant number of US weapons systems became dependent upon imported Japanese electronics.

The situation in Europe is different again, in part because many countries' armaments industries never developed into a separate and economically significant industrial sector. Nevertheless, there is considerable evidence that the US experience in microelectronics applies across the board in Europe as well. As long as the 'pull' from the civilian market is sufficiently ambitious and demanding, most of the demands of the military market could be met by using civilian-driven technological developments.

The EU's Framework Programme is well equipped to support RTD related to security in areas that traditionally have not been associated with the military. Each Framework Programme's six-year duration provides the necessary continuity and flexibility to cope with changing requirements. It is also important to stress that parts of the Framework Programme that are *not* associated with the European Security Research Priority within FP7, may nevertheless have significant security implications.

For those industries in decline for which economic conversion or dual-use technology policies are appropriate, the Structural Funds may be more appropriate vehicles for innovation support than the Framework Programme. Moreover, the Structural Funds can leverage innovation support mechanisms with other types of support for economic development, such as training and regional infrastructure.

C.3 Consequences for Science and Technology

Europe has an industrial policy focused on making military industry more competitive. But it must ensure that this policy serves – and does not drive – its foreign and security policy. For instance, in the initial phase of constructing a ‘Security and Space’ theme within FP7, the consultative process was conducted largely within those industries and communities associated with the development of armaments and military systems. It is hardly surprising, therefore, that the four priorities identified as part of the proposed FP7 were oriented towards protection against terrorism and crime; infrastructure security; border security; and emergency management. Within the sub-category of ‘Space’, there is also a call for the development of Global Monitoring for Environment and Security (GMES).

Three of these four priorities are already orientated towards security *within* Europe as opposed to more traditional territorial defence, and GMES incorporates environmental security. Hence, the means of reorienting science and technology priorities for European security towards non-military applications already exist. The crosscutting themes within the security sub-category are: security systems integration and interoperability; security and society; and security research co-ordination and structuring. Of which, ‘Security and society’ has the potential for identifying ‘mission-orientated research’ based on citizens’ perception of security-related needs such as technologies for crime prevention, detection and prosecution, for reducing other types of risk (e.g. financial, health, employment, accidents) for safeguarding privacy and civil liberties, and research on ethics. It will be important to involve social science disciplines to investigate and analyse risk perceptions among European citizenry.

Other priority areas of science and technology relevant to European security enhancement can be identified within other parts of the Framework Programme as well. For instance, biotechnology poses a range of new threats and opportunities that need careful assessment and application. HIV/AIDS is one example of how a global pandemic threatening to Europe can be addressed through international research cooperation. The GMES activity has already provided a platform for space technology focusing on satellite systems for global navigation and remote sensing, relevant for both military and non-military use.

C.4 Implications for the external dimension of EU policy

Cooperation in military technology development has occurred through intergovernmental agreements, and through small-scale programmes such as EUCLID. But mainstream science and technology cooperation in the EC/EU and in other organisations such as European Cooperation in the field of Science and Technology Research (COST) and Eureka, has been deliberately restricted

to non-military R&D. This civilian, cooperative approach should now be exported to the wider world.

European international cooperation (INCO) policy for research and technological development is also in transition. With the publication of *The International Dimension of the European Research Area* in 2001 (EC, 2001), EU research and technology policy became linked with foreign policy objectives for the first time. Rather than being tied to industrial competitiveness (the *raison d'être* of the Framework Programme), policy for INCO focuses on largely *non-economic* objectives more typically associated with public sector responsibilities and services.

C.5 Implications for transatlantic relations

NATO scientific cooperation has been relatively small-scale in comparison with intra-European science and technology cooperation programmes, although it also has mainly concentrated on civilian research areas. Unlike the industrial focus of European programmes, however, NATO prioritised areas of basic science and mathematics. From the early 1990s, Partner countries from Eastern Europe and the former Soviet Union became eligible for support, which broadened to address security concerns such as economic conversion.

In 2003 NATO renamed its Science Programme the NATO Programme for Security Through Science. There are currently two main priority areas. The first is scientific collaboration for defence against terrorism, which concentrates on rapid detection of WMD agents or weapons, rapid diagnosis of their effects, physical protection, decontamination, destruction of agents and weapons, medical countermeasures etc. The second is scientific collaboration to counter other threats to security, including environmental security (e.g. desertification, pollution, etc.), management of water and non-renewable resources, modeling sustainable consumption (e.g. food, energy etc.), disaster forecasting and prevention, information security, and so on.

To the extent that European objectives align with those of NATO's Security Through Science programme, therefore, EU Member States already have a vehicle for transatlantic cooperation. This could be further developed, although there would not appear to be a case for participation at EU level unless a specific demand were to emerge.

C.6 Technology relations with neighbours

The *International Dimension of the European Research Area* document (EC, 2001) specifies various technologies that are priorities for cooperation with Mediterranean and Western Balkan countries as part of the FP6. These include specific reference to the promotion of co-development for greater 'stability, prosperity and security', with an implied need for technology transfer. Priority areas include 'integrated management of water, agriculture and the agro-food industry, health and environmental protection...' - consistent with the types of security-building activities identified earlier in this report. Perhaps most interestingly, there are measures specifically aimed at meeting social challenges, for example, the preservation of cultural heritage: particularly important when building trust and good relations between nations of different faiths.

EU cooperation with certain neighbouring countries is further developed and formalised through Association Agreements. Specified research priorities for cooperation with Russia and the Newly Independent States have also been identified. The latter are intended to stabilise the research capacities of these countries, with particular attention to conversion of military research to civil applications, and cooperation on problems such as non-proliferation, health and environmental safety related to industrial change.

C.7 Importance of arms control

The inadequate level of knowledge about states' weapon programmes has been highlighted as a general problem in arms control in recent years. The risk of states acquiring nuclear, biological or chemical (NBC) weapons has been exaggerated in some cases and either underestimated or simply not recognized in others. Arms control is particularly relevant vis-à-vis scientific cooperation and technology transfer: for instance, in the fields of treaty verification; the provision of alternative research for those engaged in military R&D; and in arms export controls.

The verification of arms control treaties requires technological expertise in the weapons systems under control, a system for monitoring technology development and testing, and the deployment of weapons (through remote sensing, seismology, radiation detection, through intercepting communications, and other techniques) and a method for evaluating the implications of information gathered. There are serious deficiencies in all three respects in Europe. It would seem sensible to build upon the types of research expertise and accumulated knowledge through EU initiatives, in the first instance through consulting experts and then by consolidating existing arms control, verification and peace research in Europe.

The EU has played a useful role in helping scientists who participated in the massive Soviet military industrial complex to find peaceful employment. This research effort needs to continue to focus on a finite set of individuals in known locations in countries that previously have invested in military research. However, this needs to be supplemented by proliferation prevention measures that can be applied more widely, including in the scientific communities of countries not known to have developed NBC weapons.

Building on an assessment of the extent to which the work already carried out in the science centres established in Moscow and Kiev contributes to non-proliferation, alternative ways to expand and modify this approach should be the subject of cooperative research. The development of new technologies, for example in the fields of biotechnology, cyber warfare and nanotechnology, against the background of the threat of mass impact terrorism requires the expansion of non-proliferation efforts into new functional areas and new parts of the scientific community.

Another example of cooperation between Europe and the states of the former Soviet Union in the area science and technology is INTAS: the International Association for the Promotion of Cooperation with Scientists from the New Independent States (NIS). Interestingly, INTAS supports research in social and human sciences, as well as in the natural sciences. Apart from its aerospace-related research, the INTAS research programme is more closely related to that of COST than the Framework Programme. Developing space-related security in relation to the proposed FP7 research in the 'Security and Space' thematic area may be one way to build upon INTAS's achievements to date.

For other areas, linkages to COST may be the most fruitful way to realise synergies with existing INTAS partnerships. Research organisations in eleven non-COST countries currently participate in COST actions and the extent of this international cooperation, as well as a good match of COST with INTAS thematic coverage, makes closer cooperation between the two a realistic prospect.

Export controls are a preventive measure that already engages industry and the research community in non-proliferation efforts. However, the traditional approach to export controls has been challenged by a variety of changes - in technology, in the ways that industry operates, and in the increasing sophistication of proliferators. A control system that accounts for the movement of intangible technology and prevents unauthorised access to dangerous items is needed: a system that still allows the legitimate growth in international trade and commerce.

C.8 Implications for a European Research and Innovation Area

Europe provides a tried and tested model for S&T partnership that manages scientific, legal, commercial, intellectual property, and financial aspects of collaboration - for the most part successfully. Evaluating proposals with reference to existing foreign policy objectives already occurs. So, adjusting this to address security policy objectives would be a natural extension.

Europe has shown that collective decision-making and the distribution of research responsibilities are not only workable but also help to build capacity and stability within dispersed research communities. This experience is translatable to the wider world. While most European researchers are likely to appreciate the need for genuine partnership with collaborative partners, many in the rest of the world – accustomed to more hierarchical, nationally-based and non-collaborative models – may find it harder to adjust. And certain Europeans themselves may need to overcome traditional patterns of ‘partnership’ that have not always adequately recognised the skills of non-European partners.

The EU is already highly active in external relations and the Commission currently has a diplomatic presence in over 120 Delegations and Offices abroad, with a network of science councillors posted around the world. It maintains liaisons with various S&T-related international organisations or their agencies or subsidiary bodies.

There is significant participation by non-EU countries in the mainstream consortia of the Framework Programme. Typically this participation is self-financed, but any non-EU research or international organisation may participate (as long as this conforms with Community objectives) and receive EC funding in order to fulfill European objectives. COST currently involves more than 80 organisations in 11 non-COST countries and international organisations.

It is not only the research community that is gaining international collaborative experience; a growing body of S&T policy-makers and civil servants have experience of negotiating priorities for European research, monitoring and evaluating programmes, and participating in policy fora. A scientific advisory system is emerging in Europe to support the full range of research objectives: priorities for knowledge generation and diffusion; policies to promote industrial competitiveness; regulatory development for consumer, public health and environmental protection, and so on.

One of Europe's under-utilised resources is its own immigrant population. As Europe has been a training ground for scientists and engineers from around the world, many have remained in Europe and are employed in all types of innovation-related activities. Along with foreign students, these expatriates have helped to establish diasporic networks connecting communities within Europe to colleagues around the world. These international links can be used to develop collaboration in security-related sectors and to enlist expatriate researchers in the design and implementation of policies for international S&T cooperation.

C.9 Implications for scientific advisory systems

There are three principal implications of European security for the organisation of science advice, related to both internal and foreign policy. As understanding of security-related research and technology development inevitably moves beyond traditional military concerns, it is important that scientific advice is set up in a way that anticipates new aspects of security-related innovation and can react to incremental technological developments emerging from the armaments industries.

Scientific advisory committees will be important to ensure that international extensions to existing RTD instruments (Framework Programme, EUREKA, COST) and S&T cooperation agreements negotiated between the EU and other countries are consistent with European security objectives. Advisors should: be drawn from as many of the EU25 as possible (those with a significant armaments industry as well as those without); have expertise in defence, aerospace and electronics industries, and in related areas such as border control and domestic surveillance; some should be drawn from academia (including medical, environmental, and social science); and at least 40 per cent should be of the opposite gender to the majority.

In areas such as trade, where the EU represents the interests of all its Member States and is responsible for negotiating international agreements, technical experts in areas such as biotechnology, disaster response, Internet regulation, and refugee health should be mainstreamed into the 'diplomatic' process. Finally, Europe needs to participate actively in international scientific advisory systems related to European and global security concerns.

Conclusion and Recommendations

It is incumbent upon Europe to share the solutions it has developed over the past half century with its global partners, and to find collaborative means of applying lessons learned in a way that is applicable to science and technology partnerships globally.

The research that underpins this study has identified a number of key areas of science, technology and innovation where EU investment as part of FP7 would significantly enhance Europe's long-term security and that of the wider world. The following recommendations explicate the priorities identified as part of the proposed FP7 (2007 – 2013) namely: protection against terrorism and crime; security of infrastructures and utilities; border security; and restoring security in case of crisis – with a strong emphasis on social science and humanities as well as the interaction between security and technology.

- Developing the basis for a European 'strategic culture' on security matters, including the identification of a common European security and threat assessment. The objective would be to deepen the EU's understanding of threats, risks, opportunities and common (foreign and security) policy responses. These assessments should be continually revisited in the face of a changing security environment.
- Renewed emphasis in the social sciences to combine area studies with security studies, in order to investigate the regional context of contemporary security concerns, such as civil wars, terrorism, failed states, weapons proliferation, poverty, organized crime etc., but also threats arising from natural causes, and as byproducts of socioeconomic and technological activities. The aim here is to explore how best to combat the root causes of emergent threats by enhancing conflict prevention, improving the targeting of aid, investing in poverty reduction, sustaining engagement in post-conflict peacebuilding, promoting good governance, and so on. This must include a recognition that threats occur *within* the EU as well as from outside, or from systems in which the EU is dynamically linked to other parts of the world (former colonies, for example), and a recognition that such linkages can be exploited for building systems and institutions to strengthen European, and global, security.
- Invest in a new generation of arms control experts with the necessary scientific skills to be able to understand the new challenges posed by existing and emerging technological breakthroughs (across traditional WMD fields - chemical, biological, radiological and nuclear - but also those in IT, nanotechnology, and new conventional weaponry) and the means for their regulation and constraint through multilateral and regional frameworks, including verification technologies and methods.
- Expanded co-operative threat reduction programmes – providing technical assistance in disarmament, conversion of military industries and alternative employment for weapons scientists. Targeted research into sensors, communications and other technologies relevant for the detection and monitoring of programmes for the production of WMD. Expand ISTC/STCU-type of activities to other countries that have given up the option of producing WMD, or are prepared to do so.

- Provide greater near-term and sustained practical and technological assistance to the EU's potential accession states and neighbours to enable them properly to enforce export controls (especially in relation to dual-use technologies and materials) and the control of their frontiers (primarily as a means of tackling organized crime and terrorism). This will involve fairly rudimentary technological assistance as well as building partnership with these countries, which both assimilate ongoing technological innovation and have the capacity to contribute to mutual learning and cooperation.
- Promote a transatlantic rapprochement, while simultaneously reinforcing the EU's strategic autonomy to be able to act without the US when necessary, through carefully designed S&T policy. The EU should seek to engage the US in ways that promote research into sustainable development, solutions to problems in health, agriculture and the environment, and into improving mutual understanding and cooperation around the world. It should orient its technological innovation along its own political/security requirements, keeping in mind that international peace and security will in many cases be better served by international preventive limitation and cooperation in non-military S&T than by military expansion e.g. into space.
- Creation or strengthening of expert bodies - reporting to the Commission - capable of advising on the security effects of research and new technology. Priority thematic areas include biotechnology, nanotechnology, electronics and communications systems, nuclear technology and aerospace. Compulsory consideration of security implications in applications to the research programmes of the EU, both by applicants and reviewers. Support for dialogue fora of security and technology experts on relevant themes, particularly in the biotechnology and nanotechnology areas.
- Increased investment in research on alternative energy sources and the promotion of improvements in agricultural production with the aim of reducing threats stemming from energy dependence and poverty.

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