FINAL REPORT

Contract No: SOE1-CT98-1079
Project No: TSER PL 1272

Title: Managing European Technology: Defence and Competitiveness Issues

(METDAC)

Project Coordinator: Peter Healey, SPSG, London

Partners:

Philip Gummett, PREST, Manchester
Bjorn Hagelin, SIPRI, Stockholm
Peter Lock, EART e.V, Hamburg
Jordi Molas-Gallart, ICT, Barcelona
Giulio Perani, CeSPI, Rome
Claude Serfati, C3ED-UVSQ, Versailles-Saint Quentin
Wim Smit, UTwente, Twente

With the participation of

Ksenia Gonchar, BICC, on Russia
Andrew James, University of Manchester
Judit Kiss on Hungary
Judith Reppy, Cornell University, on the United States

Reference period: from March 1998 to October 2000

Starting date: 20 March 1998 Duration: 30 months (extended)

Date of issue of this report: 31 January 2001

Project funded by the European Community under the Programme Targeted Socio-Economic Research (TSER)

Contents

Abstract p.5

1. Executive summary p. 7

2. Background and objectives of the project p.13

3. Scientific description of the project: results and methodology p.19

   3.1 Innovation System Approaches and their Application to the Defence Sector p.19

   3.2 Methodological approach p.25

   3.3 Statistical and R&D issues p.27

   3.4 Key themes emerging p.37

   3.5 Innovative aspects p.89

4. Conclusions and policy implications p.91

5. Dissemination and exploitation of results p.107

6. Acknowledgements and references p.113

7. Annexes, publications, conferences and outputs p.121

Abstract

This report describes the work conducted between March 1998 and November 2000 by the METDAC (Managing European Technology: Defence and Competitiveness Issues) Network, building on earlier work done by participants on the restructuring of the European defence industrial and technological base.

The initial focus of the work was to analyse the institutional forms and policies that have been developed by firms and governments in response to the problems presented to the defence technology sector by the conjunction of globalisation and the end of the Cold War. This entailed data collection and analysis of information at the levels of governments, firms, and industrial sectors about institutions and policies/strategies.

Confirmation of data limitations, together with a desire to understand (via application of analytical approaches drawn from the 'national systems of innovation' school) how different elements of national defence innovation systems relate to each other, and what happens at the boundaries of such systems, led to a refocusing of the study.

With this refocusing, the aim of the study became one of identifying obstacles to, and incentives and pressures for, an integrated European defence industry, in order to evaluate the prospects for such integration in the face, in particular, of the geopolitical position of the USA and the more specific standing in our field of study of US defence firms.

The methodological approach used, within the framework of the national systems of innovation approach, was to combine country studies with the development of heuristic scenarios.

Conclusions are drawn as to the degree of policy convergence between the US and Europe, and how this may affect defence equipment requirements and the structures of defence firms; the degree to which civil-military integration is taking place at the technological and industrial levels; the particular role of stock market pressures on firms that are serving the defence sector, post-Cold War; and the value of the theoretical approach adopted, and how it in turn may be further developed by taking into account the defence sector.

1. *Executive Summary*

This report describes the work conducted between March 1998 and November 2000 by the METDAC Network, and which builds on earlier work done by participants on the restructuring of the European defence industrial and technological base.

METDAC (Managing European Technology: Defence and Competitiveness Issues) has been a TSER thematic network, running from April 1998-November 2000. Members were drawn from 7 EU member states, with additional participants from Hungary, Russia and the United States. The work was conducted in the standard way, namely, a succession of carefully planned workshops, with tasks to be performed in the periods between workshops.

Three of the workshops aimed at wider participation of academics and users (from industry, government, and intergovernmental bodies): in Berlin with the Aspen Institute (May 1998); in Rome, in association with IAI (November 1999); and in Brussels (October 2000). A fourth workshop, in Budapest, provided the occasion for bringing into the network analysts from Hungary and Russia. Three other workshops, in Paris (April 1998) involving part of the group, and in London (April 1998) and Manchester (May 2000), where the whole group were present, focused exclusively on reporting and refining our analysis.

In addition, a policy of active dissemination has been followed, via participation in other meetings, through publications, and through the development of a Project Website (www.spsg.org/credit). The website has been used to provide regularly updated information on workshops, and has enabled access to the four discussion papers and 19 working papers produced in the course of this study.

The initial focus of the work was to analyse the institutional forms and policies that have been developed by firms and governments in response to the problems presented to the defence technology sector by the conjunction of globalisation and the end of the Cold War. This entailed data collection and analysis of information at the levels of governments, firms, and industrial sectors about institutions and policies/strategies.

These analyses included:

- Collection of statistical data, in an attempt to systematise our understanding of how defence technology capabilities were changing across Europe;
- Examination of how firms and governments have responded to the 'dual use problematique';
- Analysis of the structural linkages and institutional forms that have been developed between civil and military firms, and government, within and across national systems of innovation.

In respect of the first of those items, our review confirmed continuing shortcomings in the availability of basic data for the study of the defence innovation system. Differing national concepts of the boundaries of the defence sector, and the changing technology base, render analysis in this area extremely difficult. Although the more general trends in the evolution of defence R&D can be derived from existing data, interpretation is

not always straightforward, and the data lack the detail, rigour and homogeneity necessary for in-depth long-term and cross-national analysis.

We therefore concluded (and offer as a recommendation) that, given the difficulties of defining specifically *defence* technologies in a rigorous way, the main focus of data gathering should be restricted to the R&D spending patterns of defence agencies, and public programmes officially earmarked for defence purposes. It is also important to monitor the independent R&D investments of corporations involved in defence production. Even this, however, would require a co-ordinated analytical effort bringing together a systematic international study and data gathering exercise based on definitions and approaches adapted to the present circumstances.

We further concluded that such a study was beyond our means in this thematic network. Accordingly, we changed our methodological emphasis from 'measuring' to 'mapping'. This was not merely a counsel of necessity: it also emerged from our emphasis on understanding how different elements of national defence innovation systems relate to each other, and what happens at the boundaries of such systems.

With this refocusing, the aim of the study became one of identifying obstacles to, and incentives and pressures for, an integrated European defence industry, in order to evaluate the prospects for such integration. Pressures and incentives may originate from international competition, defence and international security policies, and technological features such as civil-military integration and the increasing emphasis on systems integration. In these respects, the principal contrast upon which the study focused was that between Europe and the United States (a contrast which is made explicit in the title of our forthcoming book – see below). The definition of 'Europe' was also taken, for the purposes of our work, to include Hungary and Russia – an aim of the project having been to expand our understanding of defence innovation changes to include central and eastern Europe and to Russia.

A further important objective was to relate our understanding of defence technology dynamics to current innovation theory. A key recent development in the study of the innovation process has been the emergence of a 'systems of innovation' literature. This approach emphasises the collective character of innovation: in particular, it focuses attention on the interaction of firms with other institutions and organisations, in the production, diffusion and use of new knowledge.

Such an approach emphasises three principal components of the system:

- the *institutions* and *organisations* that contribute to the production, diffusion and use of new knowledge, which may include firms (including suppliers, users and competitors), universities, public and private research organisations and the government;
- the *relationships* between those elements and their interdependence and interaction within the system, which may be formal or informal, and may be based on market or non-market means;
- the *boundary* of the system, which may be national but may equally be regional or international in scope.

An overview of the areas covered by the network after this refocusing may be conveniently gained from the table of contents of the book which is being prepared as the summation of the project:

TITLE: *UNITED STATES, DIVIDED EUROPE?*

SECTION ONE: INTRODUCTION
- The dynamics of change (what is stimulating change?)
- Features of the changing arms economy
- The concept of systems of innovation (& technological systems)

SECTION TWO: ANALYTICAL APPROACHES AND CASE STUDIES
- Institutions and Relations (networks)
  - a) Procurement changes;
  - b) Corporate changes
- Technological change
  - a) Civil-Military integration
  - b) Systems integration

SECTION THREE: CONSEQUENCES (in terms of some possible scenarios)
- For defence industries:
  - a) "Fortress Europe"
  - b) Trans-Atlantic structures
  - c) National retrenchment
- For innovative capacities
  - a) of individual countries
  - b) of Europe

PRINCIPAL CONCLUSIONS

We summarise here only those conclusions that relate to the substantive policy agenda. For conclusions on the theoretical utility, and development, of the national systems of innovation approach, please consult the main body of the report.

In the context of the stage in the evolution of global political economy which emerged during the nineties, we conclude that a new, internationalised (but not yet globalised), arms economy is taking hold. Economic and security challenges are becoming closely intertwined. They are doing so within a world in which only one military superpower now exists, and in which that military superpower is also the most powerful economic actor. Hence the role of the United States in shaping the future of the arms economy is crucial. The internationalisation of the arms sector both revolves around, and is developing in opposition to, the United States.

How the relationship between military doctrines in the United States and Europe, and the corresponding configurations of arms industries, will develop on the two sides of the Atlantic is not so easy to state. Indeed, it should be the subject of further research.

Much will depend on how far political and security agendas converge or, contrarily, remain distinct. In this respect, the legacy of Kosovo may prove to be a touchstone.

US political and military circles continue to regard peacekeeping and peacemaking interventions in a different light from their European partners. Whereas in Europe such interventions have come to the fore in defence debates, and traditional Cold War concerns have moved to the rear of the stage, no such clear shift has occurred in the United States. Put more strongly: what, in Europe, is now regarded as perhaps the prime function of military forces is still seen in the United States as a distraction from the proper role of the military.

To the extent that the purposes of US and European military forces remain distinct, this is likely to lead to different military requirements and therefore to different equipment requirements. What is less clear is whether this will lead to different structures for the arms industries. Put in different terms, the policy networks on the two sides of the Atlantic might grow no closer together than they presently are; but this does not necessarily mean that the same will apply to the production networks. Indeed, an important question for future research is to consider what effect the growing number of transatlantic defence firms may have on the dynamics of these processes.

These high level political and security considerations provide the general framework within which our study has focused on defence-industrial affairs. At this lower level, we conclude first that, while the prospect which some, in the 1980s, saw for a transformation of military production based on the concept of dual-use technologies, has proved optimistic, nevertheless efforts at reforming defence procurement to promote growing civil-military integration have been substantial and ambitious. We see evidence of this in various of the countries that we have studied.

However, the impact of these measures has so far been relatively limited at the level of prime contractors. Indeed, at first glance, there may even be thought to be a counter-tendency, arising from the fact that most of the defence prime contractors who survived the shakeouts of the 1990s are at least as heavily concentrated on defence production as previously, if not more so.

Important examples of civil-military integration can, though, be found among suppliers, and also in the production processes being used by defence primes. Outsourcing practices among defence primes are also increasing the relevance of civil-military integration in the supply chain. These trends do not appear to be due directly to the main governmental procurement reform efforts. They appear to be the consequences of decisions made within production networks rather than as emerging from official procurement reforms, although some governments have also encouraged defence primes to draw SMEs into their supply chains. The extent to which such policies have been implemented in practice, or sustained over time, is not, however, as clear as is the fact that, in times of difficulty, policy networks have tended to focus more on the maintenance of an adequate core of prime contractors than on the interests of lower tier suppliers.

Arguably, a stronger influence on the role of SMEs is a combination of technological and stock market pressure: technology, in the sense of the familiar phenomenon that the sources of innovation often lie outside the major corporations, the more alert of which, however, are quick to co-opt them; and stock market pressure in the sense that, in those countries where private (typically, mainly institutional) investors are now able to exert leverage over defence firms, they are likely to apply greater pressure than governments for returns on capital invested, thus encouraging defence primes to look actively at new modes of sourcing.

As a final exercise, our study applied these conclusions to, three 'scenarios', offered as heuristic devices for exploring various features of the policy opportunities and threats that face Europe. Details may be found in the main body of the report.

It remains to be seen which of the scenarios will prove closest to reality. The key point to make about them is that their resolution is not simply a matter of 'waiting to see', but rather of seeking to influence them through appropriate appreciation of the underlying factors, and their consequences. While actions (as national systems of innovation theorists would be quick to observe) cannot determine outcomes in any simple way, nevertheless the future remains to be *constructed* rather than to be *forecast* in any simple-minded way, or *awaited* in any spirit of fatalism.

In this respect, Europe has choices. The recent strengthening, via mergers and acquisitions, of the leading European firms has altered the transatlantic defence industrial landscape, even though the major source of finance in this field remains the Pentagon. The question is, which choices will the relevant actors make?

2. Background and objectives for the project

Introduction and earlier work

2.1 METDAC (Managing European Technology: Defence and Competitiveness Issues) has been a thematic network, with funding of 200k Euros, originally running from April 1998-March 2000, but extended by six months at the request of the contractors to the end of October 2000.

2.2 Our specific objectives for the **first 6 month period**, dating from April-October 1998 (months 1-7), as set out in the technical annex to our proposal, were to:

- confirm and develop overall priorities for the network through a meeting of the planning group (the coordinator and those with responsibility for taking the lead on each work packages)
- oversee the whole programme of planned work and plan work package 1 in detail through a first network workshop
- undertake work package 1
- pull together the work from work package 1
- extend the network to involve participants from Central and Eastern Europe and the former Soviet Union
- plan work package 2 in detail through a second network workshop

Our achievements during this period were reported *in extenso* in our first progress report dated 20 November 1998.

2.3 Our specific objectives for the **second 6 month period**, dating from November 1998 - April 1999 (months 8-13), as set out in the technical annex to our proposal, were as follows:

Work package 2 - Analysis of the institutional forms and policies that are being developed.

Objectives:

Collection and analysis of information at the levels of governments, firms, and industrial sectors about the institutions and policies/strategies that are/have been developed in response to the problems raised by the conjunction of globalisation and the end of the Cold War. These analyses included:

- how firms and governments are responding to the 'dual use problematique';
- the structural linkages being developed between civil and military firms within and across national systems of innovation;
- the institutional forms being adopted for defining technological needs (e.g., foresight; prospective studies; *la vieille technologique*; technology scanning) across the civil-military interface.

Development of a matrix showing the trends in civil-military integration in different technological and industrial sectors. The purpose would be to identify the areas in which the concept of distinct and separate *defence* technologies is becoming obsolete, and those in which, on the other hand, there may be increasing specialisation within the defence field.

2.4 As explained in our November 1998 report, we decided at the end of Work Package One that certain changes of emphasis were needed in the light of experience to the overall design of the programme for work package two, to reflect the level of funding made available (compared with the 360k ECU originally sought), and to take better into account the particular strengths and opportunities among network members.

2.5 More specifically, we agreed that there would be a general focus in Work Package two on:

CIVIL-MILITARY INTEGRATION,

which became the title of the work package.

This was led by Claude Serfati, who also contributed a paper on France.

The work of this period was reported to a workshop in Berlin in May 1999 and summarised in our second progress report, dated 30 June 1999.

Basis for Work Packages 3 and 4

2.6 In Berlin we set a strategy for the work for the rest of the network's life, in work packages three and four, so as to bring our work over these two years together. The aim was to identify obstacles as well as opportunities for an integrated European defence industry. These were to be coupled to pressures and incentives for such an integration in order to evaluate the prospects for integration. Pressures and incentives may originate from international competition, defence and international security policies, and technological features like civil-military integration and increasing emphasis on system integration.

2.7 The development of defence technology and the production of arms and other defence systems were not seen to occur in an anonymous market. The primary customers, typically the MoDs and military services, are well known to the developers and producers. The defence companies, national defence research laboratories, the MoD and the military are tied up in long-standing traditional relationships, constituting a production network. Within such a network the actors are mutually interdependent. To what extent defence production networks exist, generally differs between countries. Within a country it may also differ between different defence sectors, like naval defence technology and aerospace.

2.8 Similarly arms exports were not seen as occuring on an anonymous market but to a great extent going to traditional customer countries.

2.9 Arms production and defence technology development were seen to be special in another sense. They are related to policy making in three domains: defence policy, foreign and international security policy, industrial and technology policy. To what extent these three policy domains influence arms production and defence technology development, generally differs between countries. Policy making in these three areas are not necessarily always in agreement. Conflicts of interest may occur. For instance when from an industrial point of view particular weapons should be procured domestically, whereas the military want to procure abroad because of the qualities of the desired weapon system. Conflicts of interest may also occur when the military want to procure from the USA, whereas foreign policy would favour procurement from European defence companies.

2.10 There might even be only an indirect relation between international security policy and weapons procurement due to the 'inner momentum' and inertia in the production network. Because policy making doesn't coincide with what happens within the production network, it is useful to distinguish the policy making arena from the production network, though some actors, e.g. the MoD, may be part of both. The actors of the policy arena together make up a policy network, with the typical feature of sustained mutual interactions. Typical actors within the policy network are governmental departments (MoD, MoEA, MoFA), the president and Ministers, parliament and political organisations, and international organisations like NATO.

2.11 Major procurement decisions often are to be approved by parliament. This by no way means that parliament determines what weapon systems are to be developed or procured. Approval is often no more than sanctioning a route that has already been walked down a long way. But again the way decisions in policy network(s) are related to the production networks may strongly differ between countries or defence sectors. Anyhow, one distinguishing feature is whether defence equipment is procured domestically or abroad, because of the different roles of production networks in these cases (or even the absence of a production network).

2.12 The existence of national defence production networks and their relations to policy networks imply strong traditions and vested interests which are often hard to change. They are part of the (National) Defence Innovation System. They may pose obstacles to trans-national integration, for instance to a European Defence Innovation System. On the other hand if a European Defence Innovation System is to emerge, it has to be built upon the existing defence production networks by transforming them into an international network. That this is no easy task is exemplified by many troublesome international co-operation efforts of the past. That it is not impossible is illustrated by some successful international collaboration projects.

2.13 An integrated European defence industry not only implies different production networks, but also requires changes in procurement practices and policies, that is changes within the (national) policy networks. Questions that remain open in this context are: does a common European defence policy call for an integrated European defence industry. Or the other way around: does an integrated European defence industry require a common European defence policy? In other words to what extent are a possible future European defence production network and policy network necessarily interlinked? Current opinions on these issues differ.

2.14 Another question is to what extent peace keeping and peace-enforcing intervention forces will change procurement policies and influence defence technology developments. Will there be more emphasis on technologies and strategies that will keep to a minimum one's own manpower losses?

2.15 Having reviewed this material and these issues we took the view that in our limited METDAC network we could not review the current situation in all European countries or in all defence sectors. We had to draw largely upon existing studies, covering only part of the European countries and only part of the defence sectors. We sought to use this material to point at (or uncover) existing phenomena, conditions and trends that could either facilitate or hinder developments towards international co-operation (either European or transatlantic).

The Framework for a Book

2.16 Given these considerations we decided to organise our work for work packages 3 and 4 so as to be able to produce a book-length report with the following scope:

SECTION ONE: INTRODUCTION

- The dynamics of change (ie, what is stimulating change?)
- Features of the changing arms economy
- The concept of systems of innovation (& technological systems)

SECTION TWO: ANALYTICAL APPROACHES AND CASE STUDIES

- Institutions and Relations (networks)
  - a) Procurement changes
  - b) Corporate changes
- Technological change
  - a) Civil-Military integration
  - b) Systems integration

SECTION THREE: CONSEQUENCES (in terms of some possible scenarios)

- For defence industries:
  - a) "Fortress Europe"
  - b) Trans-Atlantic structures

c) National retrenchment

- For innovative capacities
  c) of individual countries
  d) of Europe

The aim was to provide summaries by our Rome workshop which took place in November 1999, further development by our Manchester meeting in May 2000, and a complete draft text for our final workshop in Brussels which took place on 19 October 2000.

3. Scientific description of the project results and methodology

3.1 An objective: relating defence technology analysis to innovation theory

In sections 3.1 and 3.2 we set out why we sought in this study to relate defence technology analysis to innovation theory and how the development of a ***national systems of innovation*** *approach, but one that transcended national boundaries, met our needs. In terms of the reporting requirement to show innovation (section 3.5) we believe that this, together with our comprehensive engagement with the issues of defence R&D statistics in section 3.3, demonstrate innovation in terms of methodology. Both shaped our approach to our work as the study progressed. In terms of substance - the character of conclusions that can emerge from this analytic approach – we refer to our conclusions and policy implications in section 4.*

3.1.1 One of our objectives for this project was to relate our understanding of defence technology dynamics to current innovation theory. An important recent development in the study of the innovation process has been the emergence of a 'systems of innovation' literature. The systemic approach emphasises the collective character of innovation: in particular, it focuses attention on the interaction of firms with other institutions and organisations, in the production, diffusion and use of new knowledge. This approach is particularly associated with the work of Freeman (1988), Lundvall (1992), Nelson (1993), Carlsson (1995) and Edquist (1997).

3.1.2 Such an approach places particular emphasis on three principal components of the system. The *institutions* and *organisations* that contribute to the production, diffusion and use of new knowledge, which may include firms (including suppliers, users and competitors), universities, public and private research organisations and the government. The *relationships* between those elements and their interdependence and interaction within the system which may be formal or informal and may be based on market or non-market means. The *boundary* of the system which may be national but may equally be regional or international in scope.

3.1.3 Three major variants of the systems of innovation literature can be identified (Lundquist, 1997; Andersen *et al*, 1998): National Innovation Systems (NIS); Sectoral Innovation Systems (SIS); and Technological Systems (TS). I will (briefly) consider their main characteristics.

National Innovation Systems

3.1.4 The emphasis of the National Innovation Systems approach is on the interactions between institutional actors in creating, stimulating and diffusing innovations within a specific country (Nelson, 1993). The geographical boundary is taken as given and the relationships between the actors involved in the innovation process - firms, universities, public research institutes and

government - are analysed. The NIS approach emphasises the importance of existing national political and economic institutions in shaping the pattern of technical change and learning processes within a country.

3.1.5 Nelson and Rosenberg (1993) note that an important question is whether the concept of a *national* system is appropriate in an increasingly international economy. Scientific and technological knowledge is growing ever more international in its creation and dissemination and the influence of trans-national corporations are increasingly pervasive. However, as Edquist (1997) observes, there are strong reasons why we might wish to continue to talk about innovation in terms of national systems. Not least because national differences persist in institutions and the relationships between them, and national policies remain the central focus of public interventions in the innovation process.

Sectoral Systems

3.1.6 In response to some of these concerns about the national focus of much of the early innovation systems literature, another perspective has begun to emerge which focuses on Sectoral Systems (Breschi and Malerba, 1997; Andersen *et al*, 1998). Breschi and Malerba define a Sectoral Innovation System as:

> "that system (group) of firms active in developing and making a sector's products and in generating and utilizing a sector's technologies; such a system of firms is related in two different ways: through processes of interaction and cooperation in artefact-technology development and through processes of competition and selection in innovative and market activities" (Breschi and Malerba, 1997: p.131).

Note that, whilst the NIS approach takes the geographical boundary of the system as given, the SIS perspective sees it as endogenous and emerging from the specific conditions of each sector. Consequently, different sectors may have different boundaries, which are not necessarily national but may spill over national boundaries through processes of co-operation, competition and trans-national knowledge transfer.

Technological Systems

3.1.7 A third approach focuses on specific technologies rather than the national or sectoral systems in which they may develop. Carlsson and Stankiewicz state that:

> "A *technological system* may be defined as a network of agents interacting in a specific *economic/industrial area* under a particular *institutional infrastructure* or set of infrastructures and involved in the generation, diffusion and utilization of technology. Technological systems are defined in terms of knowledge/ competence flows rather than flows of ordinary goods and services. They consist of dynamic *knowledge and competence networks*" (Carlsson and Stankiewicz, 1995: p.49).

As such, this Technological Systems approach is principally concerned with the knowledge and competence networks surrounding a particular technology,

rather than the broader innovation process in which that technology is turned into commercial products.

3.1.8 The boundaries of these knowledge and competence networks are likely to vary depending on the particular technology in question. However, with the increasing internationalisation of scientific and technological knowledge, a Technological System may well be trans-national in scope.

Co -Evolution Of Inter-Linked Systems[1]

3.1.9 Most of the work on innovation systems has focused on one of these approaches. However, National, Sectoral and Technological Systems are clearly inter-linked. Firms and other organisations may be members of more than one system and changes in one of those systems may influence the context for innovation for organisations in other systems. As such, the three approaches should be seen as complementary levels of investigation and pose interesting questions about how the different systems interact (Edquist, 1997; Andersen *et al*, 1998).

3.1.10 These inter-linked systems can be seen as part of a *co-evolutionary process*, which shapes the context in which organisations innovate and influences their strategy and competitive position. The process is co-evolutionary because the adaptive development of one element alters the innovative environment of its neighbours and may cause them to also seek to adapt. Where systems are inter-connected, these changes within a system may alter the decision making environment for organisations in other systems. The stronger the inter-connection between systems, the greater the disturbance of a move or action in one system on organisations in other systems. These changes may take a number of forms and may include changes in organisations and their policies/strategies changes in the relationship between organisations and changes in the boundary around the system.

An Innovation Systems Perspective on The Defence Industry

3.1.11 The influence on National Innovation Systems of the scale and organisation of technological activity directed at national defence is often noted but has rarely been a central focus of studies in the innovation systems tradition. Thus, a heavy commitment to defence technology has long been noted as a characteristic of the post-1945 National Innovation Systems of the US, UK and France (Nelson and Rosenberg, 1993; Walker, 1993; Chesnais, 1993). This has been contrasted with the scale and organisation of such activities in Japan (Samuels, 1994).

[1] The notion of co-evolution as it might apply to innovation systems is discussed by Andersen *et al* (1998).

3.1.12 *A contribution to the innovation systems approach.* Within the innovation systems literature, there is general agreement on the need for more cross-national comparative work. Edquist (1997) notes that without comparisons between existing systems it is impossible to argue that one national system is specialised in one way or another. Consequently, Andersen *et al* (1998) call for more comparative and historical work on similar *Sectoral Systems operating in different national contexts.*

3.1.13 The defence sector would seem an appropriate choice. It has framed the

context for innovation in many countries in the post-War period. At the same time, we already know that there is considerable institutional variety between National Innovation Systems (Gummett and Stein, 1997). This METDAC Network is engaged in some comparative work of this kind compiling a series of case studies of the defence industries in Europe, the US and Japan. The Cornell Workshop of 1997 aimed at taking the process of trans-national comparison a stage further. This is clearly a rich vein for comparative empirical work.

3.1.14 *The innovation systems approach and understanding of the defence industry.* At the same time, the innovation systems approach may contribute to an improved understanding of the nature of the defence industry and its relationship with National Systems. The perspective raises a number of interesting questions: How does the division of labour operate in the generation and application of knowledge for defence-related objectives? What are the relationships between National, Sectoral and Technical Systems in the generation and application of such knowledge? What is the boundary around the system and is a *national* perspective still appropriate when analysing the defence industry?

3.1.15 In analysing future developments in the defence innovation system, it seems obvious to start with the concept of a Defence Sectoral Innovation System (DSIS), with a strong national stamp, for the following reasons. Firstly, there are the existing traditional borderlines between the defence and civil industry, and even within defence companies that are also involved in civil technology. Secondly, especially the big nations, have, for security reasons, always emphasised the necessity of a strong *national* defence industry. Thirdly, due to the government's legal monopoly on violence, the defence market has a monopsonistic structure - governments possess a buyer's monopoly on the weapons market. Moreover, they have to license exports. The latter issue may differ substantially between countries, due to different national *policies* and related *institutional* settings.

Why use the concept of innovation systems?

3.1.16 The Innovation Systems approach implies that the strive for civil-military integration and as well as for trans-national co-operation may be perceived as an attempt for shifting of the borderlines mentioned above of the DSISS. It also implies that one has to take into account historically evolved *institutional, organisational* and *cultural aspects.* A purely classic-economical view will not suffice in understanding opportunities and obstacles for shifting the borders. As Saviotti (1997) has argued: "The historical specificity and institutional nature of national systems of innovation (NSIs) cannot be predicted or explained by traditional economic theories…….NSIs show local and historical specificity, that is, path dependency." This doesn't exclude the emergence of new institutional structures, "but they are grafted onto and partially determined by pre-existing ones".[2]

3.1.17 Translating an Innovations Systems approach into empirical research is not an easy job, particularly because of its comprehensiveness. A useful point of departure might be to focus first on networks in the Defence Sector. *Networks* are a particular useful analytical category for operationalising an Innovation System. Networks represent a stable and repeated pattern of interactions between a set of actors (often organisations) (Elzen et al. 1996; Saviotti, 1997). Like institutions, they shape inter-individual interactions within an Innovation System. Characteristic is also the mutual interdependency of the organisations involved in the network. Networks both enable and constrain (the content of) inter-organisational interaction. They may evolve over time. *As such (pre-existing) networks may hint both at opportunities and roadblocks for creating new, for instance trans-national, networks.*

3.1.17 In order to articulate a national DSIS, we may distinguish two types of (interrelated) *networks*: a *production network* and a *policy network.* The production network represents the (combined industrial-military) Defence Sectoral System, within which defence technology is being developed and military systems are being produced. The production network thus includes both the defence companies as producers and the military services as customers, but sometimes also as co-developers. For NATO countries, the policy network represents the (combined political-military) policy arena, including MoD, government and parliament, and the NATO environment. Actually the Defence Sectoral Innovation System may consist of several 'production networks' applying for instance to different military services (navy, air force, army) or even to different military technological systems. (The latter might then resemble the Technological Systems mentioned above).

3.1.18 The crux of the distinction between 'production networks' and 'policy networks' is that, though military technological developments will to some

[2] Compare also the emergence of new socio-technical networks building on pre-existing ones, as argued by Elzen et al.. (Elzen, B, B. Enserink & W. A. Smit (1996), 'Socio-Technical Networks: How a Technology Studies Approach may help to solve Problems Related to Technical Change', *Social Studies of Science*, Vol. 26, no 1, 95-141.

extent be related to (national or NATO) security policy, the link might be only indirect. Generally, there is no direct causal relation between the two. To some degree (but not wholly) they follow their own internal dynamics. The degree to which the production and policy networks are interlinked may and will differ between countries. The degree of interrelatedness may even differ between different military production networks, like the naval and the air force production network.[3]

3.1.19 Incentives for civil-military integration in technological developments may come from within any of the two networks, from the interaction or overlap between the production and policy network, or from the network environment (for instance, the international competition, or economic situation). The same can be said about incentives for trans-national co-operation. The features of the (national) production and policy networks may give cues for the likelihood of such developments.

[3] To give some broad impressions:
In the Netherlands the naval production network seems to be only loosely linked to the policy network, where the Navy itself is some kind of 'obligatory passage point' between the two networks.
In the USA the striving for *technological superiority* may give the lead to the production network (including the defence companies and the military), rather than to the policy network (though this doesn't imply a conflict between the two)
In France the two networks might be closely interlinked.
Questions that might be asked are: *does a common European defence policy call for an integrated European defence industry. Or the other way around: does an integrated European defence industry require a common European defence policy?* In other words to what extent are a possible future European defence production network and policy network necessarily interlinked?

3.2 NSI as a central methodological focus

3.2.1 Given that our central concern was the management of defence technology in Europe (with Europe broadly defined to include central and eastern Europe, and also to some degree, for comparative purposes, Russia and the United States) we needed a conceptual approach that would allow us to bring some order to an exploration of patterns of national behaviour, together with an alertness to parallel and dynamically linked interactions between the national and the international at both intergovernmental and corporate levels. It was apparent early in our study that the national systems of innovation approach outlined above offered the most fruitful way forward. The focus upon institutional actors, the relations between them, and the boundary of the innovation system, which is central to this approach, appeared at the outset to offer conceptual categories that seemed appropriate to our agenda.

3.2.2 Such an approach seems particularly appropriate for a cross-country comparative study of defence industrial and technological developments. After all, the history of the defence sector means that it still remains, more than most, one of the last bastions of national protectionism. If emphasis upon *national* systems of innovation is no longer relevant even in the defence sector, then the conceptual approach as a whole requires some rethinking. Such a conclusion would be a valuable addition to academic debate about approaches to the study of innovation. Equally, in recognition of the way that the national boundary around defence firms has been increasingly breached by international joint ventures, mergers and acquisitions, and various forms of intergovernmental cooperation, there are interesting issues about how far innovation in the defence sector today is no longer nationally bounded. By using a tool that emphasises the *national*, we aim also to explore the relations between the national and the *international*.

3.2.3 In summary, the attractions of the national systems of innovation approach for our purposes were that:

- A focus upon *institutional actors* directs attention to who these actors are, how they are changing, and what difference the introduction of new actors makes. It emphasises, for example, the questions of the impact of new entrants (eg, from the civil sector) and of private investors;

- A focus upon the *relations between actors* directs attention to how an innovation system works in practice. It highlights the differences that can exist between states in how actors *interact*. Similarities in the formal relations between ministries of defence and firms, for example, are subject to numerous nationally specific modalities, as also is the degree to which what we will later call ‘policy networks’ and ‘production networks’ operate in synchronisation with each other. Understanding of these matters is essential to any discussion of the future evolution of the defence sector;

- A focus upon the *boundary of the innovation system* directs attention to how that boundary may now be changing under the influence of international corporate fusions, new forms of intergovernmental relations in the security field, and the globalisation of technology providers. From the point of view of a study of the evolution of European defence industrial system, an important 'boundary' for exploration (by which we also mean analysis of the actual extent and characteristics of this boundary) is that between Europe and the United States.

3.3 Measuring Defence R&D: the problems

3.3.1 There are several reasons why the analysis and international comparison of defence research efforts is difficult. There is no single and widely accepted source of international data on defence R&D, and countries have different arrangements for controlling and accounting for military research. The different ways in which R&D is defined, broken down and funded in different countries can easily lead to data being misinterpreted. This section summarises some of the main problems encountered.

Definition of R&D and the content of defence R&D

3.3.2 The main indicator used to describe the effort invested in improving the state of knowledge and generating innovations is the effort invested in Research and Development (R&D), both in terms of funds and of personnel involved. This "input" measure has been a preferred indicator for more than 30 years, since the OECD established in its "Frascati Manual" the main parameters for defining, collecting and presenting innovation data. The Frascati Manual, in its various editions, has since become the work of reference when generating and analysing comparable international series of R&D data.

Frascati Manual definition

3.3.3 The OECD has published various versions of the Frascati manual to assist in the collection of data on the "human and financial resources devoted to Research and Experimental Development". According to the Frascati definition:

"Research and experimental development comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications".

Three categories of R&D are distinguished:

- basic research
- applied research
- experimental development

3.3.4 Although the main definitions of R&D and its components are clear, there are a number of grey areas in which the classification of an activity as being R&D might be in doubt. Significantly, Frascati recognises that "possibly the greatest source of error in measuring R&D lies in the difficulty of locating the cut-off point between experimental development and the related activities required during the realisation of an innovation" (Organisation for Economic Co-operation and Development 1994, p.20-21). This problem is especially relevant to the defence industries. Experimental development and associated activities like manufacturing design, prototyping, tooling-up, pre-production series, and

troubleshooting absorb a very large percentage of the innovative efforts in the defence field. The costs of these activities are very high, and many of them, although part of the innovation process, are not always defined as a constituent of the R&D effort.

3.3.5 The Frascati Manual defines in some detail the conditions under which activities like prototyping, trials and engineering follow-through can be considered part of experimental development. For example, the production and testing of prototypes will fall within the scope of R&D as long as their primary objective is to make further improvements. Once the necessary modifications to a prototype have been introduced the R&D stage is over:
"The construction of several copies of a prototype to meet a temporary commercial, military or medical need after successful testing of the original, even if undertaken by R&D staff, is not part of R&D."[4]
The general rule of thumb, in this as well as other borderline activities like trial production and tooling up, is to exclude them from R&D where they involve preparation for manufacturing without requiring the resolution of additional scientific or technical uncertainties. Yet, the point in which a prototype has been "successfully tested" and all technical and scientific problems have been solved is not sharply delimited. Consequently, whether a borderline activity should or should not be considered R&D is often a matter of interpretation.[5]

3.3.6 This generates a set of difficulties in the evaluation of R&D expenditures that are particularly intense in the case of complex defence systems.[6] Defence procurement stages do not usually fit with the stages of research, experimental development and other innovative activities as defined by the Frascati Manual. Tasks like operational studies, engineering development, and user demonstration, which are not R&D according to Frascati, will often be included within the development stages of the weapon procurement process. The analysis of budget aggregates may therefore provide misleading estimates of R&D expenditures.

3.3.7 When the construction and testing of prototypes absorbs a considerable share of development funds, different interpretations of the nature of R&D may result in radically different estimates of research effort. For instance, it has been argued that in the case of the European Fighter Aircraft (EF2000), much of its new technologies had been demonstrated in its British precursor prototype, the Experimental Aircraft Programme (EAP). Consequently, a sizeable portion of

[4] The same applies to trial production: it should only be considered R&D when it involves full-scale testing and further design and engineering.
[5] A lax interpretation of the meaning of "success" would bring most of the prototyping activities outside the are of R&D activities. It can be argued that the long and complex process of proving that an aircraft design is satisfactory (a staged approach to confirm the performance and safety of the vehicle and identifying faults) is not R&D. Yet, it could also be argued that during this process of testing and validation, the prototype has not yet been "successfully" tested, then the activity would be considered to be R&D.
[6] The OECD has recognised this point, devoting a whole annex of the latest Frascati manual to the provision of guidelines to decide which project tasks in the defence and aerospace sectors should and should not be included in the R&D statistics.

the work carried out to produce the development batch of EF2000 would, strictly speaking, fall outside R&D (Stewart 1989). Yet such development activities constitute a sizeable share of the defence R&D investments as registered by OECD and national statistics. In Spain EF2000 accounts for well over 50% of all government expenditure in defence R&D (Molas-Gallart, Farrero and Mañà 1998), and EF2000 is a very important element of the whole R&D effort in Spain (well over 15% of *total* government R&D expenditure). Yet the largest EF2000 investment over the past few years has been linked to the production and manufacture of its prototypes. Although present R&D estimates have always considered these expenditures to be R&D, a strict interpretation of the Frascati rules could lead to the exclusion of much of the EF2000 development expenditure from the R&D statistics.[7]

3.3.8 It is widely acknowledged that the definitions that government agencies use to compile their research budgets do not necessarily comply with the Frascati definition. In France for instance, there are three different indicators of defence R&D released by the Ministry of Defence and a further one released by the Ministry of Research which attempts to present data in alignment with the Frascati definition. (Serfati 1998).[8] In the UK, the Department of Trade and Industry and the Office of Science and Technology publish statistics, including data on defence R&D conforming to the Frascati Manual definitions, in their publication *Forward Look of Government-funded Science, Engineering and Technology*. Traditionally, the British MoD R&D data has not conformed to Frascati conventions. After much debate about their quality MoD published the results of a major review of the basis on which these statistics were in 1993 collected, and attempted to reconcile previous practice with that of the Frascati convention (Gummett and James 1998). So far however, this reconciliation is done only for MoD's intramural R&D expenditure.[9] The official figures presented by the MoD in the annual *Statement on the Defence Estimates* are still being assembled under different criteria, although for most purposes the differences are not important. The main difficulties seem to arise not over the definitions of R&D, but over differing procedures within MoD and OECD for including (or not) VAT and pension costs into the R&D calculations (Gummett and James 1998).

3.3.9 A final common problem, derived mainly from the general difficulties in the definition of R&D, is the differences between government R&D support to industry as reported by public agencies and as reported by its industrial receivers. Hagelin and Reppy have noted that these differences are particularly important (and growing) in the defence and aerospace sectors. It appears that government agencies see R&D spending as funding of activities that would not be labelled as such by industry, particularly in the case of large extramural contracts where R&D and production are mixed. In the United States, the

[7] This would completely change the profile and trends displayed by Spanish defence (and total) R&D.
[8] Differences between these two sets of data have fallen over the years to a relatively small 5-10% gap.
[9] For internal purposes the British MoD distinguishes between *research* and *development* in a way that differs from the standard Frascati distinction. In MoD terms, work is 'development' if it is directly linked to a specific equipment project. It is 'research' if it is of a more general nature, not related to the current procurement of any specific item of equipment.

differences are particularly apparent in areas like missiles and aerospace (Hagelin and Reppy 1998). Although the latest "Frascati Manual" states that the flow of R&D funds should be based on the responses of the R&D performers and not on those of the funding sources (Organisation for Economic Co-operation and Development 1994, p.23), it appears that defence R&D data reported by the OECD is still based by and large, on the estimates of the public funding bodies.

Defining Defence R&D

3.3.10 The difficulties underlined so far refer to problems derived from the general definition of R&D. There is however another important problem, this one peculiar to the assessment of defence R&D: when can a R&D activity be defined as defence and when is it civil? There are two main approaches to answering this question: one can discriminate between defence and civilian R&D according to (a) the goal of the research or (b) the funding source. Significantly, the two most important organisations that collect or have collected international statistical data in this field (OECD and SIPRI), have each taken a different approach although balanced by a number of exceptions that reflect the difficulty of giving an easy answer to this problem.
The OECD Frascati Manual defines defence R&D as including:
*"all R&D programmes undertaken primarily for defence reasons regardless of their contents or whether they have secondary civil applications. Thus the criterion is not the nature of the product or subject (*or who is funding the programme*) but the objective". (Organisation for Economic Co-operation and Development 1994, p. 77-the underline is ours)*

3.3.11 The definition includes nuclear and space R&D undertaken for military purposes, regardless of who is funding it, and does not include civil R&D in areas like meteorology or telecommunications, financed by ministries of defence. Therefore, according to Frascati rules, who is funding the programme is not the consideration when distinguishing between defence and civilian R&D. In principle this seems to make sense. We know that not all defence research is supported by defence agencies and that at times, defence agencies support research that appears to pursue civilian objectives.[10] However, earlier attempts to measure defence R&D took a different approach.

3.3.12 In the early 1970s SIPRI started to publish with certain regularity, military R&D estimates in its Yearbooks. According to SIPRI "military research and development" included:

1. all R&D financed through the budget expenditures of a country's defence department (or comparable administrative unit); and
2. all other R&D, financed by national government departments and agencies, which is officially identified as being conducted for military,

[10] In the US, for instance, nuclear weapons research has always been funded by the Department of Energy. In Britain, in the days of the ministries of Aviation and of Technology in the 1960s, the main defence-related research establishments were outside the scope of the Ministry of Defence.

defence, or civil defence purposes, or concerned mainly with weapons. (1972)

This definition revolves around *who* carries out the research, rather than trying to define its objectives. To account for the cases in which substantial defence R&D was funded outside the defence agencies (as in the case of nuclear weapons research in the US), SIPRI added to its estimates any other R&D, regardless of source, that had been *officially* identified as being conducted for military purposes.

3.3.13 Both approaches have their difficulties. The SIPRI definition refers only to Government expenditure, and leads to the issue of whether defence R&D can be assessed only on the basis of government expenditure. The OECD definition relies on the ability of the analyst to decide whether research is being conducted *"primarily"* for military or for civilian goals, and is faced with the problem of dual-use research (i.e. research that can be applied to both military and civilian goals). We deal with these two problems in turn.

"Government R&D"

3.3.14 Defence is typically a function of Central Government; therefore when trying to assess defence R&D expenditure on a national basis it is common to focus on the central government budget. However, not all "public" funding is generated by central government. In many countries, regional and local authorities are responsible for R&D investments that are not registered in central government budgets. In Germany for example, very substantial funding for R&D is provided by regional Landers in addition to that from Federal Government (Stewart 1989); some of this is likely to be defence-related. In Spain, regional governments in Andalucia and the Basque Country have actively supported the activities of defence-related firms, and this funding is not taken into account in any estimate of defence-related expenditure, let alone of defence R&D.

3.3.15 Even if we are able to take into account the defence R&D investments from all public agencies, there is still the R&D carried out independently by private firms. It has been argued that in countries with large military R&D efforts, privately financed defence R&D is only a fraction of government-funded efforts. In contrast, in countries with smaller government defence R&D programmes (like Switzerland and Japan), private R&D may account for a substantial share of total defence R&D (1972). This situation may be changing with the decline in defence budgets and the new types of relationship being established between defence customers and producers. As shown by recent national studies (Serfati 1998, Hagelin and Reppy 1998, Gummett and James 1998) the structure of defence R&D activities is shifting. Defence agencies are trying to transfer an increasing number of responsibilities to their suppliers, and would like to see an expanding role for the private enterprise funding of defence-related R&D. The firms more able to pick up this challenge will be the top defence producers in countries like the US, UK, and France.[11] Changes in the structure of industry may also affect the volume of industrial funding of

[11] It must also be noted also that independent defence R&D investment by firms is often recovered at least in part through the overhead payments included in government cost-based contracts.

defence R&D, although the effects of the change on independent R&D are as yet, unclear (Hagelin and Reppy 1998).

Defence vs. civilian R&D and the problem of dual-use

3.3.16 The results of much R&D, regardless of funding sources, can often be applied to military as well as civilian goals; in other words, R&D activities regularly generate dual-use outputs. Within large diversified firms in sectors like the aerospace industry, much R&D work is conducted for *both* military and civil goals (Stewart 1989). Moreover, the constantly changing nature of technology prevents the development of stable criteria defining boundaries for the types of technology with potential military applications (Cuthbertson 1983). This creates a long-recognised problem for the definition and evaluation of defence R&D. Particularly affected by this problem are the definitions of defence R&D based on the nature of research or, like the Frascati Manual, on its objectives.

3.3.17 The OECD approach falls further into problems when attempting to deal with basic research, which by definition is *primarily* undertaken to acquire new knowledge. Strictly speaking, OECD's definition of defence R&D and basic R&D are incompatible, and should result in the exclusion of any basic research, (even if funded by defence agencies,) from defence R&D statistics. Basic research can yield results with potential application in a range of areas (military or civilian), or no practical results at all. However, the military, particularly in the US, has over the years supported basic research in areas that are felt may later feed into technical developments of interest. As shown by 1960s Pentagon research (e.g. project HINDSIGHT), the results of fundamental research funded by the US Department of Defense resulted, over time and after complex diffusion processes, in substantial military innovations.

3.3.18 Technology that has no other conceivable application than a military one is the exception rather than the rule. General fundamental research may feed innovations used in both military and civilian fields, and the same can be said of research in most applied experimental fields (materials research, structures, electronics, propulsion research, aerodynamics, communications, etc.). The US Department of Defense (DoD) continues to be heavily involved in the funding of basic and applied research in a variety of scientific fields. Hagelin and Reppy (1998) study of the US defence innovation system shows that the DoD supports 68% of all federally-funded research in social psychology, 60% of research in mathematics and computer sciences, and 40% in psychology. DoD fundamental research programmes during the decades before 1986 resulted in 20 Nobel prizes, and military policies for manpower training, revitalisation of university instrumentation and facilities have led the way for similar federal policies in these areas.

3.3.19 The OECD acknowledges that "where there is pressure to 'spin off' defence R&D to civil uses, or *vice versa*, the blurring of the objectives can become substantial. In such cases, only the organisation funding the R&D may be able to decide on its objective -and thus its classification as either defence or civil R&D"(Organisation for Economic Co-operation and Development 1994, p.77). This is far from clear, but appears to provide an exception to the OECD

procedure for defining the military nature of R&D by its objective rather than its funding source.

3.3.20 Meanwhile, the dual-use nature of much research has the potential of further confusing the interpretation of government R&D budgets. In France, a new budgetary line has appeared during the 1990s called "dual research", whose objectives remain unclear. Also since 1997, research funds earmarked for "dual-use objectives" are not included in the defence R&D budget, but in the procurement budget (Serfati 1998). Our discussion in this chapter suggests that such functional definition of research as "dual-use" is bound to be subjective in the extreme and that in fact, most research efforts can be labelled as dual-use. The separation of budget entries on the basis of the alleged dual-use nature of the research component is likely to further obscure the nature of the research and its objectives.

3.3.21 It follows from this discussion that trying to estimate defence R&D on the basis of the potential application of the research conducted or its primary goals is fraught with problems and often subjected to judgements that may not be correct in the long run. Taking into consideration the dual-use potential of much R&D a safer approach to defining defence R&D would be to return to the original SIPRI definition. This included all R&D funded by defence agencies plus other R&D expenditures *officially* identified as being conducted for military purposes, although funded by other public organisations.

Globalisation of R&D

3.3.22 A further problem in accounting for R&D is created by the handling of R&D contributions to work carried out in another country. Payments like licence fees and levies contribute to R&D but are included within the cost of a product rather than being accounted for as contributions to research. Formally, Defence GERD (Gross Expenditure in R&D) should exclude R&D performed in foreign territory and include R&D performed in national territory financed by foreign sources (National Group of Experts on Science and Technology Indicators 1986). Instead, if data is based on funding sources (such as funding from defence agencies), R&D performed abroad and funded nationally would be included in the defence R&D indicators, while R&D performed at home but funded from abroad would be excluded. The volume of these discrepancies is bound to grow as defence R&D activities become more internationalised.

3.3.23 International comparisons of defence R&D are also subject to the common problems affecting the comparability of any national-based financial data: the translation of national currencies into a common denomination. The basis on which the exchange rates are calculated (average commercial exchange rates, industrial prices, implicit GDP price index, purchasing power parity) and the ways in which inflation is accounted for; can affect substantially the final data.[12] It is not uncommon for differences of over 40% among estimates to be derived solely from the application of different exchange rates.

[12] The "Frascati manual" recommends the use of purchasing power parities and implicit GDP price index for use with R&D statistics.

Measuring R&D: Sources of data

3.3.24 An examination of the defence R&D data sources reveals important deficiencies in existing R&D data. Three main sources of defence R&D data can be identified:

- International estimates aiming at comparability across countries. The main source is the OECD (OECD *Main Science and Technology Indicators*).
- Estimates assembled by central national authorities like central statistical offices.
- Estimates contained in national budgets and other documents of individual government departments and agencies.

International estimates aim at offering comparable data; but nationally-based data often provide more detail and the possibility of identifying with some degree of accuracy, the application of the funds and the changing trends in the structure of defence R&D programmes.

3.3.25 OECD data is based on a survey of official budget and expenditure data. National or OECD analysts must assess when funds are applied to military use even when the government organisations involved are not defence agencies.[13] We have seen in the previous section that this approach faces serious methodological difficulties.

3.3.26 Furthermore the process and criteria used for these decisions are not wholly transparent. There is wide scope for individual interpretations of what is, and what is not, defence research and the existence of broad areas of research with dual-use application makes such decisions increasingly problematic. In some cases the "allocation" of such grey areas can cause important variance in the final estimates. In Spain (Molas-Gallart, Farrero and Mañà 1998) the main government research establishment under the direction of the Ministry of Defence is INTA: the national aerospace laboratory. The Ministry of Defence R&D expenditure in INTA is considered by the OECD to be space research and not defence; even when the Ministry of Defence controls the establishment and provides most of its funding. As the primary defence government research establishment, the evolution of INTA funding provides a main indicator of the shifting Ministry of Defence preferences between "intramural" and "extramural" research (Molas-Gallart 1992). Following OECD data, shifts towards "intramural" research would be presented as shifts from defence to space research.

3.3.27 A final problem with OECD data is that in practice, it does not include private defence-related investment in R&D carried out by firms independently from government-granted R&D contracts. A brief discussion of this problem has been presented above. Because the volume of private non-reimbursable

[13] It must be noted that, traditionally, the United States "Science Indicators" reports defined "civil R&D as excluding both defence and civil space R&D", while the OECD defines it as total R&D less defence R&D, therefore including civil space (National Group of Experts on Science and Technology Indicators 1986).

defence-related R&D effort is likely to vary from country to country, and also from year to year the OECD data may include systematic biases.

3.3.28 For non-OECD countries, like Switzerland and Eastern European countries, a source of data is the UN. Since 1980 the UN has compiled a register of military expenditure based on data supplied by national governments. In some cases, this information has included data on defence R&D, but this has proven to be the exception rather than the rule (Arnett 1998).

3.3.29 In its latest yearbooks, SIPRI has been using a combination of OECD and UN data to provide global statistics for defence R&D. In doing so, SIPRI is distancing itself from its own previous practice of considering all defence-funded R&D as military R&D. At the national level many governments provide defence R&D data, yet the quality of these official sources varies. For many countries information is fragmented and at times incomplete. In these cases, the elaboration of defence R&D estimates would require careful independent analysis and monitoring of public spending across a variety of areas. In summary, although world-wide reporting of R&D data has improved (Arnett 1996), the quality of defence R&D data is often lacking and does not provide a solid foundation for comparative and longitudinal analysis.

Other measures: innovation output and the use of patent analysis

3.3.30 This section has concentrated on the availability of defence R&D data. When available, this data can be used in international analysis and to assess the evolution of expenditures over time. In the cases where detailed data is available, studies of the sectoral distribution of innovation efforts may also be possible. Yet defence R&D data can be combined with other indicators to provide a fuller picture of the characteristics of the innovation system in the defence industries. For instance, Serfati and his colleagues at the *Observatoire des Sciences et des Techniques* (OST) have combined official data on the firms receiving R&D contracts from the French Ministry of Defence and other government departments, with patent data to analyse the technological performance and innovative characteristics of defence-related firms (Serfati, Carpentier et al. 1997). This example shows how a broader set of indicators can provide useful analytical tools. In particular, the use of patents can provide information on the innovative patterns of defence-related firms, and their evolution across time. The application of this methodology is particularly suited to large firms operating close to their technological frontier. For smaller firms and/or less technologically advanced companies, their patent portfolio is bound to be too small to provide reliable indications of changing patterns in company focus. It is common for the R&D and other innovative activities of such firms to focus in the adoption and adaptation of technological developments generated elsewhere. The result would be low patenting performance, which is not necessarily indicative of low innovative activity.

Conclusion: key questions for the study of defence R&D

3.3.31 This section has stressed the continuing shortcomings in the availability of basic data for the study of the defence innovation system. Although the more general trends in the evolution of defence R&D can be derived from existing data, interpretation is not always straightforward, and data lacks the detail and homogeneity necessary for in-depth long-term and cross-national analysis.

3.3.32 Given the difficulties of defining defence R&D and particularly of using definitions based on the objectives of the research activity, we suggest that the main focus of data gathering should be placed on the R&D spending patterns of defence agencies, and public programmes officially earmarked for defence purposes. It is also important to monitor the independent R&D investments of corporations involved in defence production. This would require a co-ordinated analytical effort bringing together a systematic international study and data gathering exercise based on definitions and approaches adapted to the present circumstances.

3.3.33 Our conclusions for the immediate METDAC study have been to change our methodological emphasis from ‘measuring’ to ‘mapping’. This is of course not merely a counsel of necessity since it is entirely consistent with our emphasis on understanding how different elements of national defence innovation systems relate to each other and what happens at the boundaries of such systems.

3.4 Key themes emerging

In this section we set out some of the principal themes emerging from our analysis, both in terms of changes in the European and US production and policy systems and the relations between them, and in terms of the response of three groups of European countries.

The Restructuring of the Defence Sectoral Innovation System, and the Response of Defence Firms

3.4.1 This section analyses the restructuring of the "Defence Sectoral Innovation System" that is being pursued by defence procurement agencies, and the responses from defence-related firms. While procurement reform has attempted to open up the market to new firms, and promote "civil-military integration", prime contractors have responded by seeking consolidation *within* the defence sector. Civil-military integration can however be found in the supply chain; however, the growing importance of suppliers can be attributed to factors other than procurement reform.

3.4.2 With the decline in defence procurement budgets in most Western countries and the continuing growth in the cost of new defence systems, defence customers are reviewing the ways in which military systems are developed, purchased and maintained. Until recently the paramount concern of military customers had been systems performance. Technical requirements, administrative regulations, and logistics and maintenance needs, resulted in a highly complex web of specifications, standards and procurement practices. To respond to these peculiar needs, specialised industrial corporations and divisions developed. The economic costs generated by this highly restricted market environment have been considerable.

3.4.3 In this context, defence customers have become increasingly interested in promoting the exploitation of civilian technological capabilities in military contexts. Cost considerations have moved rapidly to the top of their agendas and have resulted in initiatives to reform procurement practices and project management. Military technological superiority is now being sought through increased reliance on the civilian technology. Defence agencies are implementing "dual-use technology policies" to achieve cost reductions and to harness the technological dynamism of the civilian market. The highest profile reform initiatives have been launched in the US, where a wide-ranging set of changes has permeated the Pentagon's defence acquisition and research strategies. These initiatives have taken place against the background of comprehensive policies to reform the operations of the US Government to reduce costs and improve the delivery of government services.

3.4.4 A key element in these reforms has been the revision of the ways in which military standards and specifications are issued and used. It is widely felt that the requirements imposed on defence suppliers by distinctive defence standards and specifications are an unnecessary cause of additional costs. One of the

objectives of the reform of defence standards has been to bring to the defence industries the same administrative, research and production procedures that are applied to the rest of the economy and in this way, open the defence market to new commercial suppliers. Although the US experience has received most attention, other large defence manufacturing countries have also been implementing measures to reform the defence standardisation processes; some predating the US efforts. For instance, the preference for civil standards has been official policy in Britain since 1982. The British MoD does not develop defence standards as a first option and, instead, has become an active contributor to the activities of civilian standards organisations.

3.4.5 An immediate implication of the new approach to defence standards is a shift in the way the technical configuration of a defence system is defined. Insofar as the reform is successful in reaching its main objectives, it will substantially alter the relationship between private and public sectors when developing new systems and technologies. From a situation in which defence systems were "defined through specifications" and standards imposed by the customer-user (therefore emphasising the use of tailor-made components and sub-systems), the new approach relies instead on the utilisation of commercial counterparts whenever possible. In turn, the use of commercial practices is shifting design responsibilities to industry, thereby reducing government oversight and reporting requirements. The growing responsibility of suppliers for the design of their systems and the selection of components and sub-systems must be accompanied by increased responsibilities through the life-cycle of the system they supply. As defence firms become increasingly able to introduce commercial components in their designs, they are also made responsible for introducing obsolescence management systems and for delivering support and maintenance services once the system is delivered. This can only be done by tying the prime contractor to long-term maintenance and support contracts. In this way prime contractors are compelled to consider the long-term implications of component choices that, while assuring short-term savings, may be riskier from the perspective of long-term maintainability.

3.4.6 What can we say about the success of these government policies? The US Department of Defense claims that it is well on the road to meeting its goals of reducing the length of the acquisition cycle, minimising cost growth, and achieving "civil-military integration". This is however a long and difficult process, involving systemic change. One of the reasons why, the structure of defence production, may not be changing in the way some expected as a consequence of the defence procurement reform initiatives, is that these deal with changing the regulatory environment for the existing defence industry, more than with recruiting new entrants. There are as yet no data available on progress toward the goal of bringing in new suppliers from the civilian sector. DoD has moved to outsource part of its own activities by privatising the performance of certain "commercial activities," such as depot maintenance. This is not the same as bringing in new suppliers of military hardware, however, and some changes have tended to restrict rather than enhance competition. For instance, in order to save the administrative costs of running open-ended competitions the DoD now limits the number of bidders on new

contracts to those regarded as having a realistic chance of receiving the contract.

3.4.7 Meanwhile, at the prime contractor level, the U.S. defence industry has undergone large-scale consolidation. By 1998 the four largest contractors controlled parts of 25 companies that had existed independently in 1990. Yet, the large firms that dominate the defence market are more defence-dependent than they were at the beginning of the decade before their acquisition spree. If anything, restructuring has been accompanied by an end to the industry's brief post-cold war flirtation with diversification into civilian markets. There is an obvious disjunction here: defence officials have been strongly promoting dual-use technology and acquisition reform, even as their policies on industry restructuring have favoured a “pure play” strategy by contractors, that appears to have reinforced barriers between defence and civilian sectors, at least at the prime contractor level.

3.4.8 While prime contractors tend to be defence-specialised with limited integration between the civil and military sides of their business, we have found growing evidence of civil-military integration in their supply chains, driven in part by changes in the supply chain management practices of prime contractors. Historically, large defence contractors, encouraged by “cost-plus” defence procurement, have sought to design, develop and manufacture as high a proportion of their final product as possible “in-house”. Suppliers and sub-contractors were used as sources of extra capacity during production ramp-ups, or to provide specialist sub-systems. In contrast, large defence equipment manufacturers are now contracting out an *increasing* proportion of their activities albeit to a smaller number of suppliers and sub-contractors.

3.4.9 There are a number of factors that are driving large defence equipment manufacturers to contract-out more of their activities. Large firms are increasingly focusing on their core capabilities, which are seen to be systems integration and high value-added activities. Further, outsourcing devolves responsibility for innovation, shifting the costs and risks associated with R&D from the prime contractors to their suppliers. In dual-use mode, these suppliers can spread R&D and fixed costs among a larger number of customers in both the defence and non-defence sectors. Consequently, outsourcing provides a way of deriving dual-use benefits from spinning-in technologies developed by suppliers who serve both defence and non-defence sectors. It is among these suppliers where most evidence is found of civil-military integration. Several empirical studies suggest that, to a greater extent than has commonly been realised, production facilities in the U.S. defence industry at the level of subcontractors and third-tier vendors can be considered dual use in the sense that the same facilities produce goods for defence and civilian markets.

3.4.10 The sectoral system of innovation in the defence industries is still in a state of flux. It is clear however that the effects are different at different levels of the supply chain, and that policy and industrial strategies in different countries are moving at different pace. Further, the consequences for competition and market structure of present procurement reform initiatives are not yet well

understood. Although the reform of defence standards may open the market to newcomers, the focus on closer longer-term customer-supplier relationships may have the reverse effect: i.e. to close the market and limit competition, at least at the prime contractor level. This risk is compounded by the consolidation of the defence sector, particularly in the US but actively encouraged in Europe by the political powers. Some experts and policy-makers have argued that the means to assure competition under the new procurement regime rely on establishing a competitive market for defence sub-systems and components. What happens among these suppliers is even the more important if we consider that it is here that we can find evidence of civil-military integration.

The International Context for National Decisions

Introduction

3.4.11 States form their policies for arms development and production in relation to other states' policies and practices as well as to their own domestic situation. This is obviously so in the case of an arms race between rivalrous states, and it is no less true for the states in the NATO alliance and for the members of the European Community. Members of an alliance influence each other in many ways: through example, in both technology choices and procurement practices; through overt pressures to conform to common standards to insure interoperability of equipment; through competition in the international arms market; through joint programmes for weapons development; and through myriad contacts in the civilian sphere, including the complex interactions around dual-use technologies. Individual defence firms are also part of this transatlantic soup of rivalrous behaviour, cross-national imitation, and intermittent cooperation. Member countries of the European Community—many of them also in NATO—are even more influenced by each other as they strive to develop common policies, including now a common foreign and security policy. Finally, long-run trends in technology, costs, and budgets form a common environment for all of the countries with which we are concerned. These influences are refracted through national institutions and policies- France will react differently than Britain or the Netherlands to a technological impetus or political pressure- but no country is immune to them.

3.4.12 Specifically, with respect to new weapons technologies, we expect the national system of innovation of each country to show distinctive features but to include links across national borders to producers and users in other countries. In the chapters that follow, the defence innovation systems of a set of representative European countries are discussed in detail. In this chapter we set out some of the common features of the international scene, as they affect defence innovation in Europe. In particular, we concentrate on the role of the United States as partner and rival and on the emerging common institutions within Europe.

The Looming Presence of the United States

3.4.13 The spectre of U.S. hegemony in defence technology and weapons production has long dominated much of European thinking about defence industry restructuring. The US export drive in the mid-1990s fuelled European feelings, not least in France, that the US was deliberately attempting to undermine Europe's defence industrial base (Grant, 1997). Predictions of an emerging arms trade monopoly in which the United States would be the sole producer of the world's most advanced conventional weaponry only added to European anxieties (Kapstein, 1994). One European perspective sees an increasingly dominant U.S. leaving the European defence industry with only two choices - either to challenge the U.S. monopoly in defence or submit to the role of subcontractors and niche manufacturers. Such a choice – it has been argued – has implications that go beyond concerns about employment and technological capabilities to Europe's ability to frame its own defence and security policies (Van Scherpenberg, 1997). Certainly, considerable effort and resources have been invested by European governments in an effort to sustain a European defence industry able to keep pace with, and maintain independence from, its US rivals (Becker, 2000). Certainly, the history of the transatlantic defence industrial relationship has been one of tension between the European aspiration for autonomy versus the sheer economic and technological pressures towards collaboration with the United States (Grant, 1997; Van Scherpenberg, 1997; Becker, 2000).

3.4.14 Indeed, perhaps the single most important fact about the United States in relation to its European allies is its size. The United States spent $270.5 billion on defence-related activities in FY 1997, of which $37.0 billion was for research, development, test, and evaluation (RDT&E).[14] European members of NATO, taken together, spent about only about 73 percent as much on defence activities, and the three leading defence producers (France, Britain and Germany) spent only about a quarter as much as the United States on military R&D activities (SIPRI 1999, Tables 7A.3 and 8.2). Because of this disparity the United States is inevitably a major player in European defence markets and its internal market is an object of desire for European producers. Intra-NATO trade has been notoriously one sided, often described as a 'one-way street' in which United States defence sales to Europe greatly exceed European sales to the United States.

3.4.15 U.S. analysts portray this flow of arms from the United States to NATO partners as a 'liberal transfer of American defence technology' and perceive a widening technology gap as a result of U.S. investments in advanced information technologies for military purposes (Flamm 2000). Europeans see it somewhat differently and attribute the persistent imbalance in intra-NATO trade flows more to protectionist rules and practices in the United States than to a fundamental technology gap (Sparaco, 2000). European producers have a

[14] U.S. Office of Management and Budget (2000), Table 3.2. These figures are for government outlays and do not include additional spending by defence contractors on their independent research and development (IR&D), which currently runs around $3 billion per year. Defence-related activities includes the military budget of the Department of Defense, plus atomic energy defence activities in the Department of Energy. The fiscal year runs from 1 October to 30 September.

leading presence in a number of niche markets such as Vertical Take-off and Landing (VTOL) technologies and, taken as a whole, a competence in almost all areas of defence production. The problem for Europe vis à vis the United States has been that in Europe these capabilities have been divided among several national markets, with typically only one producer in each country, considerable redundancy between countries, and not much cross-country competition. By contrast, even after the substantial consolidation of its defence industry in the 1990s, the United States continues to enjoy a measure of internal competition in its defence market, with two or more prime contractors in all major sectors (See Figure 1).

Figure 1

Number of U.S. Prime Contractors in Selected Defence Markets

Sector	Number of Contractors (1998)
Tactical Missiles	4
Fixed-wing Aircraft	3
Expendable Launch Vehicles	2
Satellites	5
Surface Ships	5
Tactical Wheeled Vehicles	4
Tracked Combat Vehicles	2
Strategic Missiles	2
Torpedoes	2
Rotary Wing Aircraft	3

Source: Adopted from Flamm (2000).

The Consolidation of the U.S. Defence Industry

3.4.16 The U.S. defence industry saw an unprecedented wave of mergers, acquisitions and divestments during the 1990s. The consolidation process has led to major changes in the structure of the U.S. defence industry and the emergence of three giant defence companies—Lockheed-Martin, Boeing and Raytheon—whose overall size and breadth of business activities dwarf their competitors in the United States and—until recently—Europe (James, 1998; James, 2000a). Lockheed Martin has been at the forefront of defence industry consolidation, having emerged from the merger or acquisition of no fewer than 17 separate U.S. companies since the end of the Cold War. Boeing's current business activities are the product of its $3.2 billion acquisition of Rockwell in 1996 and

its $14 billion merger with McDonnell Douglas in 1997, which played a key role in Boeing's strategy to build a position in information, space and defence markets comparable to its position in commercial aircraft. Raytheon—a relatively late entrant into the consolidation process—secured its position in the top-tier of U.S. contractors with two deals in 1997, the acquisition of TI Defense for $2.95 billion and its $9.5 billion merger with Hughes Aerospace and Defense.

3.4.17 The U.S. government actively encouraged this consolidation process, with the aim of reducing procurement costs and sustaining a viable defence industrial base during a period of declining defence budgets. Mergers and acquisitions were viewed as a way of allowing companies to reduce overhead, eliminate excess capacity, diversify product lines, and cut costs. Certainly, size was regarded as a crucial factor for survival and competitiveness, and the received wisdom was that larger size would allow companies to maintain a broad portfolio of projects and programmes, making them less dependent on particular programmes and thus less vulnerable to the impact of cancellations (Center for Strategic and International Studies, 1998). At the same time, it was assumed that larger companies would be able to move capital, technology, and other resources between businesses and programmes in response to changing defence market demands. Size was assumed to provide opportunities for potential economies of scale and scope in design, development and production, with potential benefits in terms of reduced overhead costs and technological and operational synergies (The Economist, 1997).

3.4.18 The high-water mark of U.S. industry consolidation was reached in March 1998, when the U.S. Department of Defense expressed its opposition to the planned merger of Lockheed Martin and Northrop-Grumman on the grounds of its potential impact on competition in the U.S. defence industry. The two companies subsequently abandoned their effort to merge (James, 1998). Nevertheless, it would be wrong to think that this has signalled the end of all mergers and acquisitions in the U.S. aerospace and defence industry. Consolidation continues amongst the mid-tier companies. 1999 saw major deals including Allied Signal's acquisition of Honeywell, the acquisition of Sundstrand by United Technologies as well as acquisitions by General Dynamics and Northrop Grumman. At the same time, the merger wave has moved further down the supply chain to smaller suppliers and deals in the $50-500 million range grew from 14 in 1990 to over 80 in 1999 (Velocci 1999).

3.4.19 Paradoxically, at the same time that Europe set about creating its own mega-firms, the health of the post-merger U.S. defence companies was to become a subject of growing concern for U.S. policy makers and industry analysts (James, 2000a). Realising the anticipated benefits of their vastly increased size has proved to be a major organisational and managerial challenge. During 1999, dramatic falls in the stock values of U.S. defence contractors—especially Lockheed Martin and Raytheon—raised questions about their financial stability and organisational viability. The roots of this dramatic change in U.S. stock market sentiment were a growing sense that the leading companies had failed to come to grips with the management challenges posed by the integration of their acquired businesses (James, 2000b). At the same time, U.S. defence contractors—like other "old economy" companies—have suffered because they

have been unable to deliver the growth prospects of Internet and technology stocks. Indeed, the end of merger-driven growth opportunities has left companies struggling to raise their internally generated growth rates. Merger-driven consolidation amongst the leading companies has given way to divestment-driven rationalisation as they seek to create viable post-merger organisational structures, reduce their debt levels and restore Wall Street confidence. With Wall Street still sceptical about the prospects for diversification, the pressure to meet investor expectations is driving ever-greater efforts towards the internationalisation of their defence-related activities (James, 2000b).

3.4.20 Such pressures mean that U.S. defence contractors are increasingly global - or at least transatlantic - in their ambitions and the strategies that they are adopting represent a qualitative change in approach when compared with past practice. Historically, defence contractors have focused on the huge U.S. home market and—when compared with European companies—arms exports continue to represent a relatively small percentage of their total activities. In the early 1990s, against a background of declining U.S. defence budgets and increasingly intense European competition in export markets, the U.S. government took a series of initiatives to promote U.S. arms sales. The Bush Administration pushed arms sales, not least after the Gulf War. The Clinton Administration continued the Bush policy of allowing the export of increasingly advanced weapon systems and technologies. Supported by changes in U.S. government export policy, the leading companies are seeking to expand into new geographical markets. Thus, Lockheed Martin and Boeing see opportunities in Latin America that, whilst a small market at present, has the potential to develop with sales of military aircraft and defence electronics (Dub 1998).

3.4.21 The international presence of U.S. companies—in terms of production activities—has been relatively limited for companies of their size. U.S. contractors have tried to be "international" mainly to ensure market access, arranging offset deals in return for export contracts, but not making much of a long-term commitment to target markets. More often that not, their relationship with the European defence industry has taken the form of offsets, licensed assembly, or co-production. Some companies such as Raytheon, Lockheed Martin, TRW and Litton Industries operate directly owned production activities but—in most cases—these remain modest.

3.4.22 The situation is changing, however, and the companies are becoming increasingly international in their ambitions. A number of factors are driving the process, but the most important is the recognition that a focus on the U.S. defence market is insufficient to meet the growth expectations of the investment community. Even companies that are well positioned to benefit from the small increase in the U.S. defence budget and the higher growth prospects for defence electronics and information technology recognise that defence is a mature market. With Wall Street sceptical about their ability to utilise defence-related technologies to diversify into civil markets, defence companies have had to look towards overseas defence markets. At the same time, they recognize that traditional arms trade strategies based on offsets but limited technology transfer are no longer viable. New bid strategies appear to

be emerging in response to the perceived threat of a "Fortress Europe" and growing European demands for greater technology transfer and industrial participation in major programmes. These bid strategies have emphasised the scale of technology transfer from the US to European partners and the European content of the programmes. Finally, internationalisation is also being driven by a desire on the part of even the largest U.S. contractors to share programme costs, access specific non-U.S. technologies, and seek new sources of capital.

The Emergence of the European Giants

3.4.23 Whilst other factors have played their part, there is little doubt that the emergence of the U.S. industry giants has been one of the key catalysts for cross-border consolidation in Europe. The spectre of U.S. companies dominating the market for defence equipment by dint of economies of scale, technological breadth, and sheer market presence has prompted European governments and companies into cross-border restructuring in ways that would have been unthinkable just a few years previously.

3.4.24 Certainly, whilst European defence industrial consolidation has long been on the agenda, the political and regulatory constraints on such developments have been formidable. European firms have encountered important barriers to trans-European mergers, acquisitions and joint ventures (James et al, 1997). These barriers have included state ownership of some of Europe's largest companies, varying corporate laws and significant differences in production costs between national defence industries and defence contractors. At the same time, despite growing political efforts in the direction of integration through the establishment of the four-country Joint Organisation for Armaments Co-operation (OCCAR), defence continues to be viewed as a sector of strategic significance by national governments that therefore actively scrutinise foreign interventions (Commission of the European Communities, 1997a; Gummett and Stein, 1997; Lewis and Starr, 1997). However, at the heart of the European challenge have been matters of national politics and pride as well as concerns about employment and the protection of technological capabilities. Consequently, regulatory constraints and political and business realities meant that European consolidation during the 1990s tended to take the part of joint ventures and collaborative programmes based on the principle of *juste retour*.

3.4.25 Nevertheless, the late 1990s saw a growing recognition of the need for closer European defence industrial collaboration. This received political backing in the trinational declaration of December 1997 in which the UK, French and German governments called for their national industries to present a clear plan and detailed timetable for industrial restructuring and integration. In March 1998, Aerospatiale, British Aerospace, CASA and DASA responded with a report recommending the creation of a European Aerospace & Defence Company (EADC). Three core themes underpinned the emergence of the EADC concept (Schmitt, 2000). First, European companies lacked the critical mass to face the US giants and needed to merge to pool R&D resources, broaden their portfolios and enlarge their markets. Second, European joint ventures were technologically competitive but were let down by their organisation and

structures. To make them more economically efficient, the network of joint ventures, collaborative programmes and so forth had to be simplified and the strategic interests of the partners brought into line. Third, the necessity to combine civil and military businesses to create strong companies in the aerospace industry.

3.4.26 In the end, political and commercial realities meant that the EADC concept did not materialise. The trigger was the 1999 merger of Marconi Electronic Systems (owned by GEC of the UK) and British Aerospace to create BAE Systems. In response, negotiations began between Aerospatiale-Matra of France, DASA of Germany and CASA of Spain that were to eventually lead to the formation in 2000 of the European Aerospace Defence and Space Company (EADS). In parallel, Thomson-CSF of France pursued a series of acquisitions in the defence electronics sector – including the acquisition of UK company Racal Electronics – to create a leading European company in that sector. The outcome of this process of consolidation has been the emergence of three "poles" – BAE Systems, the European Aeronautic Defence & Space Company (EADS) and Thomson-CSF – with sales and breadth of capabilities that are comparable to the leading US defence companies.

3.4.27 Indeed, a brief consideration of the strategies of these companies shows how the defence industry – and its underpinning technologies – is becoming not only European but *global* in scope. *BAE Systems* has made no secret of its intent to become a global company – albeit one that is seen to be British in Britain, American in the US and so forth. Certainly, the formation of BAE Systems has created a company that can claim "home" markets in the UK, US, Sweden, France, Germany, Italy and Australia (James, 2000a). BAE Systems has sought to create a significant presence in the United States through its acquisition of Lockheed Martin's Control Systems business (LMCS) as well as its UK rival GEC Marconi (which had a strong position in North America through its 1998 acquisition of Tracor). The acquisition of LMCS in 2000 means that it is amongst the top five contractors to the US Department of Defense with North American sales of over $3.5 billion and more than 20,000 US employees. BAE systems also has a range of European relationships – not least a 35% shareholding in Saab of Sweden and a 50% stake in Matra BAe Dynamics (BMD) – and has recently acquired a joint 30% stake in Korea Aerospace Industries with Boeing (Defence Systems Daily, 2000).

3.4.28 Similarly, *Thomson-CSF* has made a number of medium-sized acquisitions abroad as part of a strategy to gain footholds in domestic markets across the world. The strategy seeks to allow Thomson to act as an indigenous supplier and be closer to customers with the weight of the French company's international muscle. In the past year, Thomson acquired full control of its South African affiliate ADS; bought a 50% stake in Australia's leading military company ADI; and took a 50% holding in the defence unit of South Korea's Samsung Corporation. Shortly afterwards it won a contract from South Africa to supply the combat systems for four corvettes ordered from German shipyards and a booking from South Korea to provide equipment for the short-range K-SAM missile. Most recently it won full control of its affiliate Shorts Missile Systems by buying out the 50% share it did not own in the Northern Ireland company from Canada's Bombardier. In addition, Thomson-CSF has a

long-standing relationship with Raytheon and they are expected to shortly announce a strategic alliance (James, 2000b).

3.4.29 Equally, *EADS* has a major joint venture in military aircraft – European Military Aircraft Company - with Alenia of Italy as well as a range of other European joint ventures, including MBD with BAE Systems (Schmitt, 2000). In addition, EADS is seeking to establish linkages with US companies. On behalf of EADS, DASA signed a Memorandum of Understanding with Northrop Grumman to evaluate potential business alliances in the areas of surveillance and reconnaissance and this was subsequently been expanded to include space equipment, interoperability technology and a number of radar technologies (Morrocco, 2000). In addition, EADS is seeking to acquire Lockheed Martin's Sanders electronic warfare business in a joint bid with US company L-3 Communications and the company has expressed its intention to seek other US acquisitions (Atkins and Hegmann, 2000).

The Developing European Defence Policy Scene

3.4.30 What is striking about these recent developments in Europe is the reversal of roles. Thus, it is no longer simply governments that are steering developments in Europe and elsewhere but industry is moving ahead of political constraints and adapting them and acting as a driving force for changes in policy and regulatory frameworks (Gnesotto, 2000). Nevertheless, company behaviour is necessarily influenced by anticipated governmental or European-level promotional or regulatory action. The laws of deterrence (and especially of self-deterrence) can be expected to apply as readily here as in the directly military arena: in particular, companies will be reluctant to spend time and energy on schemes that are likely to fall foul of national or European regulatory frameworks.

3.4.31 The years since the mid-1990s have seen a remarkable resurgence in political support for a distinctly European security and defence identity (ESDI). Progress in this direction had been impeded by concerns held by some European governments that such moves might create a backlash in the USA, with consequences for future US security guarantees towards Western Europe. Yet, even before the Congressional elections of November 1994, it was becoming clear that the USA welcomed a more self-sufficient European defence capability. President Clinton appeared to succeed, where his predecessor had failed, in persuading European governments, and especially the British and French, that he genuinely welcomed these developments.

3.4.32 Still, and despite steps towards the establishment in mid-1996 of the principle of Common Joint Task Forces (CJTFs), under which the WEU could draw upon defined elements of NATO capabilities, progress was slow. Institutional complexity (such as over the differing memberships of NATO and the EU, even with the 'bridge' provided by the WEU) and political reluctance (not only in France and Britain) towards anything that smacked of giving a defence role to the European Commission, together with the associated problems of negotiating the 1997 Amsterdam revision of the Treaty of European Union, with its provision for developing a common defence policy within the Common

Foreign and Security Policy (CFSP), and for creating the new role of High Representative for Foreign and Security Policy, did not facilitate rapid action. At the same time, the experience of Europe as it sought to intervene in Bosnia, and the realisation within the more specific context of the Kosovo campaign of how little it could contribute in comparison with the USA,[15] further made the case for progress. As Heisbourg has observed, NATO's European members spend around 60% of what the US spends on defence (or about one-fifth of global defence spending), yet do not get anything like 60% of the US' capability from it. (Heisbourg, 2000, p. 9).

3.4.33 Renewed impetus came with the Franco-British summit of December 1998. At this meeting, the Blair government, elected in May 1997, went well beyond previous commitments in supporting, with France, steps towards a real European capability in defence, within the framework of EU institutions. Both governments were careful, however, to insist that control should be retained at the intergovernmental level, through the European Council, rather than allow it to fall to the Commission.

3.4.34 Events then moved somewhat more purposefully. In April 1999, NATO's Washington Summit endorsed the further development of a 'separable but not separate' European Security and Defence Identity (ESDI). An Anglo-Italian meeting in July 1999, building on a European Council meeting in Cologne in June, began to spell out the requirements for improving defence capabilities. In October, the role of the EU's first High Representative for Foreign and Security Policy was filled by former NATO Secretary General, Javier Solana, ensuring for it a high profile; and Solana was simultaneously appointed as Secretary General of the WEU. In Helsinki in December 1999, the European Council confirmed a proposal to absorb the WEU within the EU, specified the formation of a European rapid reaction force of 50-60,000 troops by 2003 for peacekeeping and regional crisis management roles, and undertook to set up appropriate decision-making structures (including a Standing Committee on Political and Security Affairs, a Military Committee, and a military staff). Over the same period, meetings of EU defence ministers, unthinkable only a few years ago, became normal. By July 2000, NATO and the EU began for the first time to have formal contacts, and set up arrangements for exchange of confidential information, together with some working groups to cover various aspects of the EU's security and defence policy. (Letter from Javier Solana, *Defense News*, 21.8.00; and *Defense News*, 7.8.00:6)

3.4.35 The process of establishing European capabilities in defence is, de facto, further tied to that of NATO through the latter's Defence Capabilities Initiative (DCI) which was launched at the April 1999 Washington Summit, in parallel with the ESDI. The objective of the DCI is to ensure the effectiveness of future multinational operations across the full spectrum of Alliance missions, with a special focus on improving interoperability among Alliance forces. More specifically, the DCI is concentrating on the deployability and mobility of

[15] The previous Gulf conflict also showed how small is Europe's *effective* capacity compared to the US, which supplied 90% of the NATO forces, and most of the 'smart' equipment. (O'Hanlon, 1997).

forces, on their sustainability and logistics, their survivability and effective engagement capability, and on consultation, command and control.

3.4.36 These matters have a self-evident bearing on the capacity of Europe to develop the kinds of capabilities that European governments have in mind. Both within the DCI, and within the narrower European framework, one key issue is likely to be the willingness of European states to fund the relevant programmes at the necessary level. But the DCI is also yet another battleground in which competing visions of future US-European relations are being fought out. Thus, Croft et al. suggest that:

> 'For the UK, "Europeanisation" is simply a means of persuading the alliance's EU members to respond to projects such as the Defence Capabilities Initiative in such a way as seriously to enhance the European capacity of NATO. If the best way of improving burden sharing and interoperability is to wrap the project in a European flag, then, in London's view, so be it. For France, on the other hand, while it is important to increase NATO's overall capacity, it is even more important to increase that of the EU; and if that means significant duplication, then so be it'. (Croft et al., 2000: 507)

Against this background, how did the policy framework in respect of defence industrial and technological matters evolve?

3.4.37 While still constrained by the requirements of Article 223 of the Treaty of Rome, the Commission began to chance its arm in the latter part of the 1990s with proposals bearing on these matters. These included the September 1997 report, *The European Aerospace Industry: Meeting the Global Challenge*, and that of November 1997 entitled *Implementing European Union Strategy on Defence-Related Industries*, and its accompanying Action Plan. Outside of EU networks, other steps were also being pursued, from November 1996, towards the formation of a European armaments agency. These took the form of the establishment of two new organisations.

3.4.38 One of these, OCCAR (Organisation Conjointe de Coopération en Matière d'Armement; in English, the Joint Armaments Cooperation Organisation - JACO), was created as a joint management organisation for selected projects on behalf of the defence ministries of France, Germany, Italy and the UK. It was set up in the context of difficulties in reaching agreement on arrangements that had been under discussion since 1993 within the Western European Armaments Group (WEAG) on the possibility of creating a European Armaments Agency (EAA). WEAG itself was the successor, from 1993, to the former Independent European Programme Group (the European members of NATO), in turn set up in 1976 to try to promote rationalisation of the western European armaments market.

3.4.39 A condition for membership of OCCAR is that member states must have a major equipment programme in development or production on which they are willing to cooperate with the other members. Several other nations, including the three with the largest equipment requirements and industrial capabilities

outside the original membership, namely, the Netherlands, Spain and Sweden, have indicated interest in joining. An early impediment to progress with OCCAR was its lack of legal authority, but this was resolved from September 1998. This enabled OCCAR to proceed with the management of collaborative projects and to issue procurement contracts, in particular on its initial portfolio of the Tiger helicopter and the Hot, Milan and Roland missiles.

3.4.40 Almost immediately after the announcement of the formation of OCCAR, the WEU announced the formation of the Western European Armaments Organisation (WEAO), as a subsidiary organisation of WEAG. Its initial focus is primarily on strengthening the European defence science and technology base through joint activity, but is designed to permit evolutionary development of an EAA. In the immediate future, WEAO offers opportunities for countries that are unable or unwilling to participate in the current generation of major collaborative programmes, and hence cannot join OCCAR, to cooperate in research leading to the next generation of weapons.

3.4.41 It remains to be seen whether the OCCAR or WEAO model proves the more resilient. Both may have a role if a division of labour between the management of science and technology projects, on the one hand, and management of major development and production contracts, on the other, can be worked out. The future of WEAO, however, must now be seen within the context of the intention to merge the WEU into the EU. As for OCCAR, its promise, as noted by the IISS, lies in the prospects for organisational and financial reforms. In particular, it offers the possibility of ridding European defence collaboration of the disadvantages of programme-by-programme *juste retour*, instead spreading the industrial division of labour over a longer time-period and several programmes. If the membership of OCCAR grows, it could also find itself evolving to become the EAA that has for so long been desired by the European members of NATO and, with the fusion of the WEU into the EU, could even develop into an agency of the EU. Given, however, that the record thus far is heavier on possibilities than on achievement, it is idle to speculate further (Barrie and Mackenzie, 1998; International Institute for Strategic Studies, 1998; Stockholm International Peace Research Institute, 1999).

The Letter of Intent process

3.4.42 There is little doubt that – from the perspective of the European defence industry and its supporting technological base - the most significant development in recent years has been the Letter of Intent process (LoI). The LoI represents a significant initiative to provide the conditions for closer transnational defence industrial cooperation in Europe[16]. In July 1998, the defence ministers of the six major European defence equipment manufacturing countries (France, Germany, Italy, Spain, Sweden and the United Kingdom) signed a LoI aimed at harmonising existing regulations related to transnational

[16] This section draws heavily on the excellent discussion of the LOI process provided by Burkard Schmitt in his Chaillot Paper on the restructuring of European defence and aerospace industry (Schmitt, 2000).

defence industrial cooperation. Six working groups were established covering: security of supply; export procedures; security of information; research and technology; harmonisation of military requirements; and, treatment of technical information. These groups presented their reports in July 1999 and these formed the basis of a final document produced by an executive committee, and a formal framework agreement that was signed on 27 July 2000. Once ratified as necessary by national parliaments, this agreement is intended to become an international treaty. However, the entry into force of the LoI in two countries will enable them to begin to apply the treaty's provisions with the remaining countries joining in as they ratify the treaty.

3.4.43 The LOI process offers the prospect of a significant change in the regulatory environment in which the leading European defence industries operate which – if fully implemented – would ease the process of transnational cooperation between companies in the signatory countries. There is agreement that the LoI is only the beginning and that it will require considerable further effort and development. However, as Schmitt (2000) notes, its great merit is that it clarifies and spells out the real regulatory issues faced by European countries. Of course, it represents an exclusive development between the governments of the six leading defence industries in Europe and there are already efforts afoot to expand its scope to include other European governments with an interest in the area – not least the Netherlands.

Introduction to Summaries of country findings

3.4.44 The future of the European defence industry depends on policies of the individual countries (defence and foreign policy, procurement and defence industrial policy) as well as on the strategies of the defence companies in those countries. In reviewing the main findings of our study in this section, we thought it would be useful to summarise the policies and experiences of a number of European countries. These are presented in three groups: the large players, France, Germany and the UK; three medium and small players, Spain, the Netherlands and Italy, and two former Warsaw Pact members, Hungary, now a member of NATO, and Russia, whose political relationship with the rest of Europe and with NATO is still ambiguous.

France, Germany and the UK

Introduction

3.4.45 This part of the scientific report presents first the introduction of chapter 5 of our project book which is aimed at putting in context the subchapters devoted to the three largest defence industrial players in Europe. It then presents in a comparative way a series of themes addressed by subchapter's authors and presents a brief conclusion.

3.4.46 This chapter offers an overview of the defence innovation systems in the three largest defence industrial players in Europe. The authors of countries studies

used the analytical grid which has been developed in previous chapters to explore how the dynamics of changes is modifying the institutional and organisational setup of the defence innovation system in France, Germany and the UK. Common topics addressed in the three subchapters include: the relations between policy and production networks, procurement and changes in the budget, the structure of the defence industry, and relations between defence and civilian innovation.

3.4.47 As they are the three largest countries in Europe, France, Germany and the UK are different as far as defence production and innovation are concerned. Though figures related to defence expenditures have to be cautiously used for comparison between countries, it is estimated that in 1997 the defence turnover (domestic + exports) was 19 billion euros in the UK, 16,9 billion euros in France and 6 billion euros in Germany [DGA, 1999] . The three countries also differ as for the level of their R&D expenditures. In 1999, R&D expenditures amounted to 3,8 billion euros in the UK, 3,2 billion euros in France, 1,2 billion euros in Germany.

3.4.48 These figures tell only a small piece of the story. Basically, the German defence system offers a quite different picture from the French and the British ones. That an independent civilian body, the BWB (Procurement office of the armed forces) is in charge of procurement is a fact that bluntly contrasts with the key role held by the MoD Procurement Agency in the UK and the DGA in France. Another striking difference is related to the sourcing of technology needed for weapon systems. Germany abstained from creating large state-owned military laboratories like those existing in France (CEA, ONERA, DGA's technical centres) and in the UK (DERA, the Atomic Weapons Establishment). Instead, in Germany military innovation is concentrated in the private sector, with companies giving priority to the technologies designed for civilian markets which are then adapted to weapon systems. The result is that defence innovation systems significantly differ between the three countries. Whilst those of France and the UK have played and still play an important role in their national system of innovation, the defence innovation system is marginal in Germany.

3.4.49 Given so many genuine differences between the three countries does it mean that considering the three countries studies under the same heading is irrelevant? We are inclined to think not. While coming lately to the European defence playing field due to a total halt in arms production until 1955, policy and production networks gained momentum in Germany throughout the next decades. Though obviously different from that existing in France and the UK, their combination resulted in the emerging of an "idiosyncratic" military-industrial complex. In the aerospace sector, governments and companies were united in their desire to promote a robust industrial base, even at the cost of embarking in military complex projects such as the Eurofighter. In the end, it is not so different from what happened in the UK, the leading country in that aircraft project, or in France with the development and production of the Rafale. Also, the combination of policy and production networks in Germany succeeded at a regional level to lobby on behalf of the naval industry in a

similar way policy and production networks have been doing in France and in the UK for decades.

3.4.50 In the three country studies, attempts are made to gauge what are the influence of globalisation on defence systems. In the defence industry, more than any other, globalisation (here taken in the French sense of *mondialisation*) is shaped by the US and to some extent can be construed as a "transatlanticisation" process. Responses given by the three countries are different. In France, policy-makers and business as well have achieved national consolidation through privatisation with a clear pro-European inclination, a strategy which received some credentials with the creation of EADC. There is some evidence that French companies keep an eye on the other side of the Atlantic. The "Europeanisation" of the French defence industry did not go through the disappearance of major companies nor the dissolution of key relationships between the major companies and State institutions. The process was different in Germany and in the UK which have set up close relationships with the US industry ever since WWII. Not only many industrial programmes are under way in cooperation with US companies, aimed at delivering NATO forces needs, but also capital links between companies on the two sides of the Atlantic have a long record. Still, in the two countries, policy makers and companies have adopted a bold rhetoric on the need for Europe to become more integrated (read: united) as far as industry and defence security is concerned. How this will fit with the increase in industrial and technological collaboration between European and American companies is still unclear. An outcome may be the redefinition of both the boundaries of defence policy and industry networks and their types of interrelations over post-war decades.

Defence, Security and Procurement Policy

Policy and Production network actors: FRANCE

3.4.51 Various institutional actors can be identified in the French defence sector. The main actor is the DGA which combines the triple role of :

a) management. DGA awards R&D contracts to DGA institutions, technical agencies, companies and academics. Also, DGA is responsible for the maintenance of weapon systems ;
b) technology excellence centre : DGA have divisions with test labs, research centres which perform parts of R&D contracts
c) industrial, with DCN (*Direction des chantiers navals*) and "Aeronautical Maintenance service (*Service de Maintenance Aeroanautique*, SMA . Military services used to have a more minor role compared to DGA, but since the 1997 DGA reform, they got more responsibility in the negotiation of contracts.

3.4.52 Companies are key actors. They possess not only the knowledge and skills to design and integrate large weapon systems. They are able to influence the decision making process at the political level in various ways, including lobbying MPs, governments, heads of state, close relationships with DGA, etc.

Throughout the 1990s, they further reinforced their role and influence in the defence sector.

3.4.53 Parliament is in charge of voting the defence budget. This role has long been seen as relatively symbolic as the real location of political power in the Vth Republic is to be concentrated at the head of the state. For a couple of years, in relation to the fact that two Presidents have been put in a Parliamentary minority during their mandate, the balance of power has slowly evolved, if not dramatically changed.

3.4.54 The Ministry of Foreign Affairs (M of FA) is involved in the business of arms exports. The M of FA has been trying to balance arms exports with its diplomatic agenda. In some occasions, it was opposed to delivering arms to customers, mainly because of their quasi-bankruptcy situation (Iraq, Pakistan) or because of their poor human rights records. In several cases, M of FA opposition surfaced through press leaks.

3.4.55 Recently, a new actor has come to the playing field. The Ministry of Finance, and its powerful budget division, has been accused of contributing to the decline of the defence budget by imposing too strict bureaucratic regulation on spending procedures [*Cour des comptes*, 1997. The *Cour des comptes* is the French General Accounting Office] .

Policy and production network actors: GERMANY

3.4.56 An historical depiction of the transformation of policy and production networks is required if we are to understand the current situation. The demilitarisation of Germany following WW II brought arms production to a total halt until 1955. With the accession of the Federal Republic of Germany to NATO in 1955 German industry started to enter the field of arms production as a late-comer. From the sixites onwards, German industry gained momentum, even through its participation as junior partners in international programmes. Still in some defence sectors, the supply network was amenable to intensive political lobbying, involving such arguments like national sovereignty, regional employment and potential spin-off. Rivalries among the federal *Länder* helped to strengthen the position of the suppliers belonging to the extended network. At the end of the eighties the government finally imposed a consolidation of the aerospace sector and forced the *Länder* to relinquish their partial control. DASA under the helm of Daimler Benz came into existence. But this consolidation was driven by the civilian and not the military market.

3.4.57 At the end of the Cold War the “incumbent” military suppliers were knit into an elaborate policy network in which local parliamentarians, the *Länder* on behalf of their producers, and the often long serving members of the defence committee were involved. The financial burden of unification imposed a continuous more than proportional reduction of procurement, but the government proved largely incapable of setting political priorities.

3.4.58 Traditionally the parliamentary committee on defence has been dominated by declared and undeclared lobbyists from CDU and SPD alike. As a result surprisingly few critical questions are being asked in this committee. Considerably more substantive scrutiny is regularly exercised by the budget committee, but the deliberations are usually focusing on the consistency of spending plans rather than conceptual issues. Recently, the incoming social-democratic defence minister (Scharping) publicly demanded a substantially increased budget even before accepting the post. Following in the footsteps of his conservative predecessor he abstained from initiating long overdue structural reforms. The *Bundeswehr (Generalinspekteur)* came also forward with a proposal suggesting a rather limited reduction and conservative reform of the armed forces. At the same time the defence minister has already signed a pilot contract with leading suppliers of hardware and services regulating a radical outsourcing of infrastructure, repair and maintenance and other services as well as leasing arrangements. While it is too early to predict the pace and depth of the forthcoming transformation of the armed forces and the procurement process, it is safe to predict that years of stalemate have provided for an ample space for action. The active role of the *Bundeswehr* in Kosovo stimulated a substantive public debate on the future role of armed forces making it more likely than ever before that the political rhetoric will be followed by decisions. Thus, for the first time in decades the conditions are set to substantially change the structure of the armed forces.

3.4.59 The old policy network which preserved stable supplier relationships including second and even third tier suppliers for more than 30 years has been losing its currency, mainly due to the substantial reduction of procurement. With the end of the Cold War the rhetoric shifted towards the EU and the need to develop a common foreign and defence policy. But the process became more and more industry-led forcing politicians to sanction the consolidation. A major reason for Germany to support increased independence from the United States is the perceived need to develop stable relations with Russia which is only feasible as a European project if the fatal role of the “Mittelmacht” is to be avoided.

Policy and production actors: THE UK

3.4.60 Three main institutional actors can be identified in the UK defence sector: the Ministry of Defence and its related Procurement Agency; the Defence Research Establishments; and, companies engaged in the design and manufacture of defence equipment. The military services are important as customers in the requirement-setting process within MoD, as customers for R&D, and as members of project management teams, but it is important to observe that defence planning and procurement in the UK take place to a very high degree on a cross-service basis.

3.4.61 Also significant are the Treasury (for overall control of government expenditure), the Foreign and Commonwealth Office (especially for wider security policy, and over arms trade decisions) and the Department of Trade and Industry (with responsibility for general industrial policy, and for issuing of

arms export licenses). These ministries are brought together in Cabinet committees. Parliament is not a significant force directly in defence affairs (except insofar as no government can survive if it cannot maintain support from the House of Commons), although the House of Commons Defence Committee, and sometimes the Trade and Industry Committee, engage in scrutiny and commentary upon defence and security affairs, and can expose policy shortcomings.

3.4.62 The boundaries of the defence and security policy network extend beyond the UK, however. Industry is tightly entwined in international ownership relations, and also in collaborative activity. At the policy level, NATO is always a present influence in British defence decision-making, but in the sense of decision-makers being concerned about the implications of their decisions for NATO, rather than in any sense deferring to NATO. More particularly, the attitude of the United States is always important in British security policy. To this, more recently, must be added a strong interest in cultivating a stronger defence identity in Europe (meaning both the WEU and the EU), and the role of Britain therein, but always firmly within a NATO framework.

Military Doctrine: FRANCE

3.4.63 It is an understatement to claim that France's defence and security policy has changed during the last decade. The stated policy since the early 1960s of a relative autonomous posture (which obviously had never really been an independent one), between the two superpowers in international affairs, evolved in the 1990s towards a more friendly attitude with "Atlantic interests" and NATO. Just as the Gulf war was a landmark, NATO operations against Serbia, in which France conducted 8% of the air campaign, showed that French policymakers had dropped the objective of building a European defence somewhat independent of NATO. A prospective 30-year Plan was recently established. The Plan envisages multiple geopolitical scenarios and suggests procurement reforms. What seems to emerge from discussions is that pressures to increase the defence budget will be mounting over the next few years.

3.4.64 Given these constraints - accepting NATO obligations - France's main objective is to stand as the cornerstone of the European pillar. The French government hopes that this will counterbalance what it sees as US pressures on Europe, and will provide Europe with a more relative autonomous posture that the US administration would like [Sloan, 2000]. As the basis of such a hope should lie in the size of its military budget, its firms' technological capabilities, and its experience in peacekeeping operations, the huge superiority enjoyed by the US makes this desire seem rather to be wishful thinking.

3.4.65 French nuclear doctrine remains the pillar of French military doctrine. It is likely that no substantive discussion will take place before the Presidential elections, due to be held on spring 2002, a time when a new multiyear programming law will have to be voted by the Parliament. Issues that could be addressed include the future and the role of nuclear deterrence, production of a second nuclear-powered aircraft carrier to complement the Charles de Gaulle, and acquiring anti-ballistic missile capabilities. What seems to emerge is that if

France is to play the key role in Europe which is wished by its government, defence budgets will have to be driven upwards.

Military Doctrine: GERMANY

3.4.66 The specific historical heritage the German armed forces are burdened with prepared the ground for a unique externalisation of military doctrine. The FRG limited the scope of its military doctrine to a strict submission to the command of NATO. With the exception of a Gaullist temptation during the early sixties and the debate about stationing additional nuclear missiles in reaction to the Soviet SS 20 no national discourse related to the military doctrine ever took place after the SPD in 1959 had finally embraced the western orientation and the integration into NATO. Until the very end of the Cold War Article 26 of the Basic Law (constitution) was interpreted as an absolute barrier to any type of out-of-area operation. According to this view the only legitimate action the *Bundeswehr* was entitled to was territorial defence in the context of NATO. Therefore the *Bundeswehr* had not developed adequate logistics and training for missions mandated by the United Nations. On the first occasion of soldiers participating in an UN-mandated mission the SPD challenged this decision in the constitutional court. However, it ruled UN-mandated missions as legal.

3.4.67 The virtual absence of a permanent national strategic debate explains in part the extremely slow political reaction to the radically changed political environment circumstances after the end of the Cold War. There was also resistance from within the *Bundeswehr* which argued that it would be dangerous to neglect territorial defence, since the political climate and the balance of power might change again.

3.4.68 The eventual formulation of a new military doctrine as a result of the on-going debate is not likely to change the present course of the industry-driven consolidation beyond the national market.

Military doctrine: THE UK

3.4.69 As a committed member of NATO, and as a nuclear weapons power, British defence policy has long been oriented towards the perceived Soviet threat, together with more immediate protection of the territory of the UK, and its overseas interests. Clearly, the end of the Cold War required change in this posture. That change was made the subject of a major Strategic Defence Review (SDR) once Labour took office in May 1997. The White Paper began by identifying national interests and goals, rather than from consideration of military matters. It started from the position that Britain was a major European state and a leading member of the EU. It is important not to underestimate the power of the historical legacy of transatlantic relations, which extended seamlessly into New Labour from the previous Conservative governments. The 50 year old principle of defending interests in Europe by locking in the United States remained, to no-one's surprise, the bedrock of British security policy,

despite the siren voices across the Channel calling for a more distinctive European defence and security identity.

3.4.70 Britain's vital interests, said the White Paper, were not confined to Europe. The security environment was not seen as benign. Indeed, over the past eight years, more British troops had been on active operations than at any one time during the Cold War - engaged in actions that ran from the Gulf War to the rescue of British citizens from crises overseas. In addition, whereas for the past 200 years the dominant force in international affairs had been the nation state, for the next 20 years the risks to international stability were seen as more likely to come from such other factors as ethnic and religious conflict, population and environmental pressures, competition for scarce resources, and drugs, terrorism and crime. On top of this, technology was seen as having a major effect on social change worldwide, with security implications.

Procurement and changes in the defence budget: FRANCE

3.4.71 Defence procurement in France is concentrated on DGA, with 88% of the procurement budget handled by this institution. As in other countries, reforms have been introduced in order to make the procurement process more efficient. Basically, the 1997 reform introduced by M. Helmer, the DGA's head, aimed at giving more responsibility to Prime contractors in the technical design and industrial management of the weapon programmes, and more involvement by Military services in the funding of the programmes. The role of industry will be reinforced in the research phase, with R&D contracts more systematically awarded to Prime contractors. The Prime contractor will be in charge of the research programme and will be given full responsibility for subcontracting to Universities and labs. An outcome is that DGA's grip on the chain of technical activity will probably weaken. Consequently, the DGA is expected to refocus on : a) system integration competences, including qualifications and certification tests, b) management competences, with the objective stet by the DGA head to reduce by 30% armament programme costs and lead times and to reduce its own running costs by the same proportion.

3.4.72 The major problem confronting procurement is how to carry out major programmes launched in the 1980s procurement binge. France kept a high level procurement (including R&D) budget until as late as 1992, whilst NATO countries had been already engaged in strong cuts for years. The conjunction of skyrocketting public deficits and changes in the geopolitical setting led to strong decrease during the last decade (1990s). Compared to the heights reached in 1991, procurement is 30% lower in 2000. A few weapon programmes have been cancelled or dropped, the amount of them being 4 billion FRF (0.6 billion Euros). The most important is the Franco-German radar satellite HORUS.

3.4.73 Besides DGA reforms mentioned, some changes have been introduced in public accountancy rules. Since 1999, defence equipment expenditures have been subject to the general rules applying to civilian budget procurement, as they benefited from specific rules earlier. Not only were those rules are known to be

very formalistic and bureaucratic, they also prevented policy-makers from having any substantial control on the use of defence budgets.

Procurement and changes in the defence budget: GERMANY

3.4.74 Relative to total military expenditure, the volume of annual procurement continuously shrunk over the last ten years and is likely to have bottomed out in 1999. Over many years the defence debate targeted a 30 % share for procurement and other investments, but in reality the share fell well below the 20 %. Since 1994 the MoD does not any longer receive a reimbursement for the additional costs for international missions from other budget headings. The present government obviously uses the drive towards consolidation of the state finances to enforce the overdue structural reform of the *Bundeswehr*. But at the same time the chancellor has agreed that potential savings from outsourcing to the private sector will become available for the purchase of new equipment required for the envisioned international operations. Also, in case a substantial reform becomes effective, considerable resources could be mobilised by selling the real estate which can be marketed because it will not any longer be needed.

3.4.75 The long gestation periods of military platforms tends to appropriate a substantial part of future procurement resources. However, since all of them are produced jointly with other European partners, it is safe to assume that they have passed the point of no return. As a result the *Bundeswehr* presently does not have the resources required to adequately equip for the new doctrine which is likely to emerge shortly, as long as significant parts of the present organisation are not closed down.

3.4.76 At the political stage national production is still an icon appealing to politicians, but the reality in terms of value nationally added is often quite different, because major components are regularly oligopolistically controlled at international markets. In Germany procurement is still fully controlled by the BWB (the civilian procurement bureaucracy), offers of compensation in cases of export orders have contributed to the lasting grip of the BWB. Thus, international procurement often reflects a “quid pro quo” and does not reflect a market-driven internationalisation of procurement. The indications of a more market driven procurement strategy in the case of major systems are not yet visible, possibly because all the resources are presently absorbed by older “inherited” procurement programmes. The real test for a change will be the forthcoming purchases of equipment for out-of-area operations.

Procurement and changes in the defence budget: THE UK

3.4.77 Defence policy, and procurement, in the UK are organised on a cross-Service basis. There are no separate ministries for the different Armed Services. The development, design and production of defence equipment is organised through an arm of the MoD called the Procurement Agency. Set up in an earlier form as the Procurement Executive in the early 1970s, this body assumed responsibility from the former separate service and supply ministries, and from the Atomic Energy Authority, for all areas of conventional and nuclear weapons R&D and

procurement. It in turn responds to operational requirements set not by the individual armed services but by the cross-service Defence Staff. It is the Defence Staff which acts as 'customer' for research programmes and for development projects. It was recently transformed into an executive Agency. In terms of future projects, the missile for Typhoon (Beyond Visual Range Air-to-Air Missile) is perhaps the biggest and most politically sensitive. On the one side, Raytheon; on the other, Matra BAe Dynamics, later joined by Boeing. At issue is not only the future of European manufacture of air-to-air missiles, but also the possibility of European entry into the US market. Decision in favour of British product. The other big future project is that for strategic airlift capacity. This was introduced as a new requirement in 1998 during the Strategic Defence Review, which specified four large aircraft, for which more players are now in contention than at the time of the original announcement. In contention are Boeing (C-17), Lockheed Martin (new model of C-130J) and Airbus (A400M – FLA). (See Def News, 1.11.99, p.3). Less advanced is the commitment to two new aircraft carriers, where talks with France are underway.

Defence Science and Technology Innovation: FRANCE

Domestic innovation networks and international networks

3.4.78 France allocated a sizeable share of its defence budget to R&D, ranking two but far behind the US over the 1993-97 period. Two changes in defence R&D throughout the 1990s are the massive reduction of defence R&D (still, they had dramatically increased in the previous decade), and the change in allocation of defence R&D contracts. While DGA's technical institutions proper lost momentum, technical governmental agencies formally independent from DGA, but where DGA representatives sit at the scientific board, etc., remained key actors in the French innovation system. They include: CEA for nuclear, ONERA for aeronautics and space (basic, applied research and development), CNES in space (applied research and development, Prime contractor), CNET for Telecommunications sectors.

3.4.79 The changes in procurement regulations will give an increased role to contractors' labs, and international collaboration will increase. What is evident is that France has resolutely engaged in collaboration as regards acquiring new technologies. First, France cannot afford to develop competences on its own any more, and second, it is confident that, due to large amount of resources earmarked for R&D, it will be able to keep a leading role in the European playing field.

Civil-Military Integration

3.4.80 It has been documented that from the end of the 1980s onwards, policy-makers have expressed interest in dual-use technologies. This interest has been interpreted as reflecting the willingness to maintain defence technological innovation networks in the forefront of wider technological development in a context where the role of civilian technologies in weapon systems dramatically increased. Such an interest should not surprise in a country in which, ever since the 1960s, defence and civilian technological programmes launched by

government have buttressed French technological capabilities and contributed to the shaping of the national system of innovation .

3.4.81 Defence and strategic civilian technological programmes are closely related. This contributes to a strong concentration of technical capabilities in a few defence oriented industrial groups.

Defence Science and Technology Innovation: GERMANY

Domestic innovation networks and international networks

3.4.82 Most suppliers of the armed forces have long since taken the realistic view that they can not rely on defence contracts any longer for their company's survival. Therefore many well entrenched supplier relationships which were characteristic of procurement systems in Germany over many years were dissolved. In many cases the supplier stimulated the market, because the minimum level of orders was not forthcoming any longer. The bulk of procurement money is absorbed by a few big, mostly international projects, like the Eurofighter.

3.4.83 The submarine sector is marked by close relationships between the navy personnel which is not surprising since there are no alternative suppliers. In general the German arms industry is less export dependent than its counterparts in France and Britain. With the evolution of common European standards for arms exports, the national networks are likely to lose their currency and military-industrial lobbying will gravitate around Brussels.

Defence Science and Technology Innovation: THE UK

Domestic innovation networks and international networks

3.4.84 The most important source of defence science and technology activity in the UK is DERA. There is only very minor MoD-funded activity in universities. Industry itself supports defence-related R&D, and the Department of Trade and Industry also assists, via general support for the S&T "base", and via limited support to aerospace. But in expenditure terms, MOD, via DERA, is dominant. DERA supplies scientific and technical services to MoD in the areas of strategic research, applied research, operational assessments and studies, project support, the formulation of operational requirements, and equipment testing services and quality assurance. It does this partly through its own laboratories and test facilities, and partly by placing contracts with industry and universities. It also provides scientific and technical services to other government departments, and to other public and private sector customers where this supports the achievement of its main objectives.

3.4.85 DERA comprises the establishments formerly known as the Royal Aerospace Establishment (RAE), the Admiralty Research Establishment (ARE), the Royal Armament Research and Development Establishment (RARDE), the Royal Signals and Radar Establishment (RSRE), the Chemical and Biological Defence Establishment (CBDE), and some smaller research units together with

important test facilities. It was set up (in its earlier form as DRA) in April 1991 as part of a general initiative to move civil service organisations into a more commercial relationship with government, while still leaving them under ministerial control. Its aim is to provide independent high quality, efficient and cost-effective scientific and technical services to its customers, primarily to MoD.

3.4.86 Industry itself spends relatively little of its own money in comparison both to government and to industrial expenditure of civil R&D. In 1998 the Government announced its intention to explore the possibility of some form of Public Private Partnership for parts of DERA. By early 2000, this plan had suffered a severe setback because of very clear indications from the US of reluctance to continue to permit exchange of technical information on the same basis as hitherto with a privatised body.

3.4.87 The MoD currently has collaborative research programmes with 20 countries, to which it commits 10% of its research resources and effort is being directed to increasing this proportion. International collaboration is seen by the MoD as a good way of promoting technology exchange, leveraging greater returns on investment and providing wider benefits from exposure to multinational debate on defence research needs and key technologies as well as issues surrounding arms and export controls. Amongst the bilateral and multilateral research programmes in which the MoD participates are the Anglo-French Defence Research Group, the Technical Cooperation Programme (with the United States, Australia, Canada and New Zealand), the NATO Defence Research Group and the Western European Armaments Group's European Cooperation for the Long term In Defence (EUCLID) programme. In addition, the MoD has also collaborated with the United States since 1985 on technologies related to Ballistic Missile Defence (DTI/OST, 1996a; MoD, 1996). In a recent initiative, the USA, the UK, France and Germany have established committees to consider new ways of co-operating on international arms research, development and procurement.

Civil-military technology integration

3.4.88 Scientific and technological developments for defence purposes in the UK have historically been undertaken by a distinct defence innovation system. This has been organisationally (and often physically) separate from civil science and technology both in terms of its institutions (with dedicated defence research establishments and defence divisions of multi-business corporations) and a separate community of practitioners of scientists and engineers working on defence-related activities. There has been a long-running concern about the relationship between the UK's high defence R&D expenditure and the competitiveness of the national economy and, in particular, whether the UK's defence research resources, which were of course intended primarily to serve defence purposes, were nevertheless not contributing as much as they might to national wealth creation. Reports released in the eighties recommended that MoD should use its research and contractual procedures in ways that took greater account of the nation's future technological capacity, principally by encouraging investment in a broader national technology base for defence from which both the defence and the civil sectors might benefit. Such matters have

been a source of renewed policy interest with the emergence of dual-use technology issues and the decline in defence-related R&D expenditure. Collaboration with the civil sector is seen as increasingly attractive by the MoD as it can encourage "spin-off" to the civil sector and the use of dual use technologies in defence applications.

3.4.89 One of the practical consequences of its move to Agency status is that DRA and now DERA have become more open to issues of technology transfer. DERA is now pursuing a range of policies to promote the commercial exploitation of its research results by both the defence industry and the civil sector. The Defence Diversification Agency, established within DERA since the 1997 election, is also likely to pay as much attention to the scope for the spin-in of technology from the civil sector as it will the spin-out of defence origin technologies to new civil applications.

Conclusion: France, Germany and the UK

3.4.90 This section evidenced differences in procurement. The German procurement agency was set up as a civilian institution, while in the French and British cases it is a key actor of the MoD. The core role of the DGA is also an outstanding feature of the French system. It also underlines differences over relations with procurement orientation between a process domestic-centred in France, as it is more European and US oriented in Germany and the UK. These differences are related to differences in military doctrines and the degree of involvement of the three countries in NATO. Also this section provided evidence for giving due importance to analysis based on a system of innovation approach. British and French defence innovation networks maintain strong roots in their national system of innovation, while except in some niches, it is difficult to disentangle military and civilian networks in Germany.

Spain, the Netherlands and Italy

3.4.91 Here, the findings of three countries, Spain, the Netherlands and Italy are summarised. These countries have as a common feature that they are not the main, but rather medium or even small (the Netherlands) players in the European industrial defence scene. Italy, in this respect, may be called either the smallest among the key defence players or the largest among the ‘small countries’.

3.4.92 Each of them is also distinct and as such represents different possible attitudes to the future of the European defence industry. Italy has a traditional and strong defence industry, currently facing the challenges of privatisation and European integration. Spain’s defence industrial capacity is in a strong flux. Spain aims to build up a strong domestic defence industrial sector embedded in international (European) co-operation. The (small) Dutch defence related industry is more stable and, in addition to always having been internationally oriented, is still further evolving into that direction.

3.4.93 Though not the main players, each of the three countries has its own role in

the future of European industrial defence scene. Their attitude towards international co-operation is important, as to both the development of a common European defence policy and the prospects of an integrated European defence industry. In this respect it is also important to what extent these countries' international orientation has a transatlantic or mainly a European focus. A common feature of all three countries is their two-track policy regarding international alliances, mergers and co-operation in matters of defence industry and technological innovation, by opting for both European and transatlantic co-operation. They are distinct however to the degree that the defence industry is perceived as an important route for the country's national technological innovation more generally. Thus, whereas Spain is very much pushing this route, its importance in the Netherlands is rather low, and Italy is taking the middle road.

Spain

3.4.94 Spain's joining in the 1980s of NATO, WEU and the EU expressed the wish for integration within Europe. Spain's defence policy orientation, therefore, has a European rather than a trans-atlantic orientation. This is not to say that Spain's procurement policy has primarily a European focus as well. The military, in various cases preferred, for reasons of perceived quality and performance, procurement of US rather than European weapons systems. During the 1980s, a tension developed in procurement practices between the military and the Ministry of Defence (MINDEF) on the one hand, and on the other hand the Ministry of Industry (MINER) and the Spanish defence industry, implying that the military were not that strongly involved in the national defence production network.

3.4.95 On the supply side, MINER, through its industrial holding SEPI, controlled (until recently) all the main defence-related firms, and also develops policies in support of the country's industrial and technological capabilities, which have nurtured the defence industries. Whereas the Ministry of Industry would press for a substantial participation of domestic producers in defence procurement, the Armed Forces (finding expression through Ministry of Defence channels) favoured the direct purchase of foreign systems offering more "value for money". Recently, however, this relationship appears to have experienced a significant change. It is now an official and well-substantiated claim that since the new centre-right administration came to power in Spring 1996, the Spanish defence industry has experienced an unprecedented transformation, in which the collaboration between the Ministries of Defence and Industry has been both close and crucial. The Ministry of Defence now co-ordinates its procurement with MINER In that sense there is an increasing alignment between the policy and production networks in the defence sector.

3.4.96 MINER is supporting with substantial funds defence industrial projects carried out within SEPI and in the firms that SEPI has recently privatised, thus providing a financial contribution to the defence mission. This trend has become apparent particularly since 1997, shortly after the Partido Popular came

to power. MINER has thus become involved in the direct support of defence industrial programmes. During 1997, it funded defence production projects for a total value of Euro 208 million. The three main programmes being funded under this scheme are: the development and production of four F-100 frigates by Bazán, the Spanish participation in the EF-2000 programme, and the programme to procure German-designed Leopard tanks. Further, in May 1998, MINER decided to advance funds to Bazán's up to a maximum of Euro 1.351 billion over six years (1999-2004) to pay existing debts. This is a very large figure considering Bazán's turnover (about Euro 447 million in 1997). Therefore, over six years, Bazán will receive as subsidies the equivalent of about three full years of total sales.

3.4.97 This large involvement of the Ministry of Industry in the financing of weapons development and production programmes, as well as the more traditional lines of financial assistance offered to publicly-owned defence firms, have allowed the Ministry of Defence to contain its budgets while engaging in large weapons procurement programmes. It illustrates the increased engagement of integrating the Spanish defence technology innovation system into the overall national industrial and innovation system. The latter is also reflected by the large amounts of money for defence R&D. Whereas in the early 1980s Spanish Defence R&D expenditure was negligible, a sharp increase since the mid-1980s rapidly brought government defence R&D budgets to high levels: the highest point budget was reached in 1992, with a total of Ptas60 billion. A decline occurred in the following years, until sharp increases took place again in 1997 and 1998, trebling in just two years the 1996 budget and moving close to Euro 1 billion per year. Though these figures must be addressed with care - budgeted R&D figures are not necessarily a reliable guide to final expenditure (which in Spain has often been lower than the initially budgeted levels), given the extremely large volumes in relation to the Spanish research system, the defence R&D will remain a central feature of the Spanish science and technology system. OECD data has already reflected this change: after the sharp increase in 1997 and 1998 the levels of Spanish defence R&D reached unprecedented levels, both in absolute and relative terms.

3.4.98 Until recently, the main Spanish defence industrial suppliers were controlled by the public holding SEPI (*Sociedad Estatal de Participaciones Industriale*s). This holding depends on the Ministry of Industry and Energy, and has been involved in an active process of reorganisation of Spain's public sector firms, according to the 'Programme of Modernisation of Spain's Public Firms' (June 1996), which defined an ambitious privatisation plan. The main Spanish defence-related firms are Bazán (shipbuilding), CASA (aerospace), Grupo INDRA (electronics and information technologies) and Santa Bárbara (Land-based weapons systems). While Bazán and Santa Barbara are almost exclusively defence producers, CASA and INDRA are diversified corporations for which commercial markets account for more than 50% of their turnover. These are the firms that have been privatised first. While Santa Barbara has been taken over by the US company General Dynamics Land Systems. There are no privatisation plans for Bazán, among other reasons due to its financial situation but also because Bazán's privatisation would have to take place against the background of a restructuring of European defence shipbuilding, a

task which still lies in the future. Yet Bazán has entered a collaboration agreement with Lockheed Martin and Bath Iron.

3.4.99 Apart from these main systems assemblers, there are a substantial number of private firms involved in different degrees in defence production. However a consequence of the privatisation process mentioned above, is that the old distinction between the larger, state-owned, prime contractors, and the network of small, privately owned subcontractors, is rapidly become a thing of the past. Accompanying the process of privatisation at the level of prime contractors, private firms have been increasingly active in the Spanish defence market. In some cases this role has been actively supported by central and regional governments.

3.4.100 For many advanced defence technological developments, the Spanish defence industry is strongly dependent on international co-operation, which it is actively seeking. The major procurement programmes for each of the three Forces have a strong European stamp: co-operation with France, UK, Italy and Germany. By contrast this doesn't mean that alliances or mergers of Spanish defence companies are limited to Europe. The actual take-over of the producer of land equipment Santa Bárbara by the US company General Dynamics Land Systems shows that transatlantic mergers are welcomed as well. Spain continues to be an active participant in a variety of international defence R&D programmes, and continues to establish complex links and networks with foreign manufacturers selling into the Spanish market.

3.4.101 It seems that a nationally based strong defence industry, linked to foreign (either European or US) defence companies, is now a main policy goal. Domestic control and ownership of the defence industry is to great extent subordinate to embedding it in a, mainly but not exclusively, emerging European defence innovation system. The emphasis on strengthening Spanish located defence companies makes Spain opportunistic as to how to realise this. It will support a European integration of defence industry as long as it will serve this goal.

3.4.102 Thus, the Spanish defence technology innovation system increasingly crosses national borders through strategic alliances and collaborations, in addition to traditional offsets aimed at high tech transfers. In advancing the technological capabilities of the domestic industry the government strongly supports technology development while blurring boundaries between civil and military RD&T.

The Netherlands

3.4.103 The Netherlands' security and defence policy is less European oriented than that of the other two countries considered here. Traditionally, the Netherlands has tried to combine a European and Atlantic orientation, however, with a certain Atlantic bias. The decision of the European Council in Cologne, June 1999, to allow a direct involvement of the European Union in defence caused also a slight policy shift in the Dutch position, but the Netherlands still opposes a European defence organisation independent from NATO.

3.4.104 Apart from naval acquisitions, Dutch MoD's procurement of large defence systems has always shown a strong international orientation: tanks and armoured vehicles, as well as fighter aircraft and helicopters were acquired abroad, either from the United States or from other European (NATO) countries. This has been caused, of course, by the absence of a domestic industry for those systems. But also when Dutch companies were able to supply the required equipment, they generally had to compete with foreign companies.

3.4.105 Though MoD considers an indigenous defence industry necessary to remain involved in (decisions on) international matériel projects and to retain customer expertise, it generally has kept the Dutch defence related industry at an arm's length, often to the industry's dismay.

3.4.106 For the Naval systems the situation has been different: a tight national production network has been existent since before World War II, including, the Royal Netherlands Navy, two or three shipyards, the firm Rietschoten & Houwens - producer of the 'civil' electronic platform control and monitoring systems, the company Signal - producer of radar and fire control systems, LIPS - a manufacturer of screw propellors, and MARIN - the Dutch maritime research institute. Onboard weapons and helicopters are procured from abroad.

3.4.107 Whereas MoD keeps a kind of love-hate relation with the Dutch defence-related industry, the Ministry of Economic Affairs (MoEA) is eager to involve the relevant companies in defence contracts with foreign suppliers . Though defence contracts are the prerogative of the MoD, the MoEA is strongly involved in arranging offsets for the national industry. These are considered important in giving Dutch companies the opportunity to maintain or even strengthen their position as co-producers or subcontractors. Only then the Netherlands would be able to play a role of any substance in the area of defence technology. But, as the defence industry only makes up a small part of the overall industrial production and innovation system, there has never been a big governmental push to expand this industry. This contrasts with the substantial governmental support in Spain to build up a substantial defence industrial capability that, through its R&D, also has to contribute substantially to the national technological innovation system.

3.4.108 In the 1999 Defence Budget Explanatory Statement the Minister of Defence has stated that procurement policy also aims at maintaining and reinforcing the national defence industrial and technological base, in line with the second Bangemann report. Therefore the Dutch defence industry has to be involved in defence acquisitions as much as possible. To this end MoD informs the Dutch industry on procurement decisions at an early stage often via the industrial interest organisation - the Netherlands Defence Manufacturers Association NIID. But competition in quality and price remains important to MoD.

3.4.109 Dutch military production usually takes place in rather small, specialised departments of mainly civilian companies. Only three large companies are mainly dependent on defence orders: the electronics company *Hollandse Signaalapparaten (Signal)*, the naval shipyard *De Schelde*, and the ammunition factory *NWM De Kruithoorn*.

3.4.110 Most of the defence-related companies are small or medium sized enterprises (SMEs). In 1997 the share of military turnover was only 6.4% of the total turnover of the defence-related industry, whereas military exports amounted to 10.6% of its total exports. The workforce of 9000 personnel for military production amounts to only 8.2% of the overall workforce in this industry branch.

3.4.111 This defence-related industry contracts about 65% of the Dutch defence acquisition, that is, about 3 billion Dutch guilders per year (which includes between 600 and 900 million guilders for 'construction').

3.4.112 All defence related companies are privately owned. In 2000, the nearly bankrupt State-owned naval shipyard *De Schelde* was taken over by the Dutch shipyard Damen. The largest Dutch defence electronic company, *Signal*, is part of the French Thomson-CSF defence electronics company since 1990. *Van Rietschoten & Houwens* (R&H), producer of the 'civil' electronic platform control and monitoring systems, is a subsidiary of IMTECH-Maritime & Industry, a subdivision of IMTECH, which is part of the Internatio-Müller group. The ammunition manufacturer *NWM De Kruithoorn* has been owned by Rheinmetall GmbH since 1975. *DAF Special Products (DAF-SP)*, producing (components of) military land vehicles was taken over by a combination of Van Halteren Holding and Liebherr, Switzerland, in 1993. Thus most of the companies based in the Netherlands that are largely dependent on defence contracts are internationally owned.

3.4.113 As in the Spanish case, most of the Dutch defence related companies are strongly dependent on international co-operation for technological innovation. They are, therefore, keen to participate in European research projects on defence technology. This is stimulated by both the Ministries of Defence and of Economic Affairs, as a means to maintain the capability as a 'smart buyer' of defence equipment. Because of its small size, the Dutch defence-related industry also has a particular interest in an open and free-market in Europe where it could then compete with other subcontractors of the (few) large primary contractors.

3.4.114 The increasing importance of advanced technology in defence systems implies that MOD considers the continuation of a broad Dutch knowledge infrastructure of vital importance.

3.4.115 Taken together all Dutch defence RD&T roughly amounts to about Dfl. 200 million. This is only a few percent of all (governmental, university and industrial) R&D in the Netherlands. Still it is not to be neglected, if only for getting access to international co-operation programmes. It also means that expertise and know-how in specific scientific-technological areas, like aerospace, is being preserved and further developed. This is not only of importance for MoD but also for more general scientific and industrial expertise (spin off).

3.4.116 Important centres of expertise are MoD's 'house laboratory' TNO-Defence Research (TNO-DO), the National Aerospace Laboratory (NLR) and the Maritime Research Institute Netherlands (MARIN). In the past five years there

has been a broadening of TNO-DO's R&D base to cover other markets such as aerospace, transport and security.

3.4.117 In order to participate internationally the national research institutes have to distinguish themselves in areas where they are strong. Areas in which the Netherlands can substantially contribute to a European defence technology base are: advanced surface ships (design and system technology, platform automation), radar and electro-optic sensors, simulation technology, data- and telecom systems and composite materials.

3.4.118 After the bankruptcy of Fokker in 1996, the National Aerospace Laboratory (NLR) has become of even more importance to MOD as a knowledge source. In February 1997 the NIID has established the Netherlands Industrial Fighter Replacement Platform, aiming at a large and broad participation of the Dutch industry in the replacement program of the F-16. To facilitate the restructuring of the aerospace sector in the Netherlands and to maintain a firm knowledge and expertise base for participating in international programmes, MoD and MoEA jointly provide a subsidy of Dfl 180 million to the relevant industry and national research institutes. This will enable the sector to prepare for a possible participation in the "Joint Strike Fighter" project of the United States (though this doesn't imply that a choice for the successor of the F-16 fighter aircraft has been made already).

3.4.119 Most industrial defence R&D is done in close co-operation with MoD, and is often connected with concrete defence materiel projects. CODEMA (Commission for Development Defence Materiel) is an arrangement for funding defence technology development at the Dutch industry, in which the Ministries of Defence and of Economic Affairs and a company each contribute one third in the R&D investments.

3.4.120 For the Netherlands, as for many countries, it becomes increasingly difficult to develop weapon systems independently. The Netherlands, therefore, is eager to participate in international defence technology projects, for instance within the framework of EUCLID, to enlarge know-how and strengthen its technological position. Research Institutes like MARIN and NLR also have wide international contacts.

3.4.121 Much innovation within the Dutch defence industry occurs in co-operation with foreign companies, e.g. through co-development via offsets, or in the framework of European projects. Because of the importance of international co-operation for the Dutch defence technology base, MoD will, when procuring abroad, increasingly take into account political choices regarding international co-operation in matériel policy (besides traditional criteria like quality, price and delivery time). Direct participation of the Dutch industry and research institutes in development and production is preferred above offsets, as being more effective in enhancing advanced technological know-how. If direct Dutch participation in development and production is not possible, then offsets will be required.

3.4.122 As the Netherlands procures most of its weapons systems and platforms abroad it faces the dilemma to buy either European or from the United States. Without making a principal choice, and in spite of declaratory policy supporting

a strong European defence industry, again, there is a bias to buying from the United States, in spite of strong pressures from European defence companies (and their home governments). As long as no integrated European defence industry exists and as long as the United Kingdom plays the trans-atlantic card rather than committing itself to realise European integration in the defence sector, the current Dutch practice may persist. In that sense the UK plays a pivotal role in Dutch defence and procurement policy.

3.4.123 It can be concluded that the Dutch defence technology innovation system is becoming even more internationally oriented than it already has been traditionally, thus further enhancing its cross-boundary features.

3.4.124 In addition, the increased emphasis by the MoD on using civil standards will be supportive of the Dutch defence related industry and will favour the integration of civil and defence technological innovation. This will further blur the already fuzzy boundary between civil and defence technological innovation systems in the Netherlands.

Italy

3.4.125 Italy currently plays a balancing role in the European context. On the one hand, Italy is the smallest among the key defence players and is willing to play a major role in the process of integrating both the European military forces and the single countries' defence technological and industrial capacities. On the other hand, Italy is the largest among the 'small countries' and is particularly concerned with avoiding any supremacy by the UK, France or Germany in the process of integrating the European military, and is therefore keen to maintain a strong relationship with the US as well. Thus, Italy is a driving force in implementing the agreements reached within OCCAR and the LoI context, but is also strongly supporting the enlargement of both these 'clubs' through the admission of countries like The Netherlands, Belgium or – as to OCCAR – Spain and Sweden.

3.4.126 Confirming its traditional collaboration with the US, Italy is also willing to follow closely the UK in defining a political framework for fostering – currently at a bilateral, and in the future at a multilateral level – the military technological and industrial co-operation with the US. Following the US-British *entente* in February 2000, Italy talks with the Pentagon on drafting a similar agreement to provide a new institutional framework for the traditional co-operation in defence production between Italy and the US. Currently, the US is already involved in 45% of all the international co-operation programmes managed by the Italian MoD.

3.4.127 The increasing involvement, over the last ten years, of the Italian Armed Forces in peace-keeping missions abroad has fostered the process of reshaping the Italian defence policy (as well as, the Italian defence industrial policy). The Italian Armed Forces had, for more than half a century, a 'rigid' structure, strongly linked to the defence of the national territory. This attitude to the military posture has now shifted rapidly towards creating a more flexible structure.

3.4.128 A number of MoD acquisition programmes are defined to face the new operational needs that became apparent during several missions abroad: the A-129 combat helicopters and the AM-X fighters for supporting the land forces by the air, the DARDO armoured vehicle to improve the protection of infantry personnel on the ground, the TOW anti-tank missiles to protect the land forces against battle tanks and the C-130J to enhance the capability of rapid force deployment abroad.

3.4.129 The MoD is currently also replacing outdated materiel, and updating the platforms. Some large acquisition programmes are now proceeding after having been delayed several times. They include: the EF2000 fighter aircraft which is about to enter in the production phase; the Horizon frigate, currently reduced to a bi-national program with France; the EH-101 Anglo-Italian helicopter; and the AV-8B V/STOL aircraft, based on a tri-national collaboration involving Italy, the US and Spain.

3.4.130 Several defence technological and procurement programmes have begun early in the 1990s and are expected to last until the next decade. These programmes - including the Ariete MBT, the A-129 and EH-101 helicopters or the Skyguard SAM - can be considered an heritage of the previous period of military investments in Italy, when the MoD attempted to boost the acquisition of autonomous capabilities of system integration by the Italian defence industry. The results of such efforts often haven't been very positive: such programmes have been long and expensive and, sometimes, have failed in producing equipment meeting the services' requirements.

3.4.131 The next wave of acquisition, launched mainly during the last two years, include several licensed productions (U212 submarine or C-130J aircraft) and international collaborations (from the Eurofighter 2000 to PAAMS SAM). Financial resources – as well as the MoD funded R&D activity - are obviously concentrated on a few large procurement programmes.

3.4.132 Four main industrial groups are predominant in Italian defence production: *Finmeccanica (*Combat and transport aircraft, missiles and missile systems, radars, EW equipment, avionics, optronics, artillery and armoured vehicles, helicopters, submarine defence systems), *Fincantieri*, (Military surface ships, submarines, naval engines), *Fiat* (Aircraft engines, military vehicles, ordnance and explosives, naval electronics) and *Marconi* (Strategic and tactical telecommunications, electronics).

3.4.133 A long process of restructuring and downsizing is reshaping the Italian defence industry towards a quite small and efficient, dual-use industry. The bulk of the Italian defence industry, namely Finmeccanica and Fincantieri, which jointly account for more than two thirds of total military production in Italy, consists of large public-owned groups that are going through a process of privatisation. The privatisation and restructuring process is mainly oriented at selling some high-tech activities and seeking international partners for their military platforms and sub-systems producing subsidiaries.

3.4.134 The privatisation of Fincantieri is delayed – similar to the situation with Bazán in Spain - because of poor economic results of the company over the past few years. By contrast, Finmeccanica has gone on the stock market, in July 2000,

after having signed an agreement with EADS, in April 2000, for jointly running the electronic and aerospace activities of the Finmeccanica branch Alenia.

3.4.135 Finmeccanica and EADS will establish a 50/50 new joint venture (currently called JV Company) which will have three subsidiaries. JV Co. will have around 17,000 employees in Italy, Germany and Spain, and will produce military and civilian aircraft, as well as military electronics and radars. As an incentive to become a partner of the EADS, Finmeccanica has been entitled a three-year option to take a 5% stake in Airbus.

3.4.136 Finmeccanica had declined an offer of BAe for merging its activities in the military aircraft production with those of Finmeccanica's (under a British leadership), because it was looking for a partner, not to be taken over. The choice by Finmeccanica to pursue a strategic alliance in the aerospace sector with a single European partner (even though it is strengthening its links with BAe Systems and GKN) has been a novelty welcomed by the stock market investors, who were obviously concerned about a risk of "isolation" of the Italian company in the European context after it had confirmed its role as major supplier of the US company Boeing. On the other hand, Finmeccanica is still not so attractive for private investors, mainly because of the role of the Italian Finance Ministry - as major shareholder - in supervising (or influencing) the company choices. In fact, it has been stated by law - before the beginning of the process of (partial) privatisation of Finmeccanica – that, for reasons of national security, at least 30% of the stocks must be owned by the Finance Ministry.

3.4.137 A main consequence is that, even if such industrial groups are currently spending an increasing share of their turnover on R&D (between 5 and 10 per cent), they do not seem to identify their own R&D priorities according to a long-term strategic planning based on a (international) market evaluation. They rather continue to define their plans according to the (short-term) needs of the Italian military and to short-term funding opportunities from the MoD. Almost all R&D programmes funded by the MoD are carried out by the defence (related) industry.

3.4.138 As mentioned, the privatisation of Fincantieri is even slower than that of Finmeccanica. Fincantieri is currently managing to improve its weak financial situation with the support of a group of Italian banks, which are currently controlling about 17% of its stock capital. It is foreseeable that the Italian Treasury will not accelerate the privatisation of Fincantieri before the economic prospects of this company have significantly improved.

3.4.139 Compared to the above described public-owned companies, the strategies of the two main private defence groups in Italy, Fiat and Marconi, appear to be more open to the challenge of the integration of international markets and more flexible in facing the rapid evolution of the international arms industry. Some of their main, and to some extent common, characteristics are as follows. Firstly, they are both multinational enterprises having affiliated companies operating in several countries all over the World. Thus, these groups are highly diversified and are therefore able to absorb losses in their military branches during a low phase in the military production cycle. At the same time, they can exploit technological and commercial synergy within and among their different branches.

3.4.140 Secondly, the military branches of Fiat and Marconi are producing quite exclusively high-tech, R&D intensive military products. Market forecasts for such products are quite positive. These companies, therefore, will be able to offer their products to different customers, thus avoiding a too large dependence upon a single national customer. A key point is also that these private groups, contrary to Finmeccanica and Fincantieri, do not have to bear additional costs due to political choices to keep alive uneconomic production of, for instance, military platforms (such as Main Battle Tanks or large combat ships) for reasons of national security or national prestige.

3.4.141 A common problem for both public and private industrial groups is that the current restructuring and privatisation processes take place at a time when both MoD procurement spending and other sources of public support are shrinking. That is a key problem for Italy's engagement in the evolving political and industrial international agreements, since this is based on the assumption that the Italian MoD will be able to keep a sufficient level of procurement spending to sustain the process of restructuring and technological qualification in the Italian defence industry. Otherwise, the role of Italy in contexts such as WEAG, OCCAR or LoI may be severely downgraded and some industrial agreements involving Italian and foreign companies could be reshaped, possibly reducing the advantages to the Italian industry.

Summary of country findings: Russia and Hungary

The Russian defence-industrial base: opportunities for segmented informal integration.

Introduction: the chances for Russia's security integration*. In this section the perspectives of Russia's integration into the global defence industry are viewed through the prism of the processes taking place in the national system of defence innovations. It is shown that dramatic changes in the size, structure, boundaries and institutions of the defence industry brought it much closer to the international fashion than it could have been expected given the situation of political and economic weakness, long-lasting crisis, uncertainty, lack of defence identity and tough political rhetoric.*

3.4.142 The future of defence industries and markets is one of the most complex subjects in the agenda of Russia's integration into the group of countries which follow the Western model of societal organisation. Russia has made significant progress in building institutions relevant for the market economy, achieved relative macroeconomic stability, introduced democratic rules and political institutes. It has dismantled the Cold-war military machine, dramatically changed the security policies and ceased to *be* a military-industrial complex. It became significantly integrated into the world economy and several international markets, fuel and energy in particular. Nevertheless, many uncertainties exist with respect to the future of the defence industry and possibility of its plugging to the global trend to rationalise armaments manufacture and divide labour between European and transatlantic partners.

3.4.143 The idea to integrate Russian defence industries and markets in some way or other has been voiced regularly since the Soviet Union collapsed in 1991. The Russian factor is believed to have weight in the context of the big re-organisation of transatlantic relations in military technology. Several specific Russian military capacities - global navigation system, military transport, space launching services, boosters' engines, anti-missile defence, and several other areas were discussed as possible ventures for shared exploitation, leasing or joint development. However, the serious debate on the issue of Russia's security integration is practically absent: the agenda is still dominated by the traditional threat perception, only slightly adapted to the reality of Russia's economic weakness and pre-occupation with severe internal political and social problems.

3.4.144 Difficulties and risks of possible collaboration are mostly linked to the fact that for the moment Russia's defence-industrial integration only to a small extent could be driven by pragmatic economic considerations - cost efficiency, availability of complementary assets, competitive technologies, risk sharing and the like. There is reason to believe that on the Russian side the political and ideological choice, cultural specificity as well as the will of country elite to follow the norms of social behavior rewarded by supranational cooperation, readiness to compromise would matter more than considerations of rationality, at least as long as the transition period lasts. Recent opinion polls of the country elite showed that 52 percent of respondents consider that the United States is threatening Russia's security (*Profile*, 13 November 2000, No.43, p.2), though military doctrine points mostly to sub-national potential enemies.

3.4.145 From the Western side, standards and criteria of Russia's 'readiness' to be accepted into the international defence community seem to be rather vague: currently they are rather a matter of beliefs, cold war sentiments and trust than anything else. De Vestel, 1995, noted that though competitive technological and industrial expertise of the Russian transforming defence industry could make it necessary for Western and in particular European countries to collaborate, little willingness is displayed, and Cold war reflexes and individual interests dominate the politically sensitive decisions.

3.4.146 The post-Soviet society gives an impression of profound weakness, and is challenged by too many social and economic conflicts, to count on early reconciliation of internationalisation goals and specific sovereign identity. It is without doubt that national framework of the defence industry and strategic autonomy will remain the foundation of the Russian defence industry, which continues to be one of the principal expressions of its national identity, power, and international influence. Therefore the large-scale sharing of arms production with the international partners seems hardly realistic.

3.4.147 On the other hand, if there is little likelihood that Russia's security integration would materialise in the short or medium term, there seems no reason why sectoral or sub-sectoral cooperation within certain segments of the defence-industrial base should be excluded. In the sections below we try to show the major changes in the Russian national defence industry in transition and find

arguments supporting the thesis of possibility of segmented informal integration. Summing up, these arguments may be presented as follows:

- The operational part of the Russian defence-industrial base, which includes no more than one third of enterprises officially counted as 'defence', has formed an industry's core elite with specific interests, new competence and skills, which are in general much more conductive for collaboration that in the beginning of reforms.
- The policy of Russian self-sufficiency in armaments, stated in the continued rhetoric of military doctrines and other political documents, conflicts with the real practice, as well as funding and technological constraints. The Russian defence industry's isolation was de-facto broken by the growing import of components, re-established links to the low-cost manufacturers in the former Soviet republics, as well as growing military procurement in commercial rather than defence complex's market.
- The export dependency of defence branches significantly increased in the 1990s: arms exports steadily exceeded domestic procurement. This fact already brings an international dimension to the Russian defence industry in terms of complementarity, mutual dependencies, as well as the possible introduction of rules for international competition in the arms market and in non-proliferation agreements. Not to speak about co-developments targeted especially at export markets (jet trainer aircraft and fighter modernisation programme, to name but a few of the already existing projects).
- The Russian defence-industrial policy, though rather contradictory and unstable in nature, nevertheless shares many common goals with Western policies. For instance, following goals are stated as a priority: better value for money, dualisation, civil-military integration, equipment standardisation across types of armed forces and other troops (border, interior first of all). This similarity in objectives may help to bridge the gaps in other areas relevant to integration.
- The liberalization reforms of the 1990s have changed the nature of the defence industrial base profoundly, especially in respect of property rights, competition, factor markets and decision-making processes. In spite of the current official policy line, many privatised defence companies, especially export-oriented, have departed from the state and are driven in their behaviour by rather mercantile considerations, free of systemic externalities and official perceptions of security threats. Therefore informal (in the sense of without government participation) industry to industry collaboration may become realistic. Moreover, cross-border ownership of defence companies' assets, especially in the aircraft industry, was established as a result of mass privatisation and the further re-distribution of property rights.
- The gems of the Russian defence and dual-use technologies in space, computational mathematics, information technologies, new materials, atomic sciences and other fields have already been increasingly internationalised through joint R&D projects and contracts awarded to institutes and more often - to individual researchers and teams of researchers. A large share of these activities is not registered with government bodies.

3.4.148 Another factor – which is not yet significant in Russian industry - may become significant in the very near future. This is the change in the relationship between

military and civilian technologies. The weakness of technological base outside the defence industry and organisational inertia currently prevent technologies' spin-on, though there is evidence that this trend is hard to resist in the modern world, and internal integration at least at certain markets would soon materialise, especially if economic growth proliferates into the R&D sector.

Defence policy - implications for defence industry development

3.4.149 Several fundamental features of the Russian defence and security policy should be noted as part of the legacy from the Soviet past: the focus on nuclear power in line with the deterrence concept and the extended boundaries of the security policy beyond the Russian federation. Documented security plans in the format of military doctrines have been adopted and canceled several times in the 1990s, and in general failed to develop realistic guidelines to the defence industrial base. Therefore uncertainty was probably the most important effect of defence policy on industry. This uncertainty is increased by the constraints of unsettled alliance framework within the CIS countries.

3.4.150 As stated in the most recent version of the military doctrine (Voyennaya doctrina, 2000), immediate security threats originate from local conflicts along the periphery of Russia, especially influenced by the spread of religious fundamentalism, ethnic and national tensions, as well as disintegration risks, proliferation of the nuclear weapons and regional arms races, illicit arms and drugs trafficking. Another concern is the increased terrorist activity caused by the weakening of state structures in several regions, and economic distress. The armed forces received new missions, like coping with conflicts on Russian territory and participation in peace keeping operations.

3.4.151 In this respect the military officials stress the priority of nuclear forces as well as long-range precision-guided conventional munitions, electronic warfare assets and advanced communication and command, control and intelligence systems. Asymmetric warfare to 'leapfrog' potential enemies in certain weapons areas is also argued for.

3.4.152 To have the above mentioned tasks fulfilled, the military expect from the defence-industrial base concentration of resources and efforts in the priority fields, civil-military integration and shared use of general economic infrastructure in security interests. State control over the core part of the defence industry is also foreseen.

3.4.153 In addition, the military became seriously irritated by the low interoperability of forces with the other troops, especially painful during the two Chechen wars, when the armed forces and troops of the Ministry of interior could hardly cooperate[17], not to mention the duplication of weapons systems and the general

[17] Separation of the armed forces and internal troops was the trick of the late Cold war times, undertaken in order to avoid large personnel cuts required by the limits established by the Treaty on conventional weapons in Europe. Since that time the forces inherited by the new Russia have been

low level of standardisation. They press for introduction of standard equipment, 'fair' distribution of expenditures among government bodies with the military power functions and larger interoperability. This also brings changes to the industry, especially elimination of duplicating equipment and double-sourcing. The armaments programme was developed in 2000 in line with these expectations, though its claims for resources significantly exceed the funding capacities of the defence budget.

3.4.154 Given the funding constraints and uncertainties with respect to defence policy, the development path of the defence industry in the 1990s was influenced rather by the drive towards a more cost-effective military than security plans. As a result, the forces' modernisation and re-armament was delayed until after 2005. In the meantime, the main focus was targeted to strategic forces, upgrading existing hardware and the provisional ending of serial manufacturing of conventional weapons.

3.4.155 To sum up, the military guidelines to the defence industry still contain a lot of uncertainty: starting from basic questions about enemies, allies and war scenarios and ending with unrealistically high claims for resources. On the other hand, Russia shares with the Western world the estimations of the main security threats, which exclude the threat of a war of global dimensions between Russia and NATO. Russian forces participate in international peace keeping actions. The government has given up the idea to maintain a Soviet type of defence-industrial base and plans to have an industry of smaller size, of more dual-use nature, and integrated with the civilian sector. Thus it may be suggested that the defence policy is targeted to the more open and internally integrated defence-industrial base - in any case a better subject for international collaboration than its earlier designs.

Procurement policy and practice

3.4.156 The Russian defence industry has several clients: in addition to the armed forces, a number of services outside the forces buy military hardware. The Ministry of the Interior, Border troops, the Security Ministry, Service of Foreign Intelligence, and the Federal agency of governmental communication are the largest among these. The procurement budget of forces outside the Defence Ministry is not known, though some statements make it possible to suggest that they re-allocate resources comparable to the defence procurement budget.

3.4.157 A severe decline of procurement funding in 1992-1998 and its growing concentration in a relatively small number of contractors left the defence industry in a very poor financial condition (see figure 2). Data shows that the average annual procurement funding in the 1990s fluctuated around $2-3 billion

significantly reduced in number, but several attempts of re-unification of the armed forces and internal troops failed: two armies continue to exist, complicating industry's optimization. Not speaking about building of praetorian armies under the security agencies.

dollars, if a market exchange rate is used, distributed among 1,700 enterprises (in 1998 only 600 contractors remained, and in 1999 - the number reduced to 400). Not even these low budgets were paid out on time and in full measure: the arms procurement sub-category of the defence budget was in reality funded worse than others, ranging from 5 to 10 percent of planned allocations (Center for economic analysis, 1998, Russia-1998, issue 3, p.114). Moreover, when debts are being paid, the enterprises receive restructured tax exemptions and various state bonds rather than money. To sum up, funding constraints left only a few economically healthy companies in the defence market - mostly large entities, capable to compensate by export sales and other adjustment measures for the losses associated with the transactions with the money surrogates and barter.

Figure 2. 1991-1999 Output Contraction in the Russian Defence Industry

Percentage reductions on the 1991 output levels (1991 = 100)

Sources: Center for Economic Analysis, 2000a, 2000b

	Military output	Civilian output
Aircraft	16	32
Shipbuilding	50	39
Radio	34	33
Communications	9	14
Electronics	7	23
Armaments	no data	no data
Ammunition and special chemicals	17	16
Space	41	78
Nuclear	34	104
Defence complex total	19	39

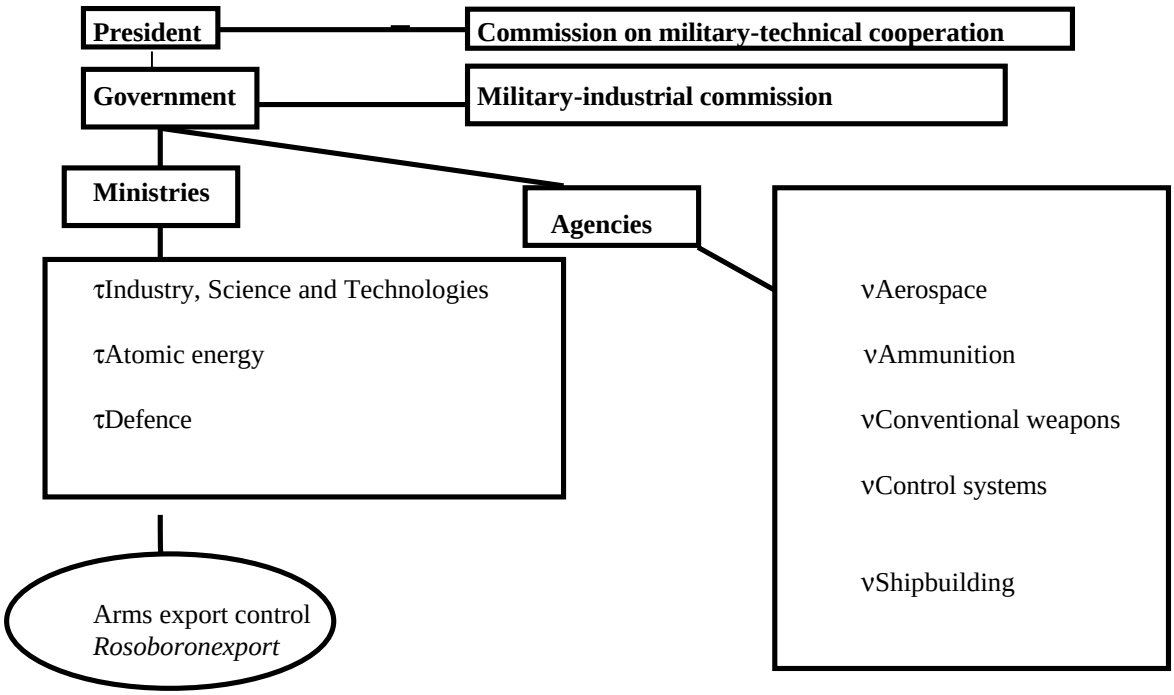
3.4.158 The situation changed in late 1999, when two factors – the recovery of energy prices and pressure of war demands – caused a growth trend in the procurement budget. A twofold growth of procurement expenditures in 1999/2000 significantly improved the financial position of the defence industry. However, this growth brought the level of military production in the defence complex back to only 19 percent of the 1991 level (the extreme cases being shipbuilding which maintained half of 1991 level and electronics with only 7 percent of 1991 level, see Figure 3) and only small series of new weapon systems, together with their repair and modernisation, became affordable (*TS-VPK*, survey February 2000, www.vpk.ru).

3.4.159 Given the relatively low domestic procurement funding, arms exports became the main source of revenue for the depressed industry. Arms export sales in the 1990s accounted annually for US $ 2-3 billion. As of 1998 90 percent of sales were shared by three sectors: 55.6 percent - aviation, 21.1 percent - electronic optics and 13.2 percent - radio industries (Astakhov, 1999). Dependency from the arms export sales is the highest in aviation (more than two thirds of military sales) and armaments industries.

3.4.160 It is interesting to note that in contrast to Soviet arms sales, in which commercial return accounted for only 10 percent of the total sales, in the Russian arms trade the cash return is somewhat higher. The former minister of economics Jakov Urinson, who was in charge of the defence industry's oversight until government reform as of 1998, has claimed that transactions in hard currency have been exploited in approximately one third of total sales, while the rest was paid out by barter and government credit loans in part of state debt servicing (Urinson, 1998). Nevertheless, this revenue used to have better economic quality than domestic procurement, and is believed to support enterprises seriously.

3.4.161 The new government taking power in 2000 plans to focus more on the export sales and to increase its role in the domestic procurement. Thus, the Defence ministry prioritises exporting companies in access to defence contracts to decrease risks. Part of export revenue is being re-channeled to R&D funding. Moreover, the government showed clear intentions to resume control over cash flows associated with the arms trade, and in some cases - control over companies' property. The merger of state arms exporting agencies into one company *"Rosoboronexport"* in late 2000 has been estimated as an important step in this direction (Figure 3).

Figure 3. Key State control bodies for the Russian Defence Industry



3.4.162 The use of imported hardware in the army's supply remains a contested issue. The official policy is to keep independence in the weapons production and internalise as large part of the value chain as possible. Parliamentary hearings in

autumn 2000 showed that industry pressed hard to prohibit military import, especially in electronics. In reality, however, Russia became dependent from import for two reasons. First, disintegration of the Soviet Union left many key suppliers out of Russia. Second, technological constraints and growing pressure for cost\benefit procurement turned the attention of the military companies to imports, at least at the component level (BICC, 2000).

3.4.163 According to Sitnov, Gaponov and Tuzhikov, 1997, Russia is able to produce only 17 weapon systems domestically, all other hardware requires supply of components from ten CIS countries. The number of non-Russian defence component's suppliers reaches 1,500 - this is comparable with the number of enterprises included in the Russian defence complex.

3.4.164 When it comes to the import of hardware from other than CIS countries, in such fields as electronic components, machinery, aircraft engines and avionics, a relatively weighty market niche is already occupied by foreign producers. However, many of the systems manufactured with the use of imported components are subject to export rather than domestic purchase.

3.4.165 In late 1999 the presidential decree on military-technical cooperation brought some light to the policy line concerning defence-industrial collaboration (President of Russian Federation, 1999). Several points should be noted:

- priority for government regulation and control of military-technical collaboration
- increased collaboration with the countries participating in the treaty on collective security
- prevention of unfair competition and shared R&D funding
- development of programmes of military-technical collaboration targeted at individual countries and regions.

3.4.166 Thus, the Russian defence procurement system, designed as closed, internalised and self-sufficient, underwent changes and developed dependencies both on exports and imports. In spite of the fact that Russia inherited up to 80 percent of the Soviet defence-industrial capacity, it is not self-sufficient in supply any more. Technological and funding constraints and the necessities of economical procurement and minimal scale economy opened the system and changed its nature. The isolated defence-industrial complex of the Soviet type remained only on paper, while real producers became engaged in a sophisticated mixture of relations outside the defence complex, including international networks, most developed with the former CIS countries.

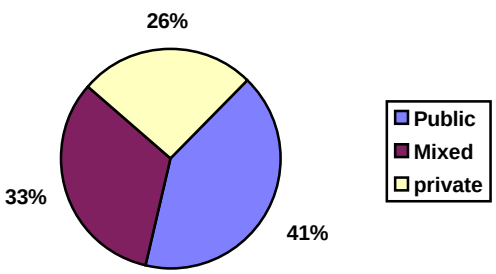
The defence production network

3.4.167 The Russian defence industry is still organized as a military-industrial complex - a set of manufacturing enterprises and research entities, subjected to regulation by defence-specific rules and legal acts. As of mid 1999 as many as 1489 enterprises have been officially included into the defence complex, including 724 industrial enterprises and 545 research organizations, grouped in

eight industrial branches (see Figure 4). In addition 115 enterprises combined research and manufacturing. Employment is estimated to account for 850,000-900,000 people. The old tradition of industry organisation, dominated by systems' duplication, double sourcing, and specific security-driven location practice, resulted in the existence of too many enterprises of prime-contractor type and huge capacity overhang. Several factors, however, changed the traditional composition of the defence complex: the concentration of economic activities in the core elite group of enterprises and idleness or very marginal activities of the rest; institutional reforms and emergence of strong new private actors in the market.

3.4.168 More than half of enterprises within the defence complex do not work for defence any more, and are grouped there either because of the requirement to maintain mobilisation capacities, due to the defence-unique character of their core skills, or because the government until recently was reluctant to close down idle plants. On the other hand, according to the former Defence Ministry's chief of armaments (Sitnov,1999) , the military place half of defence procurement contracts at enterprises outside the defence complex on the basis of regular commercial transactions.

Figure 4. The Russian defence-production network
Sources: BICC, 2000

General indicators	1489 enterprises with approximately 850,000 employees in manufacturing and 450,000 in research
Sectors	υAviation υShipbuilding υArmaments υSpace υCommunication equipment υElectronics υRadio υNuclear
Markets	λ Domestic military 17% of output λ International military 37% of output λ Domestic civilian 35% of output λ International civilian 11% of output
Institutional status	

3.4.169 The question of industry consolidation, capacity reduction and the merger of prime contractors' has been the focal point for policy discussions and initiatives in the 1990s. The government, however, failed to push these initiatives through the industry and host regions and did not find the resources to finance plant closure, lay offs and transfer of assets. By late 1999 the number of integrated companies in the defence complex reached 51, including 35 in predominantly military production, and many of them are plunged into severe conflicts (Stringel, 2000). The new restructuring programme as of September 2000 foresees that the final size and configuration of the defence complex will be shaped only by 2005. The target is to leave no more than ten technologically integrated entities within each of the five defence-industrial agencies (aerospace, shipbuilding, conventional weapons, control systems and ammunitions).

3.4.170 Privatisation of the defence industry started with single exceptional cases in 1990-1992, went through a stage of mass privatization in 1993-1995 and since 1996 has returned to a case by case pattern. As a result the share of public enterprises in the defence complex fell down from 100 percent in 1991 to 30 percent in 1995 (TS-VPK, 2000). The further privatisation process was slowed down, and the share of public entities even increased to 41 percent, mainly due to the changed configuration of the defence industry and the removal of privatised enterprises out of the defence complex. The current government has showed a clear intention to discourage further privatization of the defence industry and erect additional barriers for the new entrants to the market.

3.4.171 The actual outcome of institutional reforms led, however, to results not foreseen by the government: by late 1990s, private actors consolidated significant defence industry's property 'from below', and new private entrants - former subsidiaries of larger firms - emerged in the market, competing with the former parent public firms.

3.4.172 At least four groups of companies may be named - *NPK*, *Kaskol*, *IST* and *United engineering plans (group Uralmach-Izhora)* - which organised themselves in large diversified private holdings on the basis of defence enterprises' control stock. These holdings as a rule combine civil and military manufacturing, their private owners are closely engaged in operational and financial management, they target export markets and are often involved in networks, cross-ownership and strategic partnerships with the large number of defense and non-defence entities. There is a lot of evidence that the behaviour of these holdings is driven by strong pragmatic mercantile considerations, and their engagement in international collaboration would be most natural. The government, however, attempted to limit the expansion of these holdings (especially in access to military orders), and to resume control over arms export revenue.

3.4.173 In the meantime the industry reacted to the funding constraints, collapse of demand and numerous macroeconomic shocks with the dramatic output contraction, which has partly recovered in 1999 and 2000. Military output in the

defence complex in 1999 accounted for only one fifth of the 1991 level, being particularly low in electronics and communication sectors, which declined by 94-96 percent of the 1991 level. The nuclear and space sectors are positioned better. Civilian output did not compensate for the military downturn and was depressed no less than military production.

The defence innovation system

3.4.174 Defence innovations in Russia are still produced in separate organisations - institutes, design bureaux, and to a lesser extent - in research subdivisions of industrial enterprises. There are 545 defence R&D entities with about 450,000 employees (for sources and more detailed debate see BICC, 2001, forthcoming). The numbers are much higher than the extremely scarce resources make affordable, though in the 1990s the number of entities and personnel strength decreased at least twofold. Several specific features of the R&D part of the Russian defence complex may be noted:

- it still has a very isolated character: more than eighty percent of military R&D contracts are awarded to organisations within the defence complex. Higher school and academic institutes - significant defence contractors in the recent past - have left military work. According to the Russian military, this has negatively affected the quality of research, which tends to concentrate on technologies, while innovative venture projects are scarce;

- institutional reforms in research have been slower than in industry: as of late 1990s 54 percent of entities have been public and 29 percent were in mixed property. However, the research sector underwent more active consolidation: for example, in aircraft industry about one third of research organisations are included into holdings;

- civilian R&D in the interests of industrial clients has become the serious shock absorber for military entities, and has been especially productive in the nuclear, space and shipbuilding industries. Estimates show that about 25-35 percent of civilian research in Russia as of late 1990s has been produced by defence innovative companies. Therefore it would be safe to assume that the defence innovation system in Russia does have a kind of dual-use nature, which, however, is not based on spinning in developments from the civilian companies, - weak and slow to emerge in the new Russian market - but rather on the expansion of defence companies to the civilian sector.

3.4.175 The government experimented with various approaches to the defence innovation system, though the target in principle is to support vitally important organisations, close down or move to the civilian market the inefficient ones, integrate the R&D companies into the complete value chain by merging research firms with the strong manufacturing partners and develop defence-specific innovative infrastructure. Importance of domestic capacity in what is defined as critical technologies is another point in the defence policy views. At a moment, the aims were not achieved: weak governments found it difficult to introduce unpopular measures, while focus on the nuclear innovations, as well

as traditionally low labour productivity in science and pressure from industry to keep alive an uneconomically large group of research organisations also had their effect.

3.4.176 What refers internationalisation trend, there is evidence that the number of documented and informal ventures in the defence R&D sector is much higher than in industry: as of 1998 about 100 innovation joint ventures have been officially active in the defence complex (Kabanov, 1999). Most of the ventures, however, are focused on dual-use or civilian rather than military technologies, and deal with technology adaptation, systems' integration, service agreements than original joint research. Informal partnerships, R&D contracts awarded to the labs within the institutes and individual researchers are hard to trace, though in such fields as software engineering, mathematics, space and nuclear research, aerodynamics and chemistry they are believed to have significant weight. The main drive behind outsourcing is access to the pool of trained low-cost professionals, low level of initial investment required to launch a project and low government interference (though the last factor seems to change with the new administration). 'Body shopping' – the shuttling of professionals to do short-term work abroad - is another widely used pattern.

3.4.177 Thus informal contracts with the labs and researchers, industrial partnerships in the field of customised innovative products and intergovernmental agreements in the areas where Russia has unique skills focus currently international collaboration with participation of Russian defence researchers. Major challenges to overcome include the growing skill shortages (qualified personnel being attracted by more competitive wages in other sectors), constraints in intellectual property protection and inability to move up the value chain into the depressed domestic industry.

Conclusions

3.4.178 Many specific features of the Russian defence production network in transition make it a bad partner for collaboration: The government failed to solve the problems of structural overcapacity and industry consolidation, while poor funding and lack of investment de-valued many of its competitive advantages. Moreover, gaps in technological and business culture, different organisational routines, high transaction costs typical for transition economies may discourage any potential collaborator. On the other hand, there are equally many reasons, why the defence industry is attractive for collaboration. Those are:

- A tremendous survival and learning capacity and increased entrepreneurial dynamics, shown during the transition crisis;
- The changed nature of businesses and interests among the core elite group of defence companies.
- Technological competence and qualification in several high tech fields.
- Price competitiveness.
- And finally - strong pressure from financial and technological constraints to get engaged in international networks.

Enough arguments to launch a debate.

Hungary

3.4.179 Hungary is a representative case of those East Central European countries where the socio-economic transformations of the 1990s changed the traditional patterns that characterized the defence sector in the previous decades.

3.4.180 After the political system changes Hungary thoroughly revised its national security & military policy. After becoming a NATO member at the end of 1998 the new defence doctrine was accepted & the elaboration of the new National Security Concept is under way.

3.4.181 During the 1990s the Hungarian national defence force was radically reformed and reduced. The army stopped being a political instrument of the governing party. Armed forces personnel was cut, conscript time was significantly shortened & major steps were taken towards the professionalisation of the armed forces.

3.4.182 In the past the institutional actors of the political network (Ministry departments, central & regional Communist Party organisations) dominated completely the defence production network. Since the transformation process began, the two spheres have become more independent. At present there is still a large number of political institutional actors, often with different agenda, that have a major impact on defence issues, through both formal & informal links. The major institutional actors in the Hungarian military scenario are the Ministry of Defence, the Ministry of Economics, the Ministry of Foreign Affairs, the Office of the Prime Minister, the Defence Committee of the Hungarian Parliament, the State asset privatisation & management holding & the Hungarian Defence Industry Association. Several of these actors are also owners/co-owners of defence industry facilities, which is still the heritage of the past.

Procurement

3.4.183 The 1995 Public Procurement Law regulates defence procurement in Hungary. Procurement can take place through an open bid, by invitation & by negotiation with a sole contractor. Procurement announcements & decisions are to be made public. The Law allows exceptions from obligatory procedures if national security considerations justify it.

3.4.184 Procurement policy in the 1990s was characterised by budgetary constraints & erratic deals that followed market opportunities, instead of a strategic logic. Since Hungary's invitation to NATO, defence & procurement budgets have been increasing. In the near future Hungary's procurement policy will foreseeably be shaped by NATO interoperability requirements. Large-scale modernisation projects, envisaged in connection with NATO membership, pose the question of whether procurement should be local, European or transatlantic oriented. Since this became a very delicate political decision, it is not surprising that Hungary (in common with the other two new NATO members) postponed a decision about up-grading its fighter aircraft fleet. All three countries, at the

same time, use the prospective modernisation projects for offsets that can channel technology transfers, capital investments & stimulate international cooperation both in the military & civilian sectors of the economy.

The defence production network

3.4.185 At the peak of Hungarian defence industry production, in the late 1980s, there were about 70 companies involved directly in military-related production. 17 provided the bulk of defence output. All but one company had mixed, military & civilian production. During the 1990s the sector went through dramatic changes. Between 1988 & 1992 output fell to 1/10th. Approximately 20,000-25,000 people lost their jobs. The crisis reached its bottom in 1992-1993. The bulk of the companies became insolvent & tottered at the edge of bankruptcy.

3.4.186 Defence industry companies went through major production profile changes, internal reorganizations & ownership changes. In order to survive, most enterprises intended to extend their production profile, introducing new, civilian activities. A handful converted to fully into civilian production & another small group became predominantly military producers. Enterprises tried to streamline their production, carried out important internal reorganisations in the hope of decreasing production costs, enhancing productivity & competitiveness.

3.4.187 By & large the state withdrew from the direct regulation & massive protection of the military-related sector. By the end of the 1990s most of the former or present military-related companies were privatised. State agencies, however, supported companies by financing defence-related R&D, assisting them to obtain civilian & military quality certifications, facilitating NATO standardisation. They tried to mediate in potential export deals & occasionally provided financial aid for certain enterprises, eventually bailing some out.

3.4.188 Hungarian defence industry production was originally based almost exclusively on Soviet licenses. Indigenous research became significant from the late 1970s, principally in the military-related telecommunication & electronics industry. Despite the grave crisis of the sector & serious budgetary constraints, (a low level) development of defence technology continued throughout the 1990s.

3.4.189 In 2000 there were 62 companies involved in defence-related activity, 40 in actual production. Most of these firms were successors of former large-scale military producers. The bulk of them had a mixed profile, while a few were exclusively military contractors. Since 1995 a relative consolidation & even a modest recovery can be observed in the Hungarian arms industry.

3.4.190 Hungary's invitation to join NATO induced major changes in the development of the defence industry. Gradually increasing defence budgets, with an increasing share spent on development & the accelerated modernisation of the Hungarian armed forces, promise new opportunities for domestic military production.

Civil-military integration

3.4.191 In the past the defence sector was a separate island within Hungarian society. During the 1990s the military sector has gradually opened up & several forms of increasing civil-military integration have appeared.

3.4.192 Military decision-makers show a growing awareness of the potential superiority of civilian technologies & the usefulness of civil R&D results for military projects. At the level of financing R&D, the separation lines between civilian & military projects are not always clear. There is strong civilian-military integration at the level of the supplier system. Another new link between the military & civilian sector is created through privatisation. Since privatisation began in Hungary, civilian companies could become majority shareholders in defence-related companies. Most of them, however, concentrated on purely civilian projects, among others, because the prospects of military-related development were rather limited. Recently institutional investors bought majority shareholdings of some major defence-related companies in Hungary.

3.4.193 In the case of offset deals the blurring of civilian-military boundaries is rather evident. Attracted by the potential of the large-scale modernisation projects, Hungarian companies, both civilian & military, became interested & lobby intensely for military procurement. When potential foreign suppliers indicate possible Hungarian cooperation partners, they list both civilian & military-related companies.

Internationalisation

3.4.194 Due to drastically diminished local military budgets, foreign business contacts became vital for defence industry enterprises in Hungary. External factors play a major role in the partial recovery of the sector since the mid 1990s. Foreign business contacts & the demands of NATO membership became the major factors shaping the size, structure & nature of Hungary's defence sector. Economic links with foreign partners became an indispensable lifesaver for the struggling companies. Foreign capital investments, cooperation, technology transfers & export possibilities were major elements that helped companies out of their deadlock.

3.4.195 Thanks to the new resources & opportunities provided by the NATO membership, state agencies gradually reaffirmed their role in the promotion & coordination of military-related R&D & production. The increasing military budget & procurement opportunities make the MoD & other military-related state agencies reappear as important potential buyers both of Hungarian & imported military products. Through the offset deals offered by major foreign sellers, state agencies act as mediators & 'representatives' of the Hungarian industry, *both* civilian & military.

3.5 Innovative aspects

See the note at the beginning of section 3 which invites the assessment of this in terms of sections 3.1 and 3.2 and our conclusions in section 4, which follow.

4. Conclusions and Policy Implications

Introduction

4.1.1 This section draws together our conclusions concerning what our analysis of national systems of innovation in the defence sector reveals about the ways in which technological and industrial change, within a framework of globalisation, may be altering the arms economy. It identifies areas requiring further research. And it explores how the developments which have been examined in this project may lead companies and governments towards certain possible future scenarios.

4.1.2 These scenarios focus upon:

- *tranatlantic discord* in the form of strong, but competing, *US and European poles* in the defence sector;
- *transatlantic harmony*, with distinct European and US pillars, but operating within some framework of general understanding and cooperation; and
- *transatlantic discord via 'divide and rule'*, in which US companies 'pick off' individual European firms in partnership arrangements, leaving other firms, and governments, with a strong sense of vulnerability to decisions made on the other side of the Atlantic.

These scenarios are offered as 'possible futures', not as predictions. They allow for the possibility that developments at the industrial level, within production networks, may not be synchronised with developments at the political, and especially intergovernmental, level.

4.1.3 What overall conclusions emerge from our discussion, and especially from our application of the national systems of innovation approach to the field of defence industrial and technology policy? We introduce them under the three headings of their relations to trends within the general political economy, developments more specifically within defence industries and technology, and the value of, and our contribution to, the national systems of innovation analytical approach.

General Political Economy

4.2.1 In the context of the stage in the evolution of global political economy which emerged during the nineties, we conclude that a new, internationalised (but not yet globalised), arms economy is taking hold.

4.2.2 Economic and security challenges are becoming closely intertwined. They are doing so within a world in which only one military superpower now exists, and in which that military superpower is also the most powerful economic actor. Hence the role of the United States in shaping the future of the arms economy, as of so much else, is crucial. The internationalisation of the arms sector both revolves around, and is developing in opposition to, the United States.

4.2.3 How the relationship between military doctrines in the United States and Europe, and the corresponding configurations of arms industries, will develop on the two sides of the Atlantic is not so easy to state. Indeed, it should be the subject of further research. Much will depend on how far political and security agendas converge or, contrarily, remain distinct. In this respect, the legacy of Kosovo may prove to be a touchstone.

4.2.4 All the signs are that the US political system in general, and the military in particular, continue to regard peacekeeping and peacemaking interventions in a different light from their European partners. That is to say, whereas in Europe such interventions have come to the fore in defence debates, and traditional Cold War concerns have moved to the rear of the stage, no such clear shift has occurred in the United States. One might put the point more strongly: what, in Europe, is now regarded as perhaps the prime function of military forces is still seen in the United States as a distraction from the proper role of the military.

4.2.5 To the extent that the purposes of US and European military forces remain distinct, this is likely to lead to different military requirements and therefore to different equipment requirements. What is less clear is whether this will lead to different structures for the arms industries. Put in different terms, the policy networks on the two sides of the Atlantic might grow no closer together than they presently are; but this does not necessarily mean that the same will apply to the production networks. Indeed, an important question for future research is to consider what effect the growing number of transatlantic defence firms may have on the dynamics of these processes. Will these international firms, through their interactions with multiple national policy networks, tip the scales towards some form of policy convergence (in a transatlantic version of Monnet's European functionalism of the 1950s), or will policy networks, and their agendas, retain relatively separate identities?

4.2.6 Kosovo may also prove to be a touchstone in a second sense. The debate over how to respond to the crisis reflected a wide range of political cultures, geopolitical priorities, and economic interests, and these ran deeply within as well as between national political systems. With the resolution of the crisis, one question for history will be what effect it has on the views of military equipment requirements for the future. Kosovo confirmed what the Gulf War had already shown, namely, a vast transatlantic technological gap, and a corresponding gap in capacity to field appropriately equipped forces, for a campaign of the sort that was conducted – with precision bombing, information warfare, dependence on highly advanced intelligence gathering technologies, and so on.

4.2.7 Some would argue that this gap need not drive future policy and production choices, because the campaign, as conducted, was not an appropriate way to attempt to resolve the crisis. Others will draw a different conclusion, namely, that Europe will remain unduly dependent on the United States for any similar future circumstances unless it can equip its forces to a level approaching that of the United States, and in the types of technologies that featured over Kosovo. For the latter, and this is the dominant position in most western capitals, the

issue is whether to seek ways to buy from the United States, using partnership arrangements at both policy and production levels to try to retain such independence of action as can be achieved, or whether to press wholeheartedly for a largely independent European defence equipment development and production capability.

Defence Industry and Technology: Civil-Military Integration?

4.3.1 These high level political and security considerations provide the general framework within which our study has focused on defence-industrial affairs. At this lower level, we can observe first that, while the prospect which some, in the 1980s, saw for a transformation of military production based on the concept of dual-use technologies, has proved optimistic, nevertheless efforts at reforming defence procurement to promote growing civil-military integration have been substantial and ambitious. We see evidence of this in various of the countries that we have studied.

4.3.2 That said, the impact of these measures has so far been relatively limited at the level of prime contractors. Indeed, at first glance, there may even be thought to be a counter-tendency, arising from the fact that most of the defence prime contractors who survived the shakeouts of the 1990s are at least as heavily concentrated on defence production as previously, if not more so.

4.3.3 However, important examples of civil-military integration can be found among suppliers, and also in the production processes being used by defence primes. Outsourcing practices among defence primes are also increasing the relevance of civil-military integration in the supply chain. These trends do not appear to be due directly to the main procurement reform efforts. That is to say, they can be viewed as the consequences of decisions made within production networks rather than as emerging from official procurement reforms, although some governments have also encouraged defence primes to draw SMEs into their supply chains. The extent to which such policies have been implemented in practice, or sustained over time, is not, however, as clear as is the fact that, in times of difficulty, policy networks have tended to focus more on the maintenance of an adequate core of prime contractors than on the interests of lower tier suppliers.

4.3.4 Arguably, a stronger influence on the role of SMEs is a combination of technological and stock market pressure: technology, in the sense of the familiar phenomenon that the sources of innovation often lie outside the major corporations, the more alert of which, however, are quick to co-opt them; and stock market pressure in the sense that, in those countries where private (typically, mainly institutional) investors are now able to exert leverage over defence firms, they are likely to apply greater pressure than governments for returns on capital invested, thus encouraging defence primes to look actively at new modes of sourcing.

4.3.5 Assessing the policy consequences of these developments is not, however, a simple matter.

4.3.6 Thus, one consequence of increased civil-military integration within supply chains, whether arising purely nationally or internationally, may be to further weaken the grip of governments over the defence procurement process, although this weakening is a relative matter, given the over-riding fact that governments are the customers in this particular 'marketplace'. This point may be made even more forcefully in cases where defence production networks overlap with truly globalised suppliers, as is increasingly the case for telecommunications equipment. It arises equally when the global regulatory system impacts upon the defence sector, as it may yet do in the form of a trade war in the World Trade Organisation over subsidies to the aeronautical sector which, while formally concerned only with support to civil aviation, would inevitably have consequences for the defence sector.

4.3.7 On the other hand, developments such as 'Smart Procurement' in the UK strengthen the links between government and industry by giving industry greater responsibility both for the specification of the project and for its management. However, the fact that the state is thereby reducing its control over at least some parts of the production process does not mean that individual firms are necessarily able to act more autonomously in the defence sector.

4.3.8 What is clear, despite all the recent changes in the defence sector, and the globalisation of the sourcing of technology in so many areas of production generally, is the following. While civil-military boundaries evidently can be re-opened for negotiation under certain circumstances, there remains nevertheless a lot of inertia in the existing structure. The most impressive achievement of the military industrial complex in the United States could be said to have been the way that a very stable set of institutions (corporate and governmental) regularized the work of technological innovation so that continuous technological change did not involve anything like Schumpeter's "waves of creative destruction". The question now is, has the end of the Cold War changed the terms so much that that this stability (the boundaries around the networks) can no longer be maintained? Given the consolidation of the industry into "pure play" contractors, that is, defence specialist firms, the mechanism for opening up the boundaries is not clear. We take this discussion a little further in the next sub-section.

National Systems of Innovation

4.4.1 What does our study contribute, at the methodological level, to the NSI mode of analysis? In what ways has it benefited from it? First, we have elaborated the NSI framework through our distinction between policy and production networks, and subsequently through our observation of the scope for divergence (or at least a lack of synchronisation) between the two. We have

evidence of such divergence. Hence, the approach offers a way of characterising the multi-layered evolution of the new arms economy.

4.4.2 Second, the emphasis in the framework upon changes in institutions and environment has directed our attention towards certain key sources of dynamism in the defence sector. Going beyond the obvious issue of the end of the Cold War, these also include new ownership relations, in the form of privatisation, and also changes in the sources of new technology, both of which are indicative of changes in the traditional boundary of the defence innovation system. These observations have led us, in turn, to explore how these developments have opened up various 'gaps', such as civil-military, US-Europe, in a way that is less uni-dimensional than, say, the 1960s debate about the transatlantic Technology Gap.

4.4.3 Third, the institutional emphasis of the NSI approach draws attention to the fact that certain 'national' core competences have now shifted to *foreign* ownership (cf the Swedish case), and this also has implications similar to those identified in the preceding paragraph.

4.4.4 Fourth, the NSI approach enables us to approach from another perspective the issue of the stability of the defence industrial sector over time, alluded to at the end of the preceding sub-section. It is nearly two decades since Kaldor described the evolution of military technology under the title of the 'baroque arsenal', meaning the way in which the types of major weapons platforms (the warship, jet fighter and tank) had remained broadly fixed since the end of the Second World War, and that innovation had taken the form of incremental (rather than revolutionary) change, resulting in embellishment of these basic platforms to baroque proportions. One way to explain this form of technological stability at the level of generic platforms, combined with continuous innovation within the framework thus set, is to observe that NSI theory would expect the military and industrial institutions associated with the generic platforms to feed off each other, and to resist intruders into their network. Thus, when debate surfaced in the late 1970s and early 1980s on the question of whether precision-guided missiles spelled the end of the tank, a natural coalition of interest formed between networks associated with tanks – specifically the relevant sections within armies and their suppliers. In those countries where engagement with the Cold War was a dominant feature of defence policy, with all the consequences that flowed for the relative inviolability of defence budgets, the consequence at an institutional level would be a sealing of the network against the threat to its members, and a channelling of funds to develop answers to the threat. (In the history of technology, this is known as the 'sailing ship effect' – a reference to the way in which sailing ship technology improved under the threat of the faster passage promised by the new technology of steam-powered ships).

4.4.5 On this analysis, the end of the Cold War should result in reduced political legitimation for defence budgets, and therefore increased pressure to seek more radical approaches to defence innovation. The introduction onto the scene of a more diverse set of actors (partly because of civil-military technological

integration, discussed above, and partly because of the insertion of institutional investors into defence innovation networks) should also mean that the networks are more open to discordant influences than hitherto. A number of important policy questions arise from this observation.

4.4.6 One of these is that the continuing stability of the networks, in the sense of continued domination by firms or groups of firms with a long history of defence contracting (granting also the exiting of other such firms), and the absence of new entrants at the prime contractor level, requires comment. Several factors may be at work here. One is the relatively small size of the defence sector compared to most global commercial markets. Just as in Britain at the end of the Second World War, ICI turned down a request from the government to take over nuclear reprocessing for the atomic bomb programme because the company saw a brighter future in organic chemicals, so today, companies which may potentially have the capacity to move into the defence sector may not see it as worthwhile. Second, it may be that not enough time has yet passed for the system to change: the strategy of 'survival via consolidation' has dominated the last decade; now that this cannot go much further, other options might start to emerge. Third, in the largest of all defence markets, the United States, it may also be that the budgetary reductions have simply not yet been great enough to create the conditions for more radical change, though the other side of this argument would be that we would expect to have seen more evidence of radical change in smaller countries.

4.4.7 *Network boundaries have changed, however, and new entrants have emerged, at the level of sub-elements of the defence innovation system. That is to say, we have in the recent past seen cross-sectoral shifts* within *the defence sector (aircraft manufacturers becoming prime contractors for warship contracts, for example). In this respect, it is widely claimed that the key competence needed by prime contractors is that of systems integration. This raises a further key policy question which we have not been able to address, but which urgently requires further study, namely, how easy it is to acquire such a capacity with reference to defence systems. This is clearly a critical issue for the analysis of barriers to entry to defence networks.*

4.4.8 Put differently, how far is a 'systems integration capacity' something that can be transferred from one context to another (in the way that it is sometimes claimed that 'management' is a generic skill, and can be applied regardless of context)? If it is something that cannot be easily transferred, then even if other protective elements of the old networks are weakened (eg, by privatisation, and increased budgetary pressure), we might still expect to see (as indeed we have) the continued domination of the sector by traditional players. If it can be easily transferred, then the question becomes, why is there so little evidence of it happening? And in the light of the growing importance of civil-military technological integration, which arises mainly at sub-contractor level, it also bears asking whether the trend towards technology integration at sub-system level (the supply by sub-contractors of 'black box' technology) may also threaten to destabilise traditional concepts of systems integration, and related control.

4.4.9 A related matter deserving further analysis, within this set of questions, is the role of 'tacit knowledge' in defining a systems integration capability. A considerable body of work in the 'science and technology studies' field emphasises the importance of such knowledge, acquired by experience over many years, and often embodied in whole organisations and not simply individuals. Modern approaches to the capturing of such capabilities (eg, computer-based expert systems) can reduce the barriers to their acquisition. But the concept of tacit knowledge goes wider than this. Moreover, the modern trend to use computer-based systems to integrate the processes of design and production could be argued to require *more demanding* systems integration skills, rather than their reduction to some sort of expert system. There is scope here for further study, to establish more precisely what a systems integration capability entails, how context dependent they are, and what effect current developments may be having on their transferability across the civil-military divide.

4.4.10 Finally, of particular interest, because so novel in a number of countries, is the question of the potential influence of institutional investors in altering the balance of power within defence innovation networks. We suggest that this influence will not necessarily be the dominant one in any particular decision, but that does not mean that it will have no effect. First, in the case of diverse corporations, with minor interests in defence, it may encourage decisions to exit the defence sector: in such a corporation, shareholder behaviour is likely to be more attuned to general business prospects than to those of the defence sector in particular. In addition, it increasingly weakens the control that governments can exert over defence companies. It may also (as said above) be encouraging, or at least enabling, civil-military integration in the supply chains, below prime contractor level, with consequences for the overall stability of networks that cannot be predicted.

4.4.11 This is a complex matter, however, and one that deserves more extended study in the future. Such study will need to reflect on the fact that the transfer of control over the defence industrial sector to shareholders is proceeding at varying speeds in different countries, and in nationally specific ways. One sense in which this is so concerns the degree of control over key decisions that governments are really allowing to privatised companies. 'Golden shares', and other residual control mechanisms, remain significant forces. Thus, rational economic behaviour might lead shareholders interested in this sector to opt for holdings that gave them access to the most secure defence market in the world, that of the United States, but political controls over foreign investment may impede any such desire.

4.4.12 *A second, and more subtle, brake upon radical change arising from shareholder power can be expected to be the attitude of shareholders to future geopolitical prospects, and the degree to which they share these with other key elements of defence policy networks. Looking at this hypothesis from an international perspective, we can observe the varying degree of exposure, by country, to the new geo-political reality. Compare, for instance, the position in*

Germany, where history and geography provide direct incentives to seek a stable and cooperative security environment, with that in the United States, where a sense of responsibility for containing the decaying military structures of post-Soviet Russia is inevitably mixed with residues of Cold War arguments for maintaining military might. In France, meanwhile, there is a familiar blend of resistance to American domination and concern not to allow Germany a monopoly of contacts and cooperation with Russia, while in Britain, traditional ties with the United States and a relative remoteness from the concept of regarding Russia as part of the new Europe remain important. It is not difficult to see how these different starting points could have consequences for defence equipment decisions.

4.4.13 Against this overall background, how might the new arms economy, and especially its two main transatlantic elements develop in the future? To address this question, we consider, as already explained, three illustrative scenarios.

Possible futures

4.5.1 For heuristic purposes, we have chosen to reduce Europe's possible military-industrial futures to three basic scenarios: Transatlantic Discord between competing US and European poles; Transatlantic Harmony; and Transatlantic Discord via Divide and Rule.

4.5.2 We note in passing, however, that the European debate on military security has not yet fully appreciated the long-term consequences of the dramatic economic decline of Russia and other nations of the former Soviet Union. While Russia will command an arsenal of weapons of mass destruction for many years to come, she is economically incapable of maintaining conventional forces which would constitute a military menace to Europe. Nevertheless, Europe needs to make political stability in Russia a high priority on the agenda of security issues in order to create mutual dependencies and the gradual integration of the Russian economy including its military industries into the European procurement process. Although this process is unlikely to be completed within the next decade, we nevertheless make reference to various features of it below.

SCENARIO ONE: Transatlantic Discord: Competing US and European Poles

4.6.1 A new threat perception, arising not from the east but from the west, emerged in Europe during the second half of the 1990s. It was not a threat to national security and independence, but to European military-industrial survival and advanced technology competitiveness. Although the east-west conflict in the form of the cold war disappeared, technological competition among western countries did not. Military-technological competition among the technologically most advanced nations, partly within Europe but primarily across the Atlantic, became a decisive factor driving European common action.

4.6.2 The American threat was created by the so-called 'last supper' in 1993, when the US Secretary of Defense told the chief executives of the biggest American military companies that half of those present were superfluous (Volkman 1998). The companies, supported by Wall Street, reacted with stunning rapidity. Within a few years there was a dramatic reduction in the number of prime producers in 10 of the 12 industry market sectors identified as important to national security. The largest reductions were in aerospace markets such as tactical missiles (from 13 to three), fixed-wing aircraft (from eight to two), expendable launch vehicles (from six to two) and satellites (from eight to five). The US defence market became practically dominated by three giant companies - Boeing, Lockheed Martin and Hughes. In November 1999 the US Deputy Defense Secretary concluded that the company consolidation in the US defence industrial base had gone about as far as it could (Defence Press Service 1999).

4.6.3 The European reaction, catalysed further by the Yugoslav crises, was an acceleration of defence-related activities, both industrial and political, in an attempt to strengthen Europe's military industry's position.

4.6.4 The first scenario assumes that these developments continue to the point where a strong European defence industrial pole is created, capable of matching that of the United States.

4.6.5 Two main forces drive the Transatlantic Discord scenario. First, the urge of European governments and defence companies to remain on the competitive playing field. Second, a need to reconfirm Europe's political and economic role in the new and unipolar world characterised by US dominance. There is a desire to define a clear defence-political identity for Europe in order to give credibility to the pan-European structures and also to mark differences from the US. The evolution of the European Union and the common European market provide a background and framework for these efforts.

4.6.6 A condition for the development of this scenario is that there is no renewing of tension between Europe and Russia, or even that there is close political and defence cooperation with Russia and Europe, and perhaps even between Russia and the US. EU-Russian military cooperation, although unlikely in the short term, would further support this scenario, enabling military postures that no longer needed to follow the US military technological or political lead but concentrated on protecting Europe from external threats and contributing to peace-keeping operations under the mandate of the United Nations. As a precondition for this scenario Russia would have to accept its economic and military limitations. Just as Europe, in our second scenario, cooperates with the US, Russia would in this scenario realise that cooperation with Europe could sustain technological capabilities basically embedded in civilian high-tech industries competing in international markets. Thus, EU-Russian cooperation in military-industrial and security fields could lead to a new self-confident European defence option.

4.6.7 Also crucial for the sustainability of this scenario would be a united European will to remain and act independent of the US, not least if one consequence of

this course of action were that the US might withdraw its military presence, and perhaps also its military guarantees, from Europe. An extreme variant would be to accept the emergence of a new transatlantic order in which the NATO military alliance would no longer have a role. US domestic, mainly economic, problems and/or a neutralistic American administration would probably be needed in order to support such a decision.

4.6.8 An outcome based on competing US and European defence poles would probably be very costly for Europe since it would include facets of European superpower ambitions. Advanced European military R&D, innovation and acquisitions as well as an independent European Science and Technology Intelligence organisation (Hagelin 1999) would need to be supported. Military systems not otherwise contemplated, such as anti-ballistic missile systems, perhaps even aircraft carriers and strategic bombers, might be argued for. Satellite communication links would be a necessary ingredient in the new defence posture. In order not to remain dependent upon the US, independent and cost-effective European civilian communication infrastructures and intelligence services would be needed, resulting in a new balance between exclusively military infrastructures and intelligence and often more efficient services provided by the private sector organised in globally operating corporations.

SCENARIO TWO: Transatlantic Harmony

4.7.1 Undoubtedly, there is still political, economic and technological importance attached to nationally independent military production. However, it may be argued that in most, if not all, countries with an indigenous military industrial base, national independence has not existed in advanced military innovation, R&D, production and acquisitions during peacetime. National production of the technologically most advanced equipment is possible only with the assistance of different forms of international research and development co-operation and/or trade of skills, technologies and products. In the future, international projects are likely to define much if not all of the advanced military production or acquisitions to be considered affordable in Europe. Thus, military-relevant technology innovation will not be national but international.

4.7.2 Our second scenario assumes a happy union between European and transatlantic cooperation, in which Europe and the US make up two pillars of the same military (and military-industrial) system. Like the first scenario, however, it rests upon the same general foundation of successful European political and industrial responses to the American challenge as well as realisation of EU ambitions. The second scenario, therefore, also implies a willingness on the part of European governments to increase their military expenditures, although transatlantic cooperation may support rationalisations and cost savings.

4.7.3 But there is one decisive difference, namely that the US believes European representatives when they assure them that there is no risk of independent

European ambitions, so that the US then supports the creation of a strong European defence industrial base. Hence, as a reaction to European industrial consolidations and acquisitions, the basis for transatlantic cooperation actually improves. Part of the US support may be based on the need for an increased ratio between equipment and men in Europe as a result of NATO enlargement, and an increasing EU role in NATO power projection operations.

4.7.4 A further stimulus for this scenario could emerge from a deterioration of the European security situation, mainly in EU-Russian and US-Russian relations, with re-emerging cold war-type military rationales for NATO. One example might be Russian non-compliance with US-EU views on international arms and technology controls. Another example could be a US and perhaps also a European Theatre Missile Defence system that, in the Russian view, is partly aimed at Russia. Russian opposition could create support for faster NATO enlargement to include Finland and Sweden and result in revitalised transatlantic military including industrial ties. A destabilising, costly and counter-productive European arms race could follow.

4.7.5 On this scenario, the US administration would reduce its technology transfer restrictions in parallel with reducing the force of the Buy American Act and other constraints against American acquisition of European equipment. It would also alter the its historical unwillingness to share its most advanced technology even in NATO projects. Moving toward this alternative for both first, second and third tier suppliers is important for achieving the highest forms of European and transatlantic co-operation. Examples of steps and decisions that could illustrate this are the April 1999 DCI initiative, the Joint Strike Fighter (JSF), the US willingness to share BVRAAM missile technology, the proposals by the Defense Science Board's Task Force on Globalization and Security (Arms Sales Monitor, No. 42, Jan. 2000, p. 1), recently changed US licensing legislation, and the February 2000 Declaration of Principles between the defence ministries in the US and UK (DoD Briefing 8 February 2000).

4.7.6 Although there may be many rationales for closer transatlantic cooperation in the future (Barry & Kay 2000; Adams 2000), the buzz words in this scenario would be trade liberalisation and technology sharing, involving the whole spectrum from R&D to production and acquisition in defence as well as dual-use technologies and products. Because of the great imbalance in transatlantic defence trade, the US would not only open up its military market, but also accept spin-offs and spin-ons in American military and civilian programs in an attempt to narrow the technology gap and support increased military trade and co-operation with Europe. The future of defence spinoffs, however, may remain a controversial issue.

4.7.7 Closer and more efficient transatlantic co-operation is likely to develop in steps, starting with industrial teaming and partnerships. Over time, this would create a political, military and industrial climate that, in turn, would support ambitions on both sides of the Atlantic to achieve transatlantic mergers. Transatlantic company mergers would strengthen NATO, improve interoperability, diminish trade protectionism, maintain competition, and bring Europe into the new so

called Revolution in Military Affairs (RMA). Constructive co-operation in this field would support common requirements and NATO standardisation increasingly around European equipment.

4.7.8 However, although mergers would reflect the highest industrial form of transatlantic co-operation, they are not absolutely necessary for this scenario. The most important factor is the reduction of transatlantic political and military animosities and tension and to establish constructive US support of EU technology, defence and security ambitions. Integrated transatlantic project teams sharing as well as developing skills and technologies – perhaps following competitive R&D on each side of the Atlantic - would be one alternative. The negative result from 'the second supper' in 1999, when representatives from both sides of the Atlantic met to discuss possible transatlantic mega-deals, is therefore not necessarily critical. The UK in particular could, if it can manage its transatlantic and European balancing act, be the major European bridgehead for this transatlantic military-industrial bridge.

4.7.9 The experiences of the Kosovo war highlighted the rift between the US and European nations. For this scenario it became a cross-road in transatlantic cooperation. It elevated the European debate about integration of military capacities to an action-oriented level and contributed to eventually breaking the stalemate of extending the process of European integration to cover military affairs. Over time, developments could involve a transatlantic-wide restructuring of military and dual-use R&D and production. Certain types of equipment or technologies for the transatlantic area as a whole may be developed and produced in Europe, while others are developed and produced in the US. This means taking advantage of comparative advantages in the US and European nations.

4.7.10 This would have implications for the focus of technology innovation in Europe and the US in that it would support the creation of asymmetric but coordinated NATO or US-EU military technology innovation. That would demand hand-in-hand transatlantic cooperation, in reality basically a common military industrial base as a means to make military technology, spending and acquisitions more effective.

4.7.11 However, the analysis of the Kosovo consequences in the history books of the future may conclude that what followed was not a harmonious transatlantic relationship. Rather, US pressure upon European weapon acquisitions strengthened. The US defence establishment began to market not only military equipment but also a future military doctrine in Europe. What had hitherto been regarded as distinctly European security concerns became obscured and, even manipulated, by vested American interests.

SCENARIO THREE: Transatlantic Discord: Divide and Rule

4.8.1 There exists a fundamental risk in transatlantic relations that has to do with the types and use of the armed forces. Apart from different conclusions with regard to Russia's future, the European discussion of new threats and military out-of-

area obligations has not matured to give a clear guidance of how much military potential is enough and what this potential should be composed of. Military-bureaucratic structures are slow in redirecting the available resources to the emerging scenarios in which the armed forces are likely to be tasked with new missions requiring distinct training and new equipment. Ideological and political battles are waged over the true nature of new threats and the appropriate responses within NATO. Joint statements obscure transatlantic and intra-European differences. In this relative political vacuum entrenched bureaucratic and industrial interests as well as military subgroups continue to fight more or less successfully for their respective survival.

4.8.2 In this scenario the procurement climate in Europe would initially develop in the direction of civil-military technological integration. This would take place against a presumed background of good security relations with Russia and hence of limited pressure for national European armaments. European military expenditures would therefore not increase to the extent desired by the US. Seen from the US, Europe would not be living up to its NATO obligations, leading to a weakening of political will in Washington to work in the ways required for the Transatlantic Harmony scenario to succeed.

4.8.3 In our third scenario, Europe also does not succeed in establishing a common defence entity, and hence does not manage to create the scale of integrated arms market that could support major European defence companies, in terms both of orders and of R&D. Hence, national governmental support for national defence firms (in terms of sales, export credit guarantees, and so on) would continue to divide Europe.

4.8.4 A further consequence of this line of development is that the smaller countries would remain on the periphery. Indeed, as we already see, support for European mergers and acquisitions is most pronounced in the six Letter of Intent/Framework countries: Britain, France, Germany, Italy, Spain and Sweden. These are precisely the countries with the major defence industries and the major stakes in the common European market. But the principal inefficiency of the military institution is structurally predetermined and very obvious in the smaller European NATO-member states. The defence budgets of smaller countries may reach a point where the maintenance of a procurement bureaucracy eats up a dangerously growing proportion of the cake to be distributed in the form of procurement contracts.

4.8.5 Hence, Europe’s military-technological and defence-industrial ambitions would remain divided and driven by diverse national government and/or competitive company interests. Nor would they find much support in European defence institutions since there remains a plethora of such institutions (Assembly of Western European Union 1999). Moreover, while on the surface most of Europe's arms industry is privatised, in reality special relations remain in place between major arms manufacturers, the national procurement bureaucracy and the export promotion bureaucracies. The efficiency of the European defence effort is increasingly threatened by the fact that all organisational functions are being unproductively carried out in parallel in the major nations which

structurally lowers the ratio of disposable investment and fixed costs. The transatlantic card is only rhetorically played to enhance the respective national military effort (Detlev 1999).

4.8.6 The third scenario supposes that this unstable European situation is taken advantage of by the US. Despite the gap between the political and military ambitions on both sides of the Atlantic, there is still an American rhetoric supporting a strong and united Europe including a strong European defence industry. In reality, however, the US uses sophisticated methods in order to divide and rule. The negative US reaction in 1999 to future transatlantic mergers may well not change. In the words of one commentator: 'there will be no transatlantic merger in the strategic industries that is not a direct American takeover of a foreign company, leaving the US partner in unambiguous technological control' (Pfaff 1999).

4.8.7 The third scenario envisages that US companies will continue to be present on the European market, with economically competitive bids for defence contracts. Based on the European market structure as well as US bilateral relations, some European countries are likely to gain more than others from such contracts. Far-reaching and favourable US collaborative offers, such as the offer to the UK in 1999 for the BVRAAM alternative to the European Meteor missile, will repeatedly threaten the success of European projects. Such offers, supported by bilateral US co-operation agreements with European nations, put the European governments in dilemmas between supporting Europe or buying from the US. In this way, the US would have repeated opportunities to intervene in European moves towards closer military-industrial co-operation.

4.8.8 Even without an explicit political Divide and Rule strategy, competitive relations between US companies may complicate the strategy choices in Europe. In fact, economically more efficient arms procurement in Europe based on transatlantic solutions may in the end increase the potentials to Divide and Rule. US companies such as Lockheed Martin or Boeing may be eager to establish cooperation with major European companies because the other company has done so or in order to gain competitive benefits. Possible closer cooperation between BAE SYSTEMS and Boeing, for instance, may be a way to compensate for BAe's participation in the Lockheed Martin JSF team. The US could selectively open the US market by putting a high price on the closest forms of cooperation and influence as in the JSF, in reality restricting such participation to only a few. Again, the UK stands out as crucial. But when the JSF or similar projects are finished, or if the situation changes for other reasons, the basis for such cooperation may disappear. If European companies have then based their future strategies on the continuation and strengthening of such transatlantic cooperation, the consequences may be severe for Europe's possibilities to recuperate.

Conclusion

4.9.1 To repeat, these scenarios are offered as heuristic devices for exploring various features of the policy opportunities and threats that face Europe. It remains to be seen which of them will prove closest to reality. Indeed, the matter of their resolution is not simply one of waiting to see, but rather of seeking to influence them through appropriate appreciation of the underlying factors, and their consequences. While actions (as NSI theorists would be quick to observe) cannot determine outcomes in any simple way, nevertheless the future remains to be *constructed* rather than to be *forecast* in any simple-minded way, or *awaited* in any spirit of fatalism.

4.9.2 In this respect, Europe has choices. The recent strengthening, via mergers and acquisitions, of the leading European firms has altered the transatlantic defence industrial landscape, even though the major source of finance in this field remains the Pentagon. The question is, which choices will the relevant actors make?

5. Dissemination and exploitation of results

Introduction

5.1 It remains our view that the potential for exploitation of our work is high in that we expect its findings and perspectives to be of interest to policymakers and practitioners, as well as to other researchers. This has been exemplified most clearly by the subsequent IVA study (see below).

5.2 We have pursued six broad routes to the dissemination and exploitation of our work:

- Three **workshops with wider participation** of academics and users, in Berlin with the Aspen Institute (May 1998), in Rome with IAI and CeSPI (November 1999) and most notably in Brussels (October 2000) (see below). A fourth workshop, in Budapest, was the occasion for us bringing into the network analysts from Hungary and Russia, respectively Judit Kiss and Ksenia Gonchar. Three other workshops, Paris (April 1998) involving part of the group, and London (April 1998) and Manchester (May 2000), where the whole group were present, focused exclusively on internal reporting and refining our analysis.
- Active **individual publication and conference attendance** by individual network partners, in order to broaden the scope of dissemination but also to promote exchanges with experts in core contributory disciplines (see annexed material in section 7). The total number of relevant publications produced by the group during the network's life - in addition to METDAC discussion and working papers detailed below - was 41; the number of relevant conferences, seminars and workshops in which network members participated - again in addition to METDAC's own meetings - totals 54. This dissemination and exchange took place in 15 countries over four continents.
- A **website** (www.spsg.org/credit) which has updated people on workshops and been a route to the **discussion papers and working papers** produced in the course of this study (see list below). Discussion paper 2, 'Key questions for the study of European RTD', by Jordi Molas-Gallart, has been published in amended form in Scientometrics as 'Measuring Defence R&D: a note on problems and shortcomings' . *Scientometrics*, 1999, **45**,1, 3-16. A version of the working paper 'Defence standards and the reform of defence procurement', by the same author, has been offered to the new *International Journal of Aerospace Management*.
- A contract to CREDIT immediately after the completion of the METDAC work for **a detailed study for the Swedish Royal Academy of Engineering**, IVA, to help them make an input to Swedish policy choices (see below):
- **A book**, *United States, Divided Europe?* provisionally accepted for publication by Macmillan, and which we expect to appear in 2002.

Workshops

5.3 Within a wider business meeting of the METDAC network we held a consultative workshop at the Aspen Institute, Berlin on *Civil-Military Integration in Europe: Current Practice and Future Prospects*, on 27-28 May 1999. Policy and practitioner representatives attended from:

European Defence Industries Group (EDIG)
Swedish Agency for Emergency Planning
Defence Evaluation and Research Agency (DERA), UK – Brussels Office
Defence Research Establishment, Sweden

as well as from the European Commission (Directorates-General III and XII) and a representative of the A10 COST action, *Restructuring of Defence Industry and Conversion.* This first step with user engagement was very useful in the quality of interaction with those present if modest in scale.

5.4 Our workshop in Rome from 4-6 November 1999 was hosted by the *Istituto Affari Internazionale* (IAI - the Italian Institute for Foreign Affairs), in collaboration with CeSPI (*Centro Studi di Politica Internazionale*) . Although intended to be preparatory for the last public workshop in Brussels rather than an exercise in dissemination itself, the opportunity was taken to include a round-table to introduce the network and its work to a range of interested parties in Italy. Attendance included senior representatives of Finmeccanica and Alenia Marconi and representatives of the Italian Armed Forces and Procurement branch of the Italian Ministry of Defence, General Finizio of the Military Centre for Strategic Studies (Cemiss) as well as defence and foreign affairs analysts.

5.5 The objectives of our final workshop in Brussels on 19 October 2000 were threefold:

- to present the results of the METDAC study;
- to engage European industry and policy bodies in debate as to the consequent strategic choices for European defence and industrial capacity;
- to consider future needs for research and analysis on European defence and industrial policy.

Thirty-three people attended, chiefly from industry and government organisations. Our work was presented under the title of our forthcoming book – *United States, Divided Europe?* – the programme is presented in full in figure 5 overleaf, and the slides used in presentations form annex (a) in section 7 of this report. As can be seen, a member of the Institute for Security Studies at the WEU, a Member of the European Parliament, and a member of the staff of the European Commission responded to the presentations and introduced general discussion. All those attending have received presentation slides and will receive a copy of the final network book on publication.

Figure 5.

United States, Divided Europe?
Programme for the CREDIT-METDAC Workshop, Brussels, 19 October, 2000.

1000 - 1030	Registration and coffee
1030 - 1040	Welcome and introduction to Session 1: *What is changing and why?* : Professor Philip Gummett - changes in procurement
1040 - 1105	- corporate changes – Andrew James - civil-military integration and systems integration – Jordi Molas
1105 - 1115	*Comment:* Burkard Schmitt, Institute for Security Studies, WEU
1115 - 1215	Questions and discussion
1215 - 1335	Lunch
	Session 2: *what are the consequences and some possible scenarios?*
1335 - 1405	For defence industries: - Trans-Atlantic harmony – Björn Hagelin - Trans-Atlantic discord: divide and rule – Peter Lock - Trans-Atlantic discord: competition – Wim Smit
1405 - 1415	*Comment:* Christopher Beazley, MEP (UK)
1415 - 1500	Questions and discussion
1500 - 1520	For innovative capacities of individual countries and of Europe - Giulio Perani East European policy and possible responses: a view from Hungary – Judit Kiss
1520 - 1530	*Comment:* Pierre-Philippe Bacri, Enterprise DG, European Commission
1530 - 1600	Questions and discussion
1600 - 1630	Session 3: *what do we need to know? – future research and analysis* - Claude Serfati Discussion
1630 - 1700	Coffee and departure

Discussion Papers and Working Papers

5.6 We originally contracted to deliver 6 discussion papers and a book. Figure 6 sets out the 7 discussion papers and 17 working papers that we have produced, and their availability from the website or from authors.

5.7 The content of the networks publications has changed with the change in approach set out in the early part of this report. In net terms it has made us more productive – the book will reflect this in particular and will be a more integrated and ambitious product than we could have foreseen two years ago. However, there is one respect in which we have not achieved as we would have wished. Civil-military integration and the relationship between national innovation systems and defence RTD were originally intended to be the subject of discussion papers comparing Europe with the United States and Japan. Although we did receive some material from Japan, pre-existing collaborations

did not prove able to deliver comparative analysis as we had hoped, and we were not able to remedy this within the budgetary restrictions imposed by this network. The Japanese comparative element has as a result been largely lost.

Figure 6. METDAC Discussion Papers and Working Papers

Discussion/ working paper	Title	Author(s)	Available from
Discussion paper 1	European Defence RTD in Context	Gummett and James	Up on CREDIT website (www.spsg.org/credit) in summary in HTML and downloadable in full in PDF format
Discussion paper 2	Key Questions for the Study of European RTD	Molas-Gallart	On website in summary: subsequently published in *Scientometrics* (see Report para 5.2)
Discussion paper 3	Civil-Military Technological Integration in Europe	Serfati	To go up on CREDIT website in summary and downloadable in full in PDF format
Discussion paper 4	Transatlantic Defence Industry Consolidation – Practice and Prospects	James	To go up on CREDIT website in summary and downloadable in full in PDF format
Discussion paper 5	Germany: the benefit of late-coming – a case study of the evolution of the defence industry, the role of military technological innovation and changes in procurement	Lock	To go up on CREDIT website in summary and downloadable in full in PDF format
Discussion paper 6	Rheinmetall: a Paradigm of Restructuring of the Defence Sector in Germany	Lock	To go up on CREDIT website in summary and downloadable in full in PDF format
Discussion paper 7	The US Dual-Use Policy in Context	Reppy	To go up on CREDIT website in summary and downloadable in full in PDF format
Working paper 1	Spain	Molas-Gallart	Downloadable from website in PDF format
Working paper 2	Italy	Perani	Downloadable from website in PDF format
Working paper 3	Netherlands: National	Smit	Summary on website;

	Military innovation System		available from author perani@istat.it
Working paper 4	France	Serfati	Summary on website; available from author claude.serfati@c3ed.uvsq.fr
Working paper 5	United States: Changes in the US RTD Innovation System	Hagelin and Reppy	Summary on website; available from authors jvr2@cornell.edu
Working paper 6	Russia	Gonchar	Summary on website; available from author EARTKG@online.ru
Working paper 7	Hungary	Kiss	Summary on website; available from author jkiss@infomaniak.ch
Working paper 8	Sweden: from Vampire to Griffin	Hagelin	Summary on website; available from author hagelin@sipri.se
Working paper 9	Building the Dutch Navy & International Shipbuilding Collaboration	Smit and van Oosterhout	Summary on website; available from author W.A.Smit@wmw.utwente.nl
Working paper 10	Evolution of defence technology networks in the UK	Gummett	Summary on website; available from author p.gummett@wfc.ac.uk
Working paper 11	Policy and production networks in the defence industry: France case study	Serfati	Summary on website; available from author claude.serfati@c3ed.uvsq.fr
Working paper 12	Defence standards and the reform of defence procurement	Molas-Gallart	Summary on website; available from author j.molas-gallart@sussex.ac.uk
Working paper 13	Civil-Military Integration in the Defence Industry Supply Chain	James	Summary on website; available from author Andrew.James@man.ac.uk
Working paper 14	France and Civil-Military Integration	Serfati	Summary on website; available from author claude.serfati@c3ed.uvsq.fr
Working paper 15	US Tapping of Foreign S&T	Hagelin	Summary on website; available from author hagelin@sipri.se
Working paper 16	Military retrenchment in Europe and countervailing trends	Lock	Summary on website; available from author Peter.Lock@t-online.de
Working paper 17	Post-merger strategies of the leading US Defence Aerospace Companies – what implications for Europe?	James	Summary on website; available from author Andrew.James@man.ac.uk

The IVA Study

5.8 There had been a strong Swedish policy interest in this study from the time of the Berlin workshop in May 1999 onwards. Prior to the Manchester workshop, a year later, the Swedish Royal Academy of Engineering (IVA) identified the CREDIT network as a possible source of input to the ongoing IVA study of research and development for industry and defence, supported by the Swedish Government. Subsequently a senior member of the IVA staff attended the Manchester workshop prior to negotiating a contract with CREDIT for work in the autumn of 2000.

5.9 The aim of the study, at a time of rapid development in military and consequently industrial affairs and research, was to learn from national cases so as to obtain an overview of civil-military integration and management of military and civil/dual use technologies. Three national studies were commissioned from CREDIT

Supporting Australia's Defence Acquisitions and Defence Technology Edge: Björn Hagelin

The UK's Defence Evaluation and Research Agency – in search of a Successful Model of Technology Transfer: Jordi Molas-Gallart, Andrew James and John Rigby

Military-Civilian Integration in France: Claude Serfati

Together with a fourth summative and integrative paper by Jordi Molas-Gallart:

Dual-Use and the Interface between Military and Civilian Technology: a Comparative Approach

5.10 These papers were presented and discussed at a seminar in Stockholm on 15 December 2000 attended by analysts and practitioners from Swedish government, academia and industry. It is understood that IVA will append the CREDIT papers to its policy submission in Spring 2001. Following this, CREDIT intends to publish the papers.

5.11 The IVA study offers a good example of the skills and capacities developed and focused through the CREDI-METDAC study being put to good use in the policy development of a member state. CREDIT is on the lookout for further similar opportunities to exploit its skills and capacities.

6. Acknowledgements and references

Adams, Gordon, 'Arms across the sea', Financial Times, 9 June 2000, p. 15.

Andersen, B., J.S. Metcalfe, and B.S.Tether. 1998. Innovation systems as instituted economic processes. Paper prepared for the Thorstein Veblen Conference on Institutional Analysis of the Economy Today, Oslo, June.

Arms Sales Monitor, 'US Ponders Defense Globalization', No. 42, Jan. 2000, p. 1.

Arnett, E. (1996). Military research and development. SIPRI Yearbook 1996. Armaments, Disarmament and International Security. Oxford, Oxford University Press**:** 381-409.

Arnett, E. (1998). Military research and development. SIPRI Yearbook 1998. Armaments, Disarmament and International Security. Oxford, Oxford University Press**:** 267-290.

Assembly of Western European Union 1999, 'Armaments cooperation in the future construction of defence in Europe'. Reply to the annual report of the Council, Document 1671.

Astakhov, Andrei. 1999. «Nekotoriye Itogi i problemi Restrukturizatsii oboronnoy Promishlennosti» [Some results and problems of defence industry restructuring and conversion], in *Finansi*, September, pp.3-6

Atkins, R and Hegmann, G (2000) "EADS considers US acquisitions", *Financial Times*, 8 June: p.14.

Barrie, D and Mackenzie, C (1998) 'Europe's big 4 skirt WEU on arms agency', *Defense News*, August 10-16: 3-20.

Barry, Charles & Sean Kay 2000, 'America needs a stronger Europe', Wall Street Journal Europe, 2 June, p. 3.

Bonn International Conversion Center (BICC) (2000) *Russia's Defense Industry at the Turn of the Century*. Brief 17 by Ksenia Gonchar. October. Baden-Baden: Nomos Verlagsgesellschaft

BICC (2001) *Conversion Survey 2001. Global Disarmament, Demilitarization and Demobilization*. Baden-Baden: Nomos Verlaggesellschaft

Breschi, Stefano and Franco Malerba (1997) Sectoral innovation systems: Technological regimes, Schumpeterian dynamics, and spatial boundaries. In *Systems of*

Innovation: Technologies, Institutions and Organizations, Charles Edquist, ed. Washington: Pinter.

Carlsson, B. and R. Stankiewicz (1995) On the nature, function and composition of technological systems. In *Technological Systems and Economic Performance*, B. Carlsson, ed. Dordrecht: Kluwer.

Center for Economic Analysis, «Russia». Russian governmental quarterly in 1992-2000. Moscow: Center for Economic Analysis of the Government of the Russian Federation

Center for Strategic and International Studies (1998) Defense Restructuring and the Future of the US Defense Industrial Base, A Report of the CSIS Senior Panel on the US Defense Industrial Base, March, Center for Strategic and International Studies: Washington DC

Chesnais, F. (1993) National Innovation Systems: France. In Richard R. Nelson (ed.) (1993).

Commission of the European Communities (1997) *Implementing European Union Strategy on Defence-Related Industries*, Communication from the Commission, COM(97) 583 final, Commission of the European Communities: Brussels.

Commission of the European Communities (1997a) *The European Aerospace Industry: Meeting the Global Challenge*, Communication from the Commission, COM(97) 466 final, Commission of the European Communities: Brussels.

Commission of the European Communities (1997b) *Implementing European Union Strategy on Defence-Related Industries*, Communication from the Commission, COM(97) 583 final, Commission of the European Communities: Brussels.

Croft, Stuart; Jolyon Howorth, Terry Terriff and Mark Webber. 2000. NATO's triple challenge. *International Affairs* 76 (3): 495 – 518.

Cuthbertson, I. (1983). Response of HMG to the questions posed in Working Paper 2 (Revision 2) of the UN Study on Military Research and Development. Arms Control and Disarmament Unit, Foreign and Commonwealth Office. London.

De Vestel, Pierre (1995) *Defence markets and Industries in Europe: Time for Political Decisions*. Paris: Chaillot Paper 21 of The Institute for Security Studies, Western European Union

Defence Press Service (1999) 'DOD Concerned About Defense Industrial Base', 8 November.

Defence Systems Daily (1999) 'Pentagon sees US-European defence company mergers as inevitable', 8 July.

Defence Systems Daily (2000) "Boeing, BAE consortium bid for stake in Korea Aerospace", *Defence Systems Daily*, 16 May: http://defence-data.com

Detlev, Petry (1999) Erfahrungen des BWB mit Rüstunskooperation, *Europäische Wehrkunde* No. 12, pp.32-40.

DoD Briefing 2000 on US/UK Defence Cooperation, 8 February.

Dub, M (1998) "'Bottoming out' after the slump", *Financial Times Survey: Aerospace*, 3 September: p.12.

Edquist, Charles, ed. (1997) *Systems of Innovation: Technologies, Institutions and Organizations*. Washington: Pinter.

Elzen, B., B. Enserink, and W.A. Smit (1996) Socio-technical networks: How a technology studies approach may help to solve problems related to technical change, *Social Studies of Science* 26, 1: 95-141.

Eriksson, Arita & Jan Hallenberg (eds.) (2000) 'The Changing European Defence Industry Sector', the National Defence College, Stockholm.

Flamm, Kenneth (2000) U.S. Defense Industry in the Post-Cold War: Economic Pressures and Security Dilemmas. In *The Place of the Defense Industry in National Systems of Innovation*, edited by Judith Reppy. Peace Studies Occasional Paper, no. 24. Ithaca, NY: Peace Studies Program, Cornell University.

Freeman, Christopher (1987) *Technology, Policy, and Economic Performance: Lessons from Japan*. New York: Pinter.

Gnesotto, N (2000) "Preface" to Schmitt, B *From Cooperation to Integration: defence and Aerospace Industries in Europe*, Chaillot Paper 40, Western European Union Institute for Security Studies: Paris.

Grant, RP (1997) "Transatlantic armament relations under strain", *Survival*, 39(1): 111-37.

Gummett, P and James, A (1998) *Working Paper no. 3, United Kingdom* METDAC Project.

Gummett, P and Stein, J-A (eds) (1997) *European Defence Technology in Transition*, Harwood Academic Publishers: Amsterdam.

Hagelin, B and Reppy, J (1998) *Working Paper no. 6 Changes in the United States RTD Innovative System 1987-1997,* METDAC Project.

Hagelin, B (1999) US tapping of foreign science and technology for military purposes. Working paper, METDAC Project, the Aspen Institute, Berlin, 27-28 May.

Håkansson, H., ed. 1987. *Industrial Technological Development*. A *Network Approach*. London: Croom Helm.

Håkansson, H., ed. 1987. *Industrial Technological Development*. *A Network Approach*. London: Croom Helm.

Heisbourg, François (2000) 'European defence takes a leap forward', *NATO Review*, Spring/Summer: 8-11.

International Institute for Strategic Studies (IISS) (1998), *The Military Balance 1998/99* (Oxford: Oxford University Press).

International Institute for Strategic Studies (IISS) (1999), *Strategic Survey 1998/99* (Oxford: Oxford University Press).

James, AD (1998) *Post-Merger Strategies of the Leading US Defence Aerospace Companies*, FOA User Report, FOA Defence Research Establishment: Stockholm, 1998.

James, AD (2000) The Place of the UK Defense Industry in its National Innovation System: Co-evolution of National, Sectoral and Technological Systems. In *The Place of the Defense Industry in National Systems of Innovation*, edited by Judith Reppy. Peace Studies Occasional Paper, no. 24. Ithaca, NY: Peace Studies Program, Cornell University.

James, AD (2000a) *Strategies of Mid-Sized US Defence Electronics Companies*, FOA User Report, FOA: Stockholm

James, AD (2000b) The prospects for a transatlantic defence industry, in Schmitt (ed.) Transatlantic Armaments Cooperation *Chaillot Paper, Western European Union Institute for Security Studies: Paris.*

Kabanov, Alexandr. 1999. «Innovatsionnaya deyatelnost v otraslyakh oboronnoy promishlennosti v usloviyakh ikh restrukturizatsii» [Innovation activity in the defense industry under the restructuring conditions], in *Promishlennost Rossii*, May, pp.4-15, **www.mobile.ru**

Kapstein, EB (1994) "America's arms-trade monopoly" *Foreign Affairs* 73(3): 13-18.

Lewis, JAC and Starr, B (1997) "A landmark year for crucial consolidation", *Jane's*

Defence Weekly, 17 December: pp.20-22.

Molas-Gallart, J (1998), *Working Paper no. 1, Spain*, METDAC Project.

Molas-Gallart, J (1992) *Military Production and Innovation in Spain* Chur, Harwood Academic Publishers.

Morrocco, JD (2000) EADS, Northrop Grumman broaden cooperative links, *Aviation Week & Space Technology*, June 12: 35-6.

Nelson, Richard R., ed. (1993) *National Innovation Systems*. New York: Oxford University Press.

Nelson, RR and Rosenberg, N (1993) Technical innovation and national systems in Nelson (ed.) (1993).

Organisation for Economic Co-operation and Development (1994). *The measurement of scientific and technological activities. Frascati Manual 1993* Paris, OECD.

Pfaff, William (1999) Transatlantic Mergers of Arms Industries Aren't On, *International Herald Tribune*, 6 August, p. 6

President of Russian Federation (1999) *On the measures to increase efficiency of military-technical collaboration.* Decree No.1164 from 6 September. Available at www.vpk.ru

Reppy, Judith, ed. (2000) *The Place of the Defence Industry in National Systems of Innovation.* Occasional Paper 25. Ithaca: Cornell University.

Samuels, Richard (1994) *"Rich Nation Strong Army": National Security and the Technological Transformation of Japan*. Ithaca, NY: Cornell University Press.

Saviotti, Paolo (1997) Innovation Systems and Evolutionary Theories. In *Systems of Innovation: Technologies, Institutions and Organizations*, Charles Edquist, ed. Washington: Pinter, 180-99.

Schmitt, Burkard (2000) *From Cooperation to Integration: Defence and Aerospace Industries in Europe*, Chaillot Paper 40, Institute for Security Studies of Western European union: Paris.

Serfati, C (1998) *Working Paper no. 4, France*, METDAC Project.

Serfati, C., C. Carpentier, et al. (1997) R&D militaire, grands programmes et capacités technologiques nationales: Caractérisation et Indicateurs, Paris: Observatoire des Sciences et des Techniques.

Sitnov, A., Gaponov, A., Tuzhikov, V. (1997) *Voyennaya economika i tekhnicheskaya osnaschennost' vooruzhennikh sil Rossiyskoy Federatsii* [Defence economics and technical supply of the Russian Federation armed forces]. Teaching course at the Academy of the Defence industries. Moscow: Academy of the Defence Industries.
Sitnov, A (1999) Interview to the magazine *Export vooruzheniy*, November-December, pp.20-22. www.cast.ru
Sparaco, Pierre (2000) France disputes Europe's defense gap. *Aviation Week & Space Technology* 152 (6 March): 24, 26.
Stewart, W. (1989). International Comparisons of Defence Research and Development. A report for British Aerospace.
Stockholm International Peace Research Institute (SIPRI) (1999) *SIPRI Yearbook 1999: Armaments, Disarmament and International Security*. New York: Oxford University Press.
Stringil, A. (2000). «Oboronniy complex na podyeme» [Defense complex is growing], in *Promishlennost Rossii*, January 2000, pp.34-36. www.mobile.ru
Taylor, T (1999) "Transatlanticism versus regional consolidation", in David G. Haglund and S. Neil MacFarlane (eds.) *Security, Strategy and the Global Economics of Defence Production*, McGill-Queen's University Press, Montreal & Kingston.
TS-VPK, information agency, www.vpk.ru
Urinson, Jakov. 1998. Interview to the magazine *Export voorizheniy*, on 5 August 1998, *Export vooruzheniy*, No.4, www.cast.ru
Van Scherpenberg, J (1997) Transatlantic competition and European defence industries: a new look at the trade-defence linkage, *International Affairs* 73,1: 99-122.
Velocci, AL (1999) Pentagon still backs slimmer supply chain, *Aviation Week & Space Technology*, April 12: p.67.
Volkman, Alfred G. 1998, (Assistant Deputy Under Secretary of Defense), European Defense Industry Perspectives. The American viewpoint (http://www.acq.osd.mil/ip/speeches/volkman_europe.htlm).

Voyennaya doktrina Rossiyskoy Federatsii [Military doctrine of the Russian Federation], 2000, in *Nezavisimaya gazeta*, 22 April.

Walker, W (1993) National Innovation Systems: Britain. In Richard R. Nelson (ed.) (1993).

7. Annexes: publications, conferences and outputs

Publications which constitute part of the planned output of the METDAC network are listed in section 5 of this report. This section comprises:

(a) the slides presented at the final Brussels workshop in October 2000, and which constitute an alternative, graphical, summary of the findings and results of this thematic network (p.122);

(b) the individual dissemination efforts of members of the network – through publications and conference and workshop participation – which helped to ensure a lively exchange of ideas with academics and practitioners during the course of the METDAC study (p.169).

Annex (a):

Slides from the CREDIT-METDAC Brussels Workshop, 19 October 2000

United States, Divided Europe? Defence Technology Options for the Future.

Philip Gummett

The CREDIT Group

METDAC Project

****

Workshop Objectives:

- To present the results of the METDAC study
- To engage European industry and policy bodies in debate as to the consequent strategic choices for European defence and industrial capacity
- To consider future needs for research and analysis on European defence technological and industrial policy

Philip Gummett – slide 2

DYNAMICS OF CHANGE

END OF COLD WAR

- BUDGETARY/“LEGITIMACY” CUTS
- SECURITY POLICY IMPLICATIONS
- CIVIL-MILITARY SHIFT IN HIGH-TECH INVESTMENT

REACTIONS

- CORPORATE CONSOLIDATION
- NEW INSTITUTIONAL ACTORS
  - PRIVATISATION
  - INSTITUTIONAL SHAREHOLDERS

Philip Gummett – slide 3

ANALYTICAL APPROACH

NATIONAL SYSTEMS OF INNOVATION

Focuses on:

- INSTITUTIONAL ACTORS:
  - Who?
  - How changing?
  - What difference do new actors make?

- RELATIONS BETWEEN ACTORS:
  - Differences between States in how actors interact
  - Policy Networks and Production Networks: possibility of lack of synchronisation

- THE SYSTEM BOUNDARY:
  HOW IS IT CHANGING?
  - International corporate developments
  - Intergovernmental developments
  - Globalisation of technology providers
  - What is happening to the US-Europe boundary?

Andrew James - slide 1

Globalisation & the European defence industry

Andrew James
University of Manchester, UK
Andrew.James@man.ac.uk

Presentation to CREDIT-METDAC network workshop "United States, Divided Europe? Defence technology options for the future"
Brussels, 19 October 2000

Andrew James - slide 2

The Cold War defence industry

- Autonomous national defence industrial capacity seen as key to national security
- Home government represented principal customer, regulator of export activities - & owner
- Top management team & main facilities of defence companies rooted in home country
- Trans-national collaboration government-led & based on principle of juste retour

Andrew James, University of Manchester, UK

Andrew James - slide 3

Defence industry globalisation – what's new?

- Whilst Europe has long depended upon collaborative programmes – and the US…
- … trans-national relationships are growing & deepening:
- Collaborative ventures between companies
  - JSF
- Company ownership
  - EADS; BAE Systems; Thomson-CSF; United Defense-Bofors
- Growing use of commercial & dual-use technologies

Andrew James - slide 4

Globalisation of technology

Drivers

- Civil & dual-use technologies increasingly important as a result of:
  - Diverging civil-defence technological trajectories
  - Procurement reforms encouraging COTS
  - New military doctrines emphasising IT, sensors & C3I

Policy implications

- Captive defence industrial base being replaced by commercial multi-nationals
- Ensuring attention to defence needs
- Security of supply & obsolescence issues
- Traditional export control regimes face challenges
- Global proliferation of militarily sensitive technologies & “levelling-up”

Andrew James, University of Manchester, UK

Andrew James - slide 5

Globalisation of ownership

Drivers

- Shareholder expectations
- Market access
- Synergies in R&D, production & marketing?

Policy implications

- Change in national government-industry relationship
- Company strategy rather than traditional national security concerns becoming key industry driver?
- Loss of government influence over weapons design?
- Export & technology transfer regimes

Andrew James - slide 6

Broadening & deepening of collaborative relationships

Drivers

- Access overseas markets
- Acquire technology
- Share development & production costs
- Changing relationship between prime contractors & global dual-use suppliers

Policy implications

- Export controls & technology transfer regulations present barriers to operation
- Complex inter-relationships raise competition concerns
- Evaluating "local content" in teamed bids becoming increasingly difficult

Andrew James, University of Manchester, UK

Andrew James - slide 7

Policy responses

- Letter of Intent process
  - FR, GER, IT, SP, SWE, UK
  - Expansion beyond the Six?
  - Relationship between LoI-US initiatives?
- US-UK Declaration of Principles
  - Aims to improve cooperation on: common weapons; security of supply; export procedures; research; rules on cross-border industrial ventures & M&A
- US Defense Trade Security Initiative
  - New ITAR licensing exemptions for firms meeting specified US security criteria & adopting security controls comparable to US
  - Political will?! UK & Australia first – how far & fast for others?

Andrew James - slide 8

Trans-national defence industry futures

EADS
ESDI
LOI
European procurement agency

European?

BAE Systems
United Defense-Bofors
Defense Trade Security Initiative

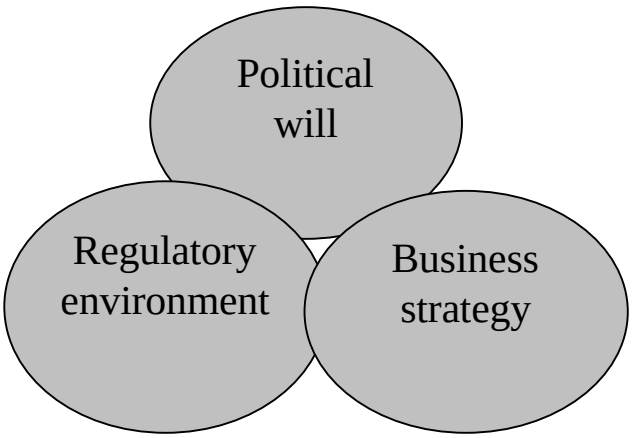
Transatlantic?

BAE Systems
Thomson-CSF
Role of commercial technologies

Global?

Andrew James - slide 9

3 forces will shape trans-national restructuring



Andrew James, University of Manchester, UK

Andrew James - slide 10

Political will?

US

- Mixed signals?
- "Globalization" initiative a major development…
- … but DoD attention has shifted to health of US defence industry
- Mixed messages from State Dept. & Congress
- Competition or protection of US defence industry?

Europe

- "Fortress Europe" or transatlantic markets?
- Europe does not speak with a single voice
- Ambivalence over relationship with US
- Consolidation not competition has dominated agenda

Andrew James, University of Manchester, UK

Andrew James - slide 11

Regulatory environment?

- US reforms show recognition from DoD of the need for change...
- ... but major barriers remain to technology transfer, transatlantic trade & foreign ownership
- UK-US "Declaration of Principles" provides a bi-lateral model for deeper transatlantic relationships...
- ... but how easily can it be extended to other countries?

Andrew James, University of Manchester, UK

Andrew James - slide 12

Business strategy?

Opportunities

- Market & technology access
- Portfolio shaping by US companies
- Lower tier consolidation
- New US bid strategies for European competitions
- DoD efforts to stimulate US competition?

Challenges

- Most leading companies face post-merger integration issues
- US regulatory barriers hinder foreign ownership
- ... & technology transfer will remain difficult
- Wall Street sceptical about European deals
- Potential partners limited to some companies & countries?

Andrew James - slide 13

Summary

- European defence industry increasingly global – or at least transatlantic - in scope
- Technological pressures
- Ownership changes
- Broadening & deepening of collaborative relationships
- A new policy, regulatory & business strategy agenda is emerging

Andrew James, University of Manchester, UK

Jordi Molas - slide 1

What is changing and why

Civil-military integration and systems integration

Jordi Molas-Gallart

CREDIT-METDAC Workshop

Brussels, 19 October 2000

SPRU Science and Technology Policy Research

Jordi Molas - slide 2

Defence procurement reform: the need

Decline and stagnation of procurement budgets

Continued growing costs

Changing relationships between civilian and defence technologies

Jordi Molas - slide 3

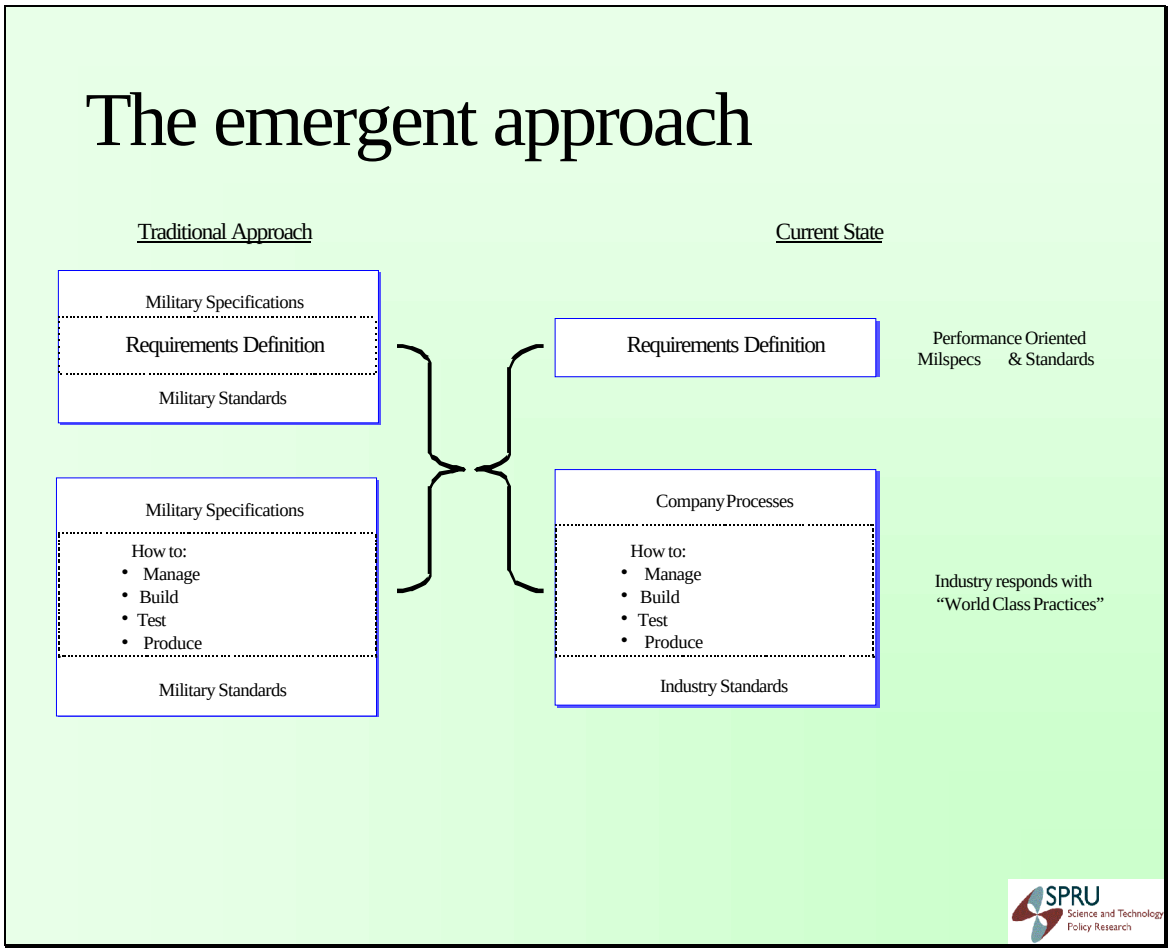
Defence procurement reform: the objectives

The pursuit of cost savings (while increasing performance)...

…by using capabilities available elsewhere

SPRU Science and Technology Policy Research

Jordi Molas - slide 4



Jordi Molas - slide 5

Organisational implications

Industrial suppliers take on increased responsibilities

Customer loses "control"

- **From quality control to quality assurance**
- **Nature of testing and validation changes**

Suppliers are "brought up a layer":

- formal participation in requirements definition
- strengthening customer/supplier relationship

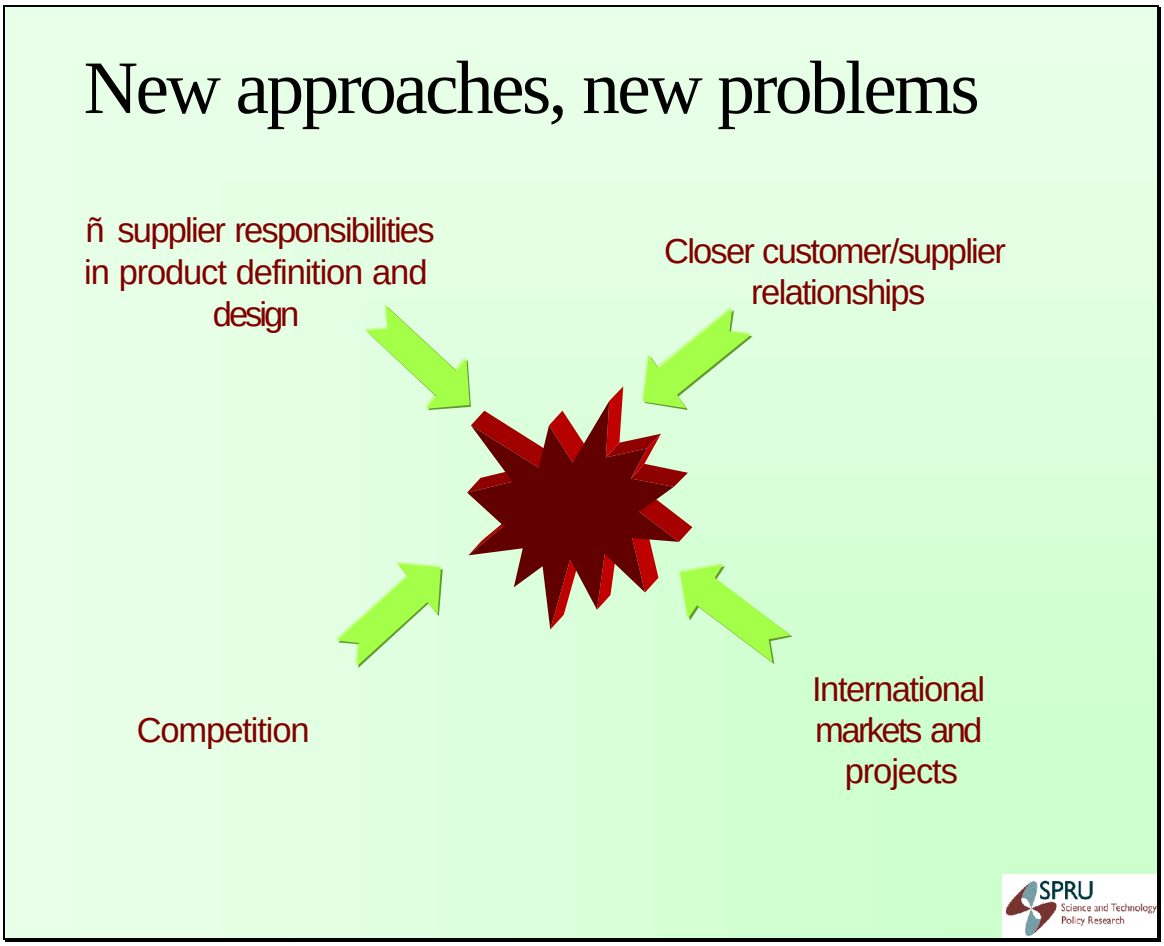
SPRU Science and Technology Policy Research

Jordi Molas - slide 6

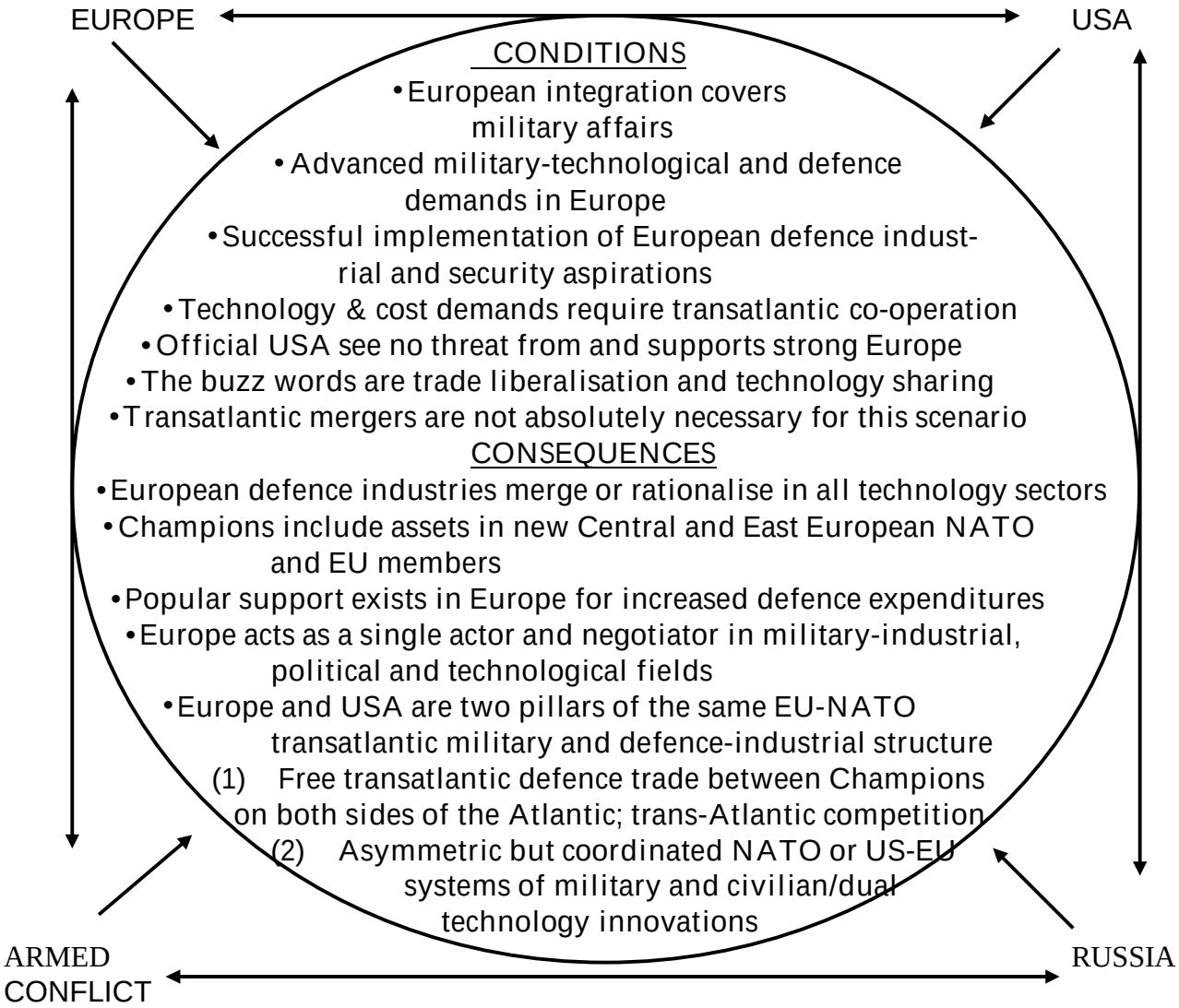
Implications for international markets

- **The customer/supplier relationship still takes place at the national level**
- **As the customer/supplier relationship becomes closer, the national character of the market may strengthen**

Jordi Molas - slide 7

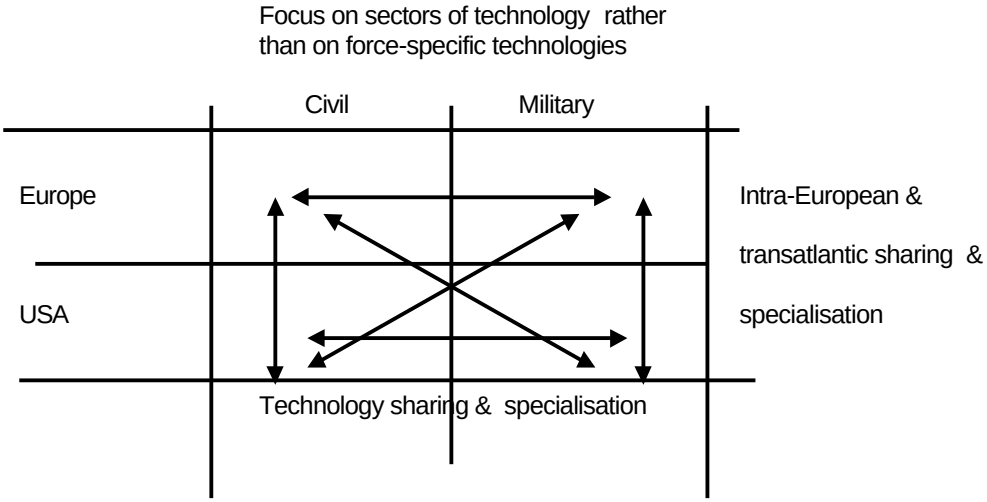


Björn Hagelin – slide 1



Björn Hagelin – slide 2

Transatlantic Harmony: possible ways of civil and military technology sharing and specialisation



Peter Lock, Hamburg – slide 1

Trans-Atlantic Discord: Divide and Rule? The Case for a European Security Identity

This emerging debate must be properly put into perspective. Even in times of the tense bi-polar confrontation when American and West European security concerns appeared to coincide at least within the delineated geographical area of NATO's joint defence concerns, European military postures often showed either signs of relative retrenchment or an orientation towards ends outside the mandate of NATO. Military engagements out-of-area, tasks related to internal conflicts and confrontational postures within the alliance meant that at various times the disparity between the political rhetoric stressing the vital importance of the joint defence and national military priorities in the face of the assumed imminent Soviet menace was profound, but largely ignored out of political convenience. Distinct European and national interests prevailed over the dominant defence rhetoric within the alliance.

Against this background **the evolution of a security architecture in Europe is not likely to move towards a truly cohesive design**. To the contrary, it is to be expected, that a blend of contradictory policies will accompany this evolution. There is little reason to believe that a united Europe will either shortly enter into a virtual military competition with the United States or turn into a obedient junior partner of a strategic design of American making.

It is more likely that the specific economic and socio-political challenges Europe has to cope with, namely how to integrate an economically decaying, nuclear-armed Russia, will eventually translate into a dominant security doctrine marked by an ideosyncratic amalgamation of military prudence and bold co-operative policies. The collective memory of war among continental European nations empowers this European emancipation from the United States which needs not be antagonistic.

A future scenario would not be complete if the EU's "new near abroad" of central and eastern Europe would not be taken into account as an important factor shaping both the evolution of the emerging European defence doctrine and the military-industrial landscape likely to mirror a maturing security doctrine in Europe. The attitudes towards Russia presently swing between sustaining the old threat perceptions and counting on the perspective that the weak Russian economy can not support the survival of a significant defence-industrial sector.

Entrenched diseconomies: The military-industrial sectors have not yet shed the structural heritage of the Cold War. This explains the inertia on both sides with respect to exploiting potential synergies. However, it is noteworthy that several joint projects based on Russian military high-tech inside the VPK targeting civilian markets have prospered. Space launches are one example. This points to institutional factors explaining the inertia. More generally, life-cycles of major military platforms approach fifty years and pose a barrier to efficiently assimilate the ever more rapidly advancing technology as well as the new electronic environments. This compares with much shorter average life-cycles of machinery and other capital goods prevailing in the industrial sectors of the civilian economy, imposed by the market and the exacting speed of technological innovation in civilian sectors. The need of the military innovation system to reinvent itself entails a chance for Europe to succeed in finding its own customised path.

Peter Lock, Hamburg – slide 2

The future scenario in Europe will be determined by a rapidly changing relationship between the new dynamics of the military-industrial network and the political discourse trying to find a new balance between the military and political dimensions of European security. In parallel the development will be marked by a continuous increase of military equipment whose core technologies originate from the civilian sector. These technologies are controlled by globally operating corporations usually beyond the reach of immediate government influence.

Europe plus Russia with less United States? As a precondition for this scenario to emerge Russia would have to abdicate its perceived role as a military superpower with global reach. Russia lacks the indispensable economic resources and by attempting such a course in isolation would also rapidly lose the necessary technological capability which can only be maintained if embedded in thriving civilian high-tech industries competing in international markets. At the same time Europe is without alternative for Russian (energy) exports**.**

The European devolution within NATO: At the level of military technology Europe is for all practical purposes decoupled from the United States, in spite of 50 years of co-operation in NATO. European aspirations to match the military power of the United States have no foundations in the continent's long-term interests. The tacit decoupling from the United States will remain a persistent trend because the American aim for global supremacy, total preemptive intelligence and an absolute intervention capability is not shared in Europe. These systems are of lower priority or even inappropriate in the European context. Thus, a secular trend towards a distinct European level of military technology and operational reach will help to support the eventual consolidation of a common security doctrine in Europe. In the course of this European devolution within NATO it would become easier for Europe to fully exploit commercial technologies for her security architecture and strictly limit the number of customised systems for military missions.

Transatlantic dissent and co-operation: For many years to come Europe will remain in the inconvenient position of having to cope with American supremacy and unilateralism. Technologies of supremacy versus technologies of sovereignty might serve as a rough characterisation of the distinct benchmarks likely to become more manifest, once the emerging European identity is translated into a security doctrine. Whatever the speed of a differentiation of military procurement on both sides of the Atlantic will be, it will be accompanied by constant transatlantic discord and agitated compromises imposed by mutual strategic interests. Over the next years the most divisive issue will be Russia's role.

Wim Smit, Twente – slide 1

Sub-scenario 3A:

discord through competition

- Integrated European defence industry
- integrated European military force
- European procurement agency
- Europe aims for independent military role
- Russia not included
- Emulating US military technology
- Aggressive export competition with US

Attractive to European defence industry:

- Assured ‘market’
- Governmental support

Wim Smit, Twente – slide 2

Sub-scenario 3B:

discord through a different route

- No global military power ambitions
- Common European security policy
- Russia included
- Contributing to UN peacekeeping forces
- Military technology appropriate for UN missions:
  Sufficiency rather than *supremacy*
- Reduced European defence industry
- Either
  limited number of (national) defence companies or
  limited number of trans-national defence companies

Giulio Perani – slide 1

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

For innovative capacities of individual countries and of Europe

Giulio Perani - CeSPI, Rome

Giulio Perani – slide 2

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

F How to measure "innovative capacities" in defence?

1) statistics

- input indicators (R&D spending and personnel, procurement spending, etc.)
- output indicators (scientific publications, patents, high-tech production and export, etc.)

2) subjective evaluation (experts)

For innovative capacities of individual countries and of Europe, Giulio Perani, CeSPI

Giulio Perani – slide 3

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

Are statistics useful to compare the technological performance in the field of defence at national level?

PROs:

- to have an "objective" measurement;
- to have comparable data;
- to perform analysis and benchmarking activities.

CONs:

- definitions are questionable;
- data are not (or only partially) available;
- existing indicators are often misleading.

For innovative capacities of individual countries and of Europe, Giulio Perani, CeSPI

Giulio Perani – slide 4

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

Data currently available for measuring the innovation capacities in defence:

à OECD *Main Science and Technology Indicators (Defence R&D)*

à NATO *(Data on military and procurement spending)*

à SIPRI *(Data on military turnover of the largest companies, data on military exports)*

à National sources *(Military spending, Procurement spending, defence R&D, etc.)*

For innovative capacities of individual countries and of Europe, Giulio Perani , CeSPI

Giulio Perani – slide 5

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

Are available data on defence sufficient?

1) the need for supplementary indicators:

- patents;
- high-tech turnover and exports;
- stock prices.

2) the bias due to other factors:

- the development of dual-use activities;
- the extent of the globalisation of R&D.

For innovative capacities of individual countries and of Europe, Giulio Perani, CeSPI

Giulio Perani – slide 6

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

An example: using indicators on R&D and military spending

Four indicators considered:

1) *defence related*
- share of the GDP devoted to military spending (source NATO, year 1999)
- share of the Government spending for R&D devoted to defence (source OCDE, year 1998).

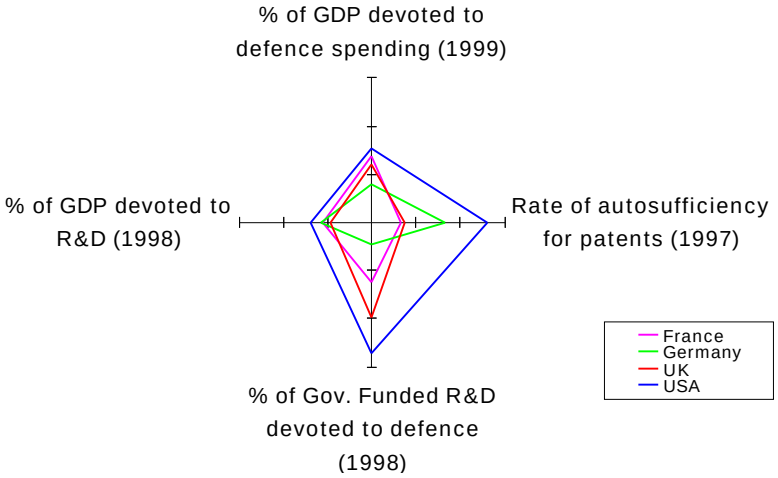
2) *S&T indicators*
- share of the GDP devoted to R&D (source OECD, year 1998)
- rate of autosufficiency for patents (source OCDE, year 1997).

For innovative capacities of individual countries and of Europe, Giulio Perani, CeSPI

Giulio Perani - slide 7

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

R&D Indicators and Military Spending (1)

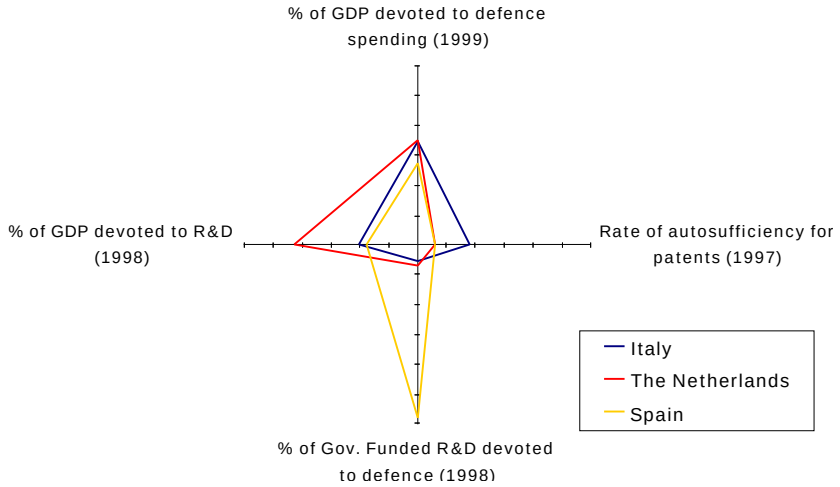


For innovative capacities of individual countries and of Europe, Giulio Perani , CeSPI

Giulio Perani - slide 8

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

R&D Indicators and Military Spending (2)



For innovative capacities of individual countries and of Europe, Giulio Perani , CeSPI

Giulio Perani – slide 9

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

The need for a "systemic" view

- measuring *and* mapping the defence technological activities;

- defence and the National Systems of Innovation:

"...the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies.". (Freeman, 1987)

For innovative capacities of individual countries and of Europe, Giulio Perani , CeSPI

Giulio Perani - slide 10

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

The Defence NSIs:

- Why they are "systems"?

- Why they are "national"?

- How they produce innovation?

For innovative capacities of individual countries and of Europe, Giulio Perani , CeSPI

Giulio Perani - slide 11

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

Some basic information about four key DNSIs

UK. - *Main R&D Inst.s: DERA establishments.*
- Defence R&D mainly performed by the industry (30% by DERA). - - R&D pcp 383$; funded by Gov. 30.8%; Mil/Gov 39.5%.

France. - *Main R&D Inst.s: DGA, CEA, ONERA, CNES, CNET.*
- Defence R&D mainly performed by the State.
- R&D pcp 476$; funded by Gov. 40.2%; Mil/Gov 24.8%.

Germany. - *Main R&D Inst.s: MoD labs, Nat. Res. Centres, Fraunhofer, Max Planck.*
- Defence R&D mainly performed by the industry.
- R&D pcp 510$; funded by Gov. 35.6%; Mil/Gov 8.7%.

USA. - *Main R&D Inst.s: DoD labs, Universities.*
- Defence R&D mainly performed by the industry.
- R&D pcp 794$; funded by Gov. 30.6%; Mil/Gov 52.8%.

For innovative capacities of individual countries and of Europe, Giulio Perani, CeSPI

Giulio Perani - slide 12

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

Four models for the future European
Defence System of Innovation

UK: *orienting the innovation carried out by the defence industry.*

France: *the strong link between the State (DGA) and the defence companies (public and private) .*

Germany: *the exploitation of a strong civilian technological base for defence needs.*

USA: *the move towards an open transferability of knowledge between the defence and the commercial sectors.*

For innovative capacities of individual countries and of Europe, Giulio Perani , CeSPI

Giulio Perani - slide 13

***CREDIT - METDAC* WORKSHOP - Brussels, 19 October, 2000**

Factors influencing the future European Defence System of Innovation

- The role of the institutional actors in shaping the CFSP, as well as the defence and procurement policy and the research policy at European level.

- The behaviour of the old and new actors which will play a role in the new context (relations among them).

- The boundaries of the new innovation system (relations with other subjects).

- The regional/national asymmetries within the new innovation system.

- The integration of national cultures in enterprises and laboratories.

- The overall effort by the EU in promoting R&D and innovation.

For innovative capacities of individual countries and of Europe, Giulio Perani, CeSPI

Judit Kiss – slide 1

East Central European policy & possible responses

1.) Major changes in East Central Europe during the 1990s

1.a.) political reorientation – goal : integration into NATO & Western institutional systems; new security & defence doctrines are in the making

1.b.) changes in the defence production network
- collapse after the end of the Cold War
- internal reorganizations; privatisation, remaining state stakes (goal : maintain R&D & national flagships)
- relative consolidation by the mid1990s – two models of defence industry restructuring : Hungary & Slovakia (outward-oriented, industry-led restructuring vs. inward-oriented, state-led restructuring)

2.) Present situation

2.a.) limited defense budgets, although increasing for the new NATO members, & for military-related R&D & procurement

2.b.) new East-West cooperation (subcontracting, joint R&D projects, joint upgrading projects)

2.c.) procurement : both national & international, the latter is connected to large-scale offset deals

3.) Future prospects for the East Central European defence industry

3.a.) increasing internationalisation, both through government- & industry- initiated collaboration

3.b.) increasing civil-military integration

3.c.) the future will be principally determined by East Central Europe's new security role : whether it will be a bridge or a buffer vis-à-vis Russia

Judit Kiss
8 rue des Pâquis, CH-1201, Geneva, Switzerland
Tel: 41 22 731 0 731, Fax: 41 22 793 0038, e-mail: jkiss@ infomaniak.ch

Claude Serfati – slide 1

United States, Divided Europe? Defence technology options for the future

What do we need to know? – future research and analysis

NEW RELATIONS BETWEEN ECONOMY AND GEOPOLITICS :

ECONOMY : INTER-NATIONALISATION
GEOPOLITICS : COLD-WAR
"ARMS RACE" AND NUCLEAR DETERRENCE

□

ECONOMY : GLOBALISATION
GEOPOLITICS : ONE SUPERPOWER
NEW SECURITY CHALLENGES

□

WHAT IMPLICATIONS FOR THE CONFIGURATION OF DEFENCE INDUSTRIES ?

Claude Serfati –slide 2

WEAPON SYSTEMS INTEGRATION AND TRANSATLANTIC RELATIONSHIPS:

□

WHAT CONSEQUENCES FOR :

- THE EUROPEAN DEFENCE TECHNOLOGICAL AND INDUSTRIAL BASE ?

- CIVILIAN-MILITARY TECHNOLOGY RELATIONS ?

Claude Serfati – slide 3

CORPORATE GOVERNANCE : IMPLICATIONS OF THE SHAREHOLDER-DRIVEN MODEL

□

- FOR EUROPEAN DEFENCE COMPANIES ?

- ON RELATIONS BETWEEN COMPANIES, CUSTOMERS AND OTHER 'STAKEHOLDERS' ?

Annex (b):

Individual dissemination activities of CREDIT-METDAC partners during the network's life

Ksenia Gonchar

Publications:

Gonchar, Ksenia. 2000. *Russian Defense industry at the turn of the Century*. BICC Brief 17. Baden-Baden, Germany: Nomos Verlagsgesellschaft

Gonchar, Ksenia. 2000. "Adjusting through Transformation and Reform - Russia's demobilization and Reintegration Balance Sheet". In Pauwels, Natalie (ed). *War Force to Work Force*. Baden-Baden: Nomos Verlagsgesellschaft, pp. 169-198

Gonchar, Ksenia and Olimov, Mizafarr. 2000. "Consolidating peace in Tajikistan - Reconciliation, Reinsertion and Reintegration". In Pauwels, Natalie (ed). *War Force to Work Force*. Baden-Baden: Nomos Verlagsgesellschaft, pp. 335-346

Gonchar, Ksenia and Opitz, Petra. 2000. "Regional Conversion in the Russian Case". In *International Regional Science Review*, January, pp.103-119

Gonchar, Ksenia and Maya Shukhgalter. 2000. "Defense Expenditures and the Peace Dividend in Russia". In Broemmelhoerster, Yoen (ed). Demistifying the Peace Dividend. Baden-Baden, Germany: Nomos Verlagsgesellschaft

and in addition Dr Gonchar authored all sections on Russia in the BICC annual yearbook: Conversion Survey, Global Disarmament, Demilitarization and Demobilization.

International conferences attended

1. TACIS-funded seminar, Nizhniy Novgorod, Russia, 25-28 January 1999. Delivering of a four days training seminar "Lessons of industry restructring in Russia and Eastern Germany (co-authored with Thilo Roetger).

2. NATO ARW on the reform of government scientific laboratories, Manchester, June 1999. Presentation of the paper "Russian R&D between the state and the market".

3. "The Problems and Perspectives of science and technology development in scientific cities. Russian and international experience", held in Moscow and Obninsk on 14-17 June 1999

4. OSCE seminar, Minsk (Belarus), 28-30 October 1999. Presentation "Russian experience of defense industry's reforms"

5. UN-BICC seminar "Smart sanctions, the next step: arms embargoes and travel sanctions". November 21-23, Bad Godesberg, Germany

6. BICC-IPCOS International Conference "Soldiers in Business: Military as An Economic Actor", Jakarta, October 17-19, 2000. Presentation of the paper "Russian army in business".

Björn Hagelin

General

Dr. Hagelin was on sabbatical at Middlesex University, London, UK, until August 1998.

Publications and papers

Saab, 'British Aerospace and the JAS 39 Gripen Aircraft Joint Venture'. *European Security*, Vol.7, No.4, 1998.

'Sverige i en multinationell försvarsindustri: fördel för materiel anpassning?' Research paper, the Swedish Institute for International Affairs, Stockholm, 11-12 March 1999

'Swedish for how long? The Nation's Defence Industry in an International Context'. In Eriksson, Arita & Jan Hallenberg (eds.*), The Changing European Defence Industry Sector*, the National Defence College, Stockholm 2000.

'Sveriges materielutveckling i framtiden: Begränsningar och möjligheter. En robleminventering'. April 2000. Background paper to Sweden's National Audit Agency (RRV) on limitations and possibilities of Sweden's future military acquisitions as a result of increasing international cooperation

' Supporting Australia's defence acquisitions and defence technology edge'. background paper for the Royal Swedish Academy of Engineering Sciences (IVA) defence industry study, Stockholm, 15 September 2000.

Conferences and workshops

Management Committee meeting and European Defence Industry working group meeting, COST Action A-10 (Defence Restructuring and Conversion), Paris, 12-13 November 1998.

'Security-political consequences from the internationalisation of society and economy', international conference at the Swedish Institute for International Affairs (UI), Stockholm, 11-12 March 1999.

'Arms trade and the transnationalization of the defense industry', international conference organised by the Council of Foreign Relations (USA) in London, UK, 9-11 May 1999.

'International arms transfers', international conference organised by the University of Surrey and Middlesex University, London, 11-12 June 1999.

'The changing European defence industry sector', international conference at the National Defence College, Stockholm, 11-12 November 1999.

Management Committee meeting and European Defence Industry working group meeting, COST Action A-10 (Defence Restructuring and Conversion), Glasgow, 17-19 November 1999.

'A Multi-perspective on Economy and Security', international conference at the Swedish Institute for International Affairs (UI), Stockholm, 26 May 2000.

Andrew James

Academic papers, chapters & reports

1998

Post-Merger Strategies of the Leading US Defence Aerospace Companies, FIND Programme User Report, FOA Defence Research Establishment: Stockholm. ISSN 1104-9154.

"Defence" in Cunningham, P (ed.) *Handbook of UK Science & Technology Policy*, Cartermill (with Gummett, P).

Transfer and Civil Use of Defence-Related Technologies and Diversification of Defence-Related SMEs, Final Report to the European Commission, July, Policy Research in Engineering, Science and Technology, University of Manchester: Manchester, UK, (133pp) (with Cameron, H and Gummett, P).

2000

"The place of the UK defense industry in its national innovation system: co-evolution of national, sectoral and technological systems", in Reppy, J (ed.) *The Place of the Defense Industry in National Systems of Innovation*, Cornell University Peace Studies Program Occasional Paper 25, pp.99-128, Cornell University: Ithaca, NY. ISSN 1075-4857.

Medium Sized Defence Electronics Companies and US Defence Industry Restructuring, FIND Programme User Report, FOA Defence Research Establishment: Stockholm.

"Post-merger strategies of the leading US defence aerospace companies: what lessons for Europe?" in Eriksson, A and Hallenberg, J (eds.) *The Changing European Defence Industry – Consequences for Sweden*, Forsvarshogskolans Acta B12, Strategiska Institutionen: Stockholm. ISBN 91-87136-36-8.

Forthcoming

"Post-merger management in the defence industry: learning from theory and practice", *International Journal of Aerospace Management*.

Globalisation and its Implications for Defence Industries, FIND Programme User Report, FOA Defence Research Establishment: Stockholm.

"The prospects for a transatlantic defence industry" in Schmitt, B (ed). Transatlantic Armaments Cooperation, Chaillot Paper 42, Institute for Security Studies Western European Union: Paris.

Conference and Seminar Papers

1998

"The place of the British defense industry in its National System of Innovation: Co-evolution of national, sectoral and technological systems", Invited speaker at the Workshop on *The Place of the Defense Industry in National Systems of Innovation*, Cornell University, USA, 16-18 October.

1999

"Post-merger strategies of the leading US defence aerospace companies: what lessons for Europe?" Invited speaker at a conference on *The Changing European Defence Industry – Consequences for Sweden*, National Defence College, Stockholm, 11-12 November.

2000

"Dual-use and developments in defence technologies", paper presented at the 2000 INES Conference, June 15-17 Stockholm

"Post-merger strategies of US defence companies", Invited speaker at the Centre for European Reform/Massachusetts Institute of

Technology/American Chambers of Commerce *Conference Transatlantic Defence: Bringing Reality to the Vision*, May 24-26, London.

"The prospects for a transatlantic defence industry", Invited speaker at a meeting of the Task Force on Transatlantic Armaments Cooperation, Western European Union Institute for Security Studies, Paris, 31 March.

Judit Kiss

Publications

Regional and employment consequences of the defense industry transformation in East Central Europe. Employment and Training Papers, No.32. International Labour Office, Geneva, 1999.

The transformation of the defense industry in Hungary. BICC Brief No.18., Bonn International Center for Conversion, Bonn, 1999.

"Defense industry restructuring and regional development." In: M. Brzoska and A. Markusen (Eds.) "Military Industrial Conversion." Special issue of the *International Regional Science Review*, Volume 23. No.1. 2000.

Small arms production in East Central Europe. Background paper for the Small Arms Survey, 2001. Geneva, Small Arms Survey, 2000.

Small arms production in Hungary. Background paper for the Small Arms Survey, 2001. Geneva, Small Arms Survey, 2000.

Forthcoming:
"Defense industry consolidation in East Central Europe in the 1990s." *Europe-Asia Studies*, Vol.53. No. 4. 2001.

Conference participation

Arms trade and the transnationalization of the defense industry, international conference organised by the Council of Foreign Relations (USA) at the Institute for Strategic Studies, London, UK, 9-11 May 1999.

7-9 Sept. 2000. 6th EACES Conference on *Globalization & European Integration*. Barcelona,

Roundtable on Small Arms: *Tackling small arms diffusion in South-Eastern Europe: Towards a sub-regional action programme in the context of the Stability Pact*, 17-18 Nov. 2000, Szeged, Hungary.

Peter Lock

Seminar at the university Pierre Mendez France in Grenoble: Une nouvelle course aux armements?
December 12, 2000
Est-ce qu'il y aura une nouvelle course aux armements?

Seminar in Brussels: Marquage, enregistrement et traçage des armes légères à échelle internationale: quelle faisabilité technique et politique?
December 11, 2000
Le problème du traffic d'armes légères, et les liens entre le commerce licite et le commerce illicite

Friedensratschlag 2000 at the University of Kassel
December 2, 2000
Economic causes of war

Seminar for conscientious objectors in Darmstadt organised by the Federal Office for Alternative Service: December 4.-6.2000
Warum immer noch Kriege?

Seminar in Bad Honnef organised by the Foundation for Peace and Development: Humanitarian Intervention
November 9-11, 2000
Economic causes of armed violence

Seminar in Jakarta (Indonesia) "Soldiers in Military Business as an Economic Actor"
October 17.-19.2000
Exploring the changing role of the military

Seminar in Stockholm of the COST working group
October 13.-14.2000
Directions of Military Technology (paper presented in absentia)

Seminar of Bundeskongress des BUKO in Berlin
October 6, 2000
Economic factors explaining current wars

Lecture at the Führungsakademie (General Staff College) in Hamburg
July 6, 2000
Staatszerfall und Privatisierung der Sicherheit

Lecture at the 17th Internationale Sommerakademie of the Österreichisches Studienzentrum für Frieden und Konfliktlösung (ÖSFK) Burg Schlaining
July 11, 2000
Privatisierung der Sicherheit im Spannungsfeld zunehmend gewaltoffenrer Räume und staatlichem Gewaltmonopol – Thesen zur sozialen Apartheid

Lecture at the Führungsakademie der Bundeswehr (General Staff College) in Hamburg
May 4, 2000
Neue Erscheinugnsformen des Krieges

Lecture at the Ev. Akademie Loccum
December10-11, 1999
Kommodifizierung und Privatisierung von Sicherheit

Taller sobre l'Europe et l'OTAN organisé par CIRPES (Paris)
Dec. 2, 1999
L'industrie d'armement de la Russie dans le contexte européen

Conferencia Anual de la Asociación Alemana de Investigación sobre América Latina in Hamburg
25-27th November, 1999
Paper: *Tendencias de la privatisación de la seguridad en América Latina*

Fachtagung: Menschenrechte und Kleinwaffen amnesty international (Bonn)
October 15, 1999
Paper: *Überschüssige Waffen und Waffenschieberei*

Workshop at the Foreign Ministry in Austria (Vienna)
October 2, 1999
Tackling illicit traffficking in conventional arms: Strengthening collaboration amongst EU and associated countries.
Paper: *Pervasive Illicit Availability of Small Arms*

49th Pugwash Conference in Rustenburg (South Africa)
Sept.7-13th, 1999
Solicited Paper: Light weapons and conflict in Africa
Proffered Paper: *Measures to combat illicit small arms availability*

Lecture at the Führungsakademie der Bundeswehr (General Staff College) in Hamburg
July 6, 1999
Privatisierung der Sicherheit als Problem des Krisenmanagements

Lecture at the University of Vienna (Austria)
June 16, 1999
Über den langen Nachkrieg im Kosovo

Expert meeting at the Friedrich Ebert Foundation (Bonn) on "Arms control and disarmament at the European level"
May 3, 1999
Paper: *Die Zukunft der Kleinwaffenindustrie*

Workshop in Washington D.C. World Bank
March 19-20, 1999
Microdisarmament and Development: Does the World Bank have a Role?

Workshop of the Comité International de la Croix Rouge in Oslo (Norway)
October 18.-20, 1998
Arms Availability and Violation of International Humanitarian Law and the Deterioration of the Situation of Civilians in Armed Conflicts
Papers: *Tax on ammunition; Recycling Deposit*

Jordi Molas Gallart

Conference papers

"Government defence research establishments: the uncertain outcome of institutional change" paper prepared for the second workshop of the "Europolis" network. Lisbon 5-6 June 2000.

Invited conference papers

"The political and economic context of European defence R&D" paper prepared for the first workshop of the "Europolis" network. Maastricht 13-14 April 2000.

"Defence procurement reform: consequences for defence systems engineering and international collaboration", paper prepared for the conference "The Changing European Defence Industry Sector – Consequences for Sweden. National Defence College, Stockholm 11-12 November, 1999 (revised and included in conference proceedings).

"Dual use technologies and the different transfer mechanisms", opening presentation to The International School on Disarmament Research and Conflicts (ISODARCO). 19th Summer Course. Candriai, Italy. 25 August-3 September 1998 (revised and selected for publication in forthcoming book Technology Transfer).

(with Tom Sinclair) "From technology generation to technology transfer: the concept and reality of the Dual-Use Technology Centres", 2nd International Conference on Technology Policy and Innovation, p.2.2.1-2.27. Lisbon, 2-5 August 1998 (revised and published as revised journal article in Technovation).

Presentations and lectures

"Innovation and technological change in complex products. The example of military production" A two-day seminar given to Doctoral Course organised by Departament d'Enginyeria Industrial, Univesitat de Girona, 13-14 June 2000.

Invited lecturer on "The military industry" to the Doctoral Course on Defence Economics organised by the Faculty of Economics of the Universidad de Zaragoza, Zaragoza, 22 May 2000.

"Interoperability and Standardisation: What Progress? Where?", main roundtable speaker in the "Forum Europe" 1999 European Defence Industries Conference, "Towards a North Atlantic Defence Industry? Options for Transatlantic Cooperation and Competition", Brussels, 21 May 1999.

"Ajuste de la política de compras al cambio tecnológico", lecture given to the Seminario de Economía y Defensa, "El nuevo modelo de defensa: Eficacia y coste económico", Academia General Militar, Zaragoza, 23 March 1999.

"The missile industry", presentation to the CRIS Research Seminar on the "European Defence Industry", Manchester, 6 May 1998.

Giulio Perani

Publications

with Maria Cristina Zadra, *L'acquisto di beni e servizi per la Difesa. La spesa e le procedure per l'acquisto di armamenti in Italia nella prospettiva dell'integrazione europea*, Commissione Tecnica per la Spesa Pubblica (Treasury Ministry) - Ricerche CR 4/98, Roma 1998.

"Italian Contrasts in Regional Military Industrial Conversion", *International Regional Science Review* vol.23 n.1, January 2000, pp.91-102.

“Le politiche della ricerca a livello internazionale” in Nones M, S. Rolfo e G. Perani, *Le politiche della ricerca militare e duale nei principali Paesi industrializzati*, CeMiSS, Roma 2001 (forthcoming).

Judith Reppy

1998-2000 Member of the Council on Foreign Relations study group on Arms Trade and Transnationalization of the Defense Industry

Organized PSP/MacArthur Workshop on "The Place of the Defense Industry in National Systems of Innovation," 16-18 October, 1998, Ithaca, New York

8-9 May 2000, Guest lecturer, US Military Academy, May, 2000, West Point NY.

September 2000, Conference on "The Roles and Responsibilities of the U.S. Military in the New Millennium," Chicago, IL

Publications:

"Dual-Use Technology: Back to the Future?" in *Arming the Future: A Defense Industry for the 21st Century*, Ann Markusen and Sean Costigan, eds. (New York: Council on Foreign Relations, 1999).

Ed. and contributor, *The Place of the Defense Industry in National Systems of Innovation*, Peace Studies Occasional Paper # 25, March 2000.

Claude Serfati

Refereed Articles

“Les industries européennes d'armement dans les turbulences de la mondialisation” , *Cahiers d'études stratégiques* , juin 1999

“Remaking the Military Industrial Relationship: A French-American Comparison: (with A. Markusen) , *Defense Economics*, 2000,1

Transformation of the French arms industry and innovation system in an era of globalization, *Industry and Innovation*, spring 2001

Book Chapters

'The Place of the French Arms Industry in its National System of Innovation and in the Governmental Technology Policy, dans J. Reppy (Editeur) , *The place of the defense industry in national systems of innovation*, Cornell occasional papers, 2000

L'évolution des dépenses de R&D et la gestion de l'innovation dans dans un régime d'accumulation à dominante financière, dans Moatti P., Mouhoud, E.M., *Technologie et Connaissance dans la mondialisation*, Economica, 2000

Seminars and Workshops

Capacités technologiques liées à la défense et PME, Communication au Séminaire "Ateliers d'Innovations" "PME et réseaux productifs" du laboratoire RII, Université du Littoral (Dunkerque) , 5 octobre 1998

The Place of the French Arms Industry in its National System of Innovation and in the Governmental Technology Policy, Communication au Workshop on the place of the defense industry in national systems of innovation, Cornell university, 16-18 October 1998

L'introuvable intégration des industries européeennes d'armement, Communication au Colloque CIRPES, Paris, 9-10 novembre, 1998

Transformation of the French arms industry and innovation system in an era of globalization, Communication au Workshop "Innovation, Industry and Institutions in France", CEPREMAP, 28-29 février 2000

Wim Smit

'The future of naval shipbuilding in Europe', presentation at the COST A10 seminar *Defence Industry Restructuring in Europe in the 1990s and Beyond,* Stockholm International Peace Research Institute (SIPRI), Stockholm, 13-15 October 2000

Discussant at IVA – CREDIT Seminar, *Research and development for industry and defence: International trends in the management of R&D at the civil and defence interface, problems and prospects,* IVA, Grev Turegatan 16, Stockholm, Friday 15 December, 2000.