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TNO report: Final

Development of a European Defence Technological and Industrial Base
Main report

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1 Introduction

1.1 Backgrounds to the study

The present defence industry is widely and unevenly spread across the EU27. It includes many facilities that may qualify as Centres of Excellence in R&T. However, the European defence industry also includes redundant capacity and non-competitive facilities. There is in fact no such thing as a 'European defence industry'. Unlike in other sectors, such as the rubber or metallurgical industry, no Defence Industry Code exists.

Note to the reader

This report integrates the outcomes of a study to obtain an in-depth understanding of consequences on the industry structure of the Europeanization of the defense-related industries and markets. It identifies possible initiatives for the European Commission and/or the European Defense Agency and contains policy recommendations on various levels.

In the first chapter, some backgrounds to the study are presented, including its objective and approach. The second chapter focuses on the present situation, stating the characteristics of the defense industry. The third chapter describes the various driving forces to the development of the Defense Technology and Industry Base, making a distinction between policy drivers, economic drivers, social drivers and technological drivers. In the fourth chapter, three different scenarios are described, making use of the driving forces described in the earlier chapter. A single favorable scenario for establishing an EDEM is selected. In the last chapter the gaps between the present situation and this favorable scenario are assessed and possible policy measures described to reduce these gaps.

In this report, at some moments the reader is referred to several annexes. These annexes can be found in a separate document annexed to this report.

The defence technological and industrial base (DTIB) is actually a conglomerate of subindustries. Civilian companies may constitute a vital part of the supply chain without being fully aware of their role. They certainly don't consider themselves as part of the DTIB. Likewise, the traditional defence companies are not fully conscious of their position. This implies that reflections upon the required (future) capabilities of a strong European DTIB (EDTIB) must also consider parts of the civilian 'base', offering solutions and innovations relevant for military applications. This observation is further strengthened by two factors: militarily relevant technologies are increasingly dual-use technologies, with the commercial sector taking the lead in many areas. Also, there is a tendency to outsource support tasks, e.g. strategic lift or satellite imagery, to the civilian sector.

Competition in the defence industry comes from within but increasingly also from outside Europe. However, competition is flawed because of the specific nature of the market that is also determined by particularities such as the 'national security' exception in Article 296 of the Treaty and the offset mechanism. On the demand side, the market is characterised by the dependency on one customer, the (national) government(s). This is a customer that not only procures the products and services but also regulates the market. Cross-border rationalisation of the EDTIB has made some advances through collaborative programmes as well as mergers and acquisitions. Some resulting mutual specialisations and interdependencies have been accepted between some MS in some sectors.

These developments all create the sense of urgency to create an efficient and effective European Defence Technological Industry Base, that will be able to play a global role in the field of defence.

The Commission intends to contribute to the development of a *capability-driven*, *competent* and *competitive* EDTIB. Even if over the last decade some significant steps in restructuring and consolidating the EU-wide defence industrial base were taken, the overall strength of the EDTIB is dwindling vis-à-vis the global competition – mainly from the US, but also from the rising Asian economies. In order to remain *competitive* on a global scale or to be an attractive partner for *cooperation* on an equal footing with other international players, the European defence industries need to benefit from a sustainable *domestic market*, namely Europe. This European Defence Equipment Market (EDEM) would have the appropriate size to generate economies of scale comparable to those already enjoyed by the major global competitors.
This study aims to gain an in-depth understanding of the consequences for the industrial structure of the Europeanisation of the defence-related industries and markets. This should also allow a better understanding of the reasons for support for and resistance to initiatives envisaged by the Commission and/or the European Defence Agency.

1.2 Main objectives of the study

As stated in the Terms of Reference the main objective of the study is:

> *"to obtain an in-depth understanding of consequences on the industry structure of the Europeanisation of the defence-related industries and markets. This study should also allow better understanding of the reasons for support and resistance to initiatives envisaged by the Commission and / or the European Defence Agency. The study will contain policy recommendations on various levels.*

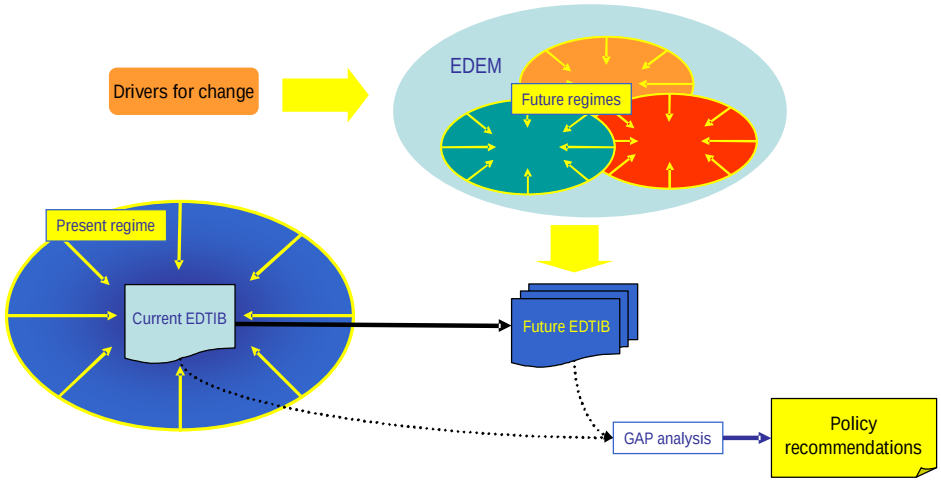
In order to achieve this objective, the commission has identified 4 underlying objectives:

1. To get an understanding of the *current situation* (the capabilities, capacities and competitiveness of the land equipment, naval, aerospace and electronics EDTIB) and how it evolved over the past decade.
2. To identify the major change drivers of EDTIB development.
3. To get an understanding of how these change drivers may play out in the mid term future (10 years) and what kind of future environments or contextual settings the EDTIB may face (three scenarios).
4. To asses the possible impact of these three different environments on the EDTIB, resulting in three different future shapes of the EDTIB (in terms of the 3 C's and the sectors).

1.3 Methodological framework

The overall methodology of this study is based on the assumption that the EDTIB evolves with a changing socio-economic regime[1]. Since it is impossible to predict the future, a comparison between the current EDTIB and a possible future EDTIB is analysed and gaps will be identified, in order to address the problems and meet the objectives of this study. The gaps between present and future will be analysed and policy recommendations will then be formulated. This methodological framework is visualised in the following diagram.

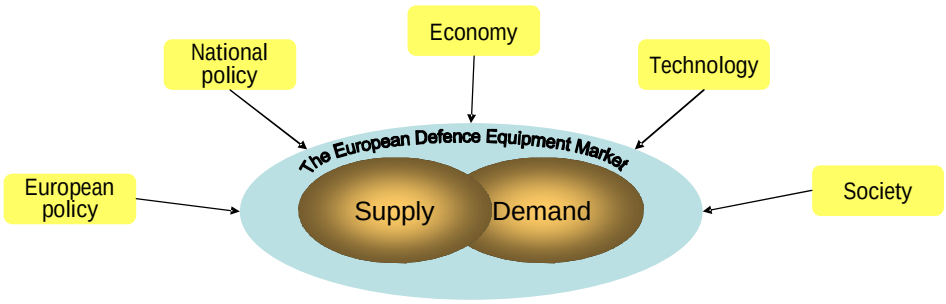
[1] A regime consists of a macrosocial set of rules, cultural or social norms that impact the firms within the EDTIB. They include the institutional regulatory pressures, as well as network dynamics.



The centrepiece of this study is the analysis of the structure of the EDTIB. This has been done using the three basic elements the EDA uses to describe an optimally functioning EDEM (EDA, 2006):

- ***Capabilities***
  The way the EDTIB is capable to deliver and sustain key military capabilities, in the short term as well as in the long term, in order to maintain the necessary levels of European and national operational sovereignty.
- ***Competence***
  The EDTIB should be able to develop new technologies and bring about innovation, in close cooperation with other R&D organisations (e.g. academia).
- ***Competitiveness***
  In business terms, the EDTIB must be competitive (cost-efficient) in a global sense, being able to export and to attract cooperation with European SMEs and non-European partners.

The analysis of the EDTIB was applied to the four core sectors that can be identified in the defence economy: Aerospace, Land equipment, Naval and Defence electronics.



The regime that influences the development of the EDTIB is analysed using the often used PEST approach (Gilespie, 2007). The PEST analysis is an assessment of the external macroenvironment that affects firms, being an acronym for the Political, Economic, Social, and Technological factors influencing the external macroenvironment. Such external factors are generally beyond control of a firm and sometimes take the form of threats. Since the political environment in this study is strongly influenced by both the national and the European environments, the researchers have chosen to divide the 'Policy analysis' into these two (sub)categories.

Like any other market the European Defence Equipment Market consists of a demand side, a supply side and a regulator. In EDEM, the two most important characteristics of the demand side are that buyer and end user of the products are not the same (governments and armed forces, respectively) and secondly that there is basically only one type of buyer, namely the government.

The five categories of environmental pressures creating important drivers for changing the EDTIB are:

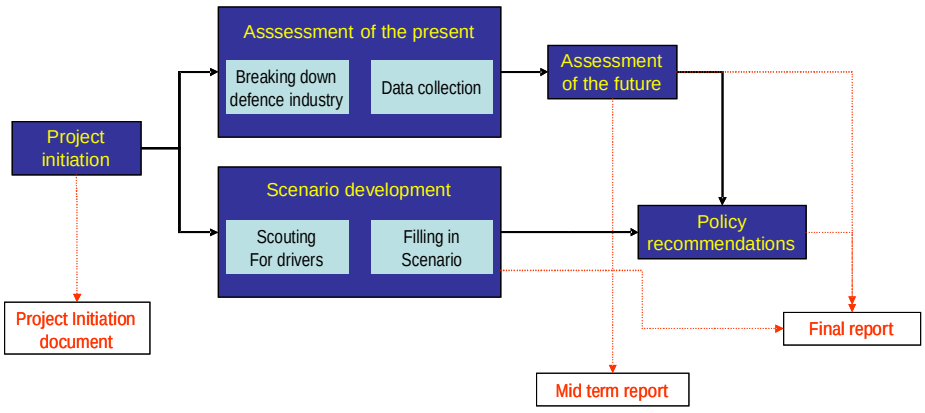
- ***European policy:*** This category includes the pressures from the European political context, including policy and policy instruments.
- ***National policy:*** The national policy environment creates a macroeconomic environment for the EDTIB, as many firms operate on a national level.
- ***Economy:*** The macroeconomic and mesoeconomic environmental factors act as drivers for the further development of the firms within the EDTIB.
- ***Technology:*** The technology base is an important aspect of the EDTIB, requiring an analysis of the technological environment in which the EDTIB will evolve, including demand drivers and supply (S&T) drivers.
- ***Society:*** Norms and values of citizens may be important drivers for changing the EDTIB, so that an analysis must be made of the broad socio-economic challenges in our society, exerting a strong influence on the defence domain.

The driving factors were used to characterise the scenarios. Since the actual value of a driving factor is not clear (the future can not be predicted), the scenarios act as a focal point in which an assumption can be made regarding their value. The scenarios provide a framework in which this assumption can be made in a more systemic way.

The three scenarios were compared with an ideal EDTIB, where the three basic elements are optimally positioned. The most comparable scenario was then used for the gap analysis (comparison with the current situation), leading to policy recommendations to bridge the gap, making a distinction between: 1) the European level, 2) the EDA, 3) the Member State level, 4) the industry level.

1.4 Approach to the study

This study is a combination of desk research and expert consultation. In the desk research public sources in both the key literature and on the internet were studied. The expert consultation consisted of a sounding board group, interviews and questionnaires.



First, the objectives and approach were discussed, after which we analysed the current situation of the EDTIB and EDEM (based on desk research and interviews). This analysis focused to the four sectors of the industry: aerospace, land equipment, naval and defence electronics, resulting in the paper 'The EU defence industrial base' (included below).

Parallel to this, the key uncertainties/dimensions were identified through desk research as well as expert consultation (scouting for drivers). During a workshop, drivers and their varying values were developed using morphological analysis. The outcome was fed back into the further project process. A number of country reports were developed to gain an insight into the current situation, as well as into the conceivable scenarios and policy recommendations. Country studies on two new Member States were instrumental in understanding the developments in Eastern Europe.

The (results of the) morphological analysis in combination with the key uncertainties allowed us to draw up the document 'Context scenarios on EDEM developments', describing four equally possible future worlds/environments: 'We the West', 'Self-reliant Europe', 'Erecting peace' and 'Northern tension'. This concept document was discussed thoroughly during a workshop with the European Commission. The output of this session was fed back into the scenario development process, producing a revised series of four scenarios. The scenarios were taken further, including a focus on the EDTIB and less so on the geopolitical situation, leading to a new set of (now) three scenarios: 'Muddling through', 'Market forces dominate' and 'Europe of different speeds'. The Witney Report *Re-energising Europe's Security and Defence policy* was one of the key sources, as well as earlier studies on the economic side of EDEM.

The selected scenarios were further elaborated through desk research and bilateral interviews with experts from the field. The outcomes were discussed with the European Commission, one scenario being selected as the most desirable scenario for the European Defence Equipment Market, based on the assessment of the impact on capabilities, competitiveness and competencies.

The last step was to identify possible actions and recommendations to address the gaps between the desired scenario and the present situation. Policy analysis and recommendations were developed with the support of the sounding board and other experts.

2 Current characteristics of the European defence industry

2.1 Introduction

Industrial economists usually analyse the European defence industry using the structure-conduct-performance paradigm. Such an approach is presented in the Appendix (see The EU Defence Industrial Base in Appendix). However, such an approach presents a broad aggregate analysis of the whole EU defence industrial base. This Chapter presents an original contribution by focusing on the sectors which comprise the EDTIB, namely, the air, land and sea systems and the defence electronics sectors. Ideally, each sector needs to identify the major prime contractors and their defence industry supply chains. Evidence is then needed on the size of each sector as measured by sales and employment together with such performance indicators as productivity, exports and profitability. Further, each sector needs to be assessed in terms of the Three Cs: capabilities; competencies; and competitiveness.

At the outset, it has to be stressed that there are major data limitations in addressing these questions. Typically, gaps in the data mean that it is not possible to obtain the statistics needed for an economic evaluation of these individual sectors. The available but extremely limited data will be presented and reviewed.

There are some limited published annual data for the European Aerospace and Defence Industries (ASD, 2007). These data are limited in that they include Aerospace which comprises both military and civil sales and employment; they exclude supplier companies; defence electronics are not included in the data; there is only a limited time-series; and there are major discrepancies with the official published data for countries such as the UK. For example, in 2007, the ASD data showed total direct employment in the UKs Aerospace and Defence Industry at 154,900 compared with the official UK figure for its defence industry employment of 305,000 personnel (the UK figures comprised both direct and indirect employment and were for defence activities only: DASA, 2008). Further serious gaps exist in our knowledge and understanding of defence industry supply chains within the EU (including the role of SMEs in such supply chains). We know that supply chains are complex and differ between each of the air, land and sea systems sectors (Hartley *et al*, 1997; Hartley, 1999).

The UK statistics on its defence industry are amongst the most comprehensive in the English language published data source. They are also well-founded on consistent definitions and economic methodology (e.g. the employment data are based on Census of Production data (now ABI data) and input-output tables). Even so, there are problems in obtaining relevant economic data for each of the air, land, sea and electronics sectors. For example, the UK defence industries groupings do not readily correspond to the air, land, sea and electronics sectors; nor do the national sales to MoD correspond to the export categories; and the UK data only publish sales figures and not employment data for each sector. The UK defence industry employment data are for the total industry with no sector data (i.e. annual total employment by direct and indirect for MoD equipment and non-equipment spending and employment dependent on defence exports: DASA, 2008).Where appropriate, this Chapter will use UK data to provide relevant insights into these sectors, including indications of their relative importance.

Some other EU nations publish some statistical data but not in English (e.g. France; Spain; Sweden).

Other data are available at the company level, based on the SIPRI Top 100 arms companies. These data will be used to analyse each sector and trends over the period 1990 to 2008, particularly for the aerospace sector where there has been substantial re-structuring. Some company and industry performance indicators will be analysed such as labour productivity, R&D, profitability and exports: a detailed analysis is presented in the Appendix (see The EU Defence Industrial Base Chapter).

A limitation of the sector approach has to be addressed. A sector focus might fail to identify industrial re-structuring opportunities between sectors. Firms seeking cost-minimising opportunities, including opportunities for achieving economies of scale and scope and minimising transaction costs will not be constrained by a traditional sector focus. They will seek profitable opportunities across defence sectors and between defence and civil markets (see EU Defence Industrial Base in Appendix; also Hartley *et al* (2008)).

2.2 General description

Structure of the value chain: The types of companies operating in this sector can be classified as:

- ***Prime contractors***
  Lead systems integrators, platform producers and producers of weapon systems): in the EU these are mainly large companies (primarily national champions),specialized on defence production. Lead system integrators assemble defence systems from several defence domains (for example, an aircraft carrier). Others are specialised in only one area (transport aircraft for example). Typical examples of prime contractors in the EU are BAE Systems (UK), EADS (France and Germany, with the headquarter in the Netherlands), Thales (France), Saab (Sweden) in fighter aircraft, Finmeccanica (Italy) in helicopters and armoured vehicles, Nexter (former Giat, of France) and Krauss-Maffei Wegmann (Germany) in major battle tanks, Thyssen Krupp (Germany), Fincantieri (Italy) and DCNS (France) in naval vessels.
- ***Tier 1 contractors***
  Specialised systems producers, for example in electronics, and producers of complete sub-systems or major components): these are often specialized firms which are subcontracted by the prime contractors. Often, these are also risk sharing partners. Examples of such companies are Rolls Royce (UK), Groupe Safran (France), MTU (Germany) in engines, and Indra (Spain) in electronics.
- ***Tier 2 contractors***
  These contractors produce components and supply services: electrical & electronic equipment, mechanical engineering, metal working, casts & moulds, etc., along with a variety of services. Usually small and medium enterprises (SME) or subsidiaries of the major defence producers (prime contractors and sub-contractors), these companies often produce dual-use goods or services. They are not always listed as defence producers since they operate at the margin of the defence sector.
- ***Tier 3 contractors***
  These are commodity suppliers and general service suppliers, as well as capacity contractors. This level also includes all providers of « general economic

infrastructure services (transport network and services, communications, externalised training, etc.). At this level of the supply chain one finds a large number of small and medium enterprises (SME) as well as subsidiaries of major defence producers (prime contractors and sub-contractors) which supply dual-use products to prime contractors or subcontractors. In the statistics of the EU defence industry or in company lists of the defence sector these companies are usually not listed since they operate mainly at the margin of the defence sector an often pursue, in addition, non-defence product lines.

SMEs involved in defence, produce small arms and ammunitions, low calibre artillery, military vehicles, small ships, military electronics, subsystems for weapons and components.

Many defence producers, mainly the large ones, but also some smaller producers, are involved at several levels of the supply chain (BIPE, 2008).

Defence spending: Reduced defence spending following the end of the Cold War resulted in major capacity and employment reductions in the European defence industry between 1990 and 2003. Re-structuring reflecting mergers and acquisitions resulted in new names emerging in the top European arms firms, namely, BAE Systems, EADS and Thales. Most European mergers were at the national level although there were a few notable cross-border mergers and acquisitions, namely, EADS and Thales. Elsewhere, some arms firms either dropped out of the top group or exited the industry. Compared with the top US arms firms, further opportunities remain for re-structuring to create larger European arms firms capable of competing with the top US companies (see The EU Defence Industrial Base in the Appendix QQ). These general industry trends will be reflected in similar developments in each of the aerospace, land, sea and defence electronics sectors of the EU defence industrial base.

Defence R&D: affects each of the three Cs: capability; competence; and competitiveness. In 2004, the major defence R&D spenders in the EU were the UK, France, Germany, Italy, Spain and Sweden. However, the total EU defence R&D spend was a mere 20% of the corresponding US expenditure in 2004. The differences are even greater when it is recognised that the EU-total comprises all spending by each Member State and is not a genuine aggregate figure. More realistic comparisons are between each EU nation state and the USA. On this basis, the UK and France each spent 6%-7% of US total defence R&D in 2004 (Hartley, 2006). More recent defence R&D data confirm the scale differences between Europe and the USA. In 2007, EU defence R&D totalled €9.5 billion compared with €56.5 billion in the USA, with the EU aggregate representing some 17% of the US effort. Again, France and the UK defence R&D was each 6%-7% of US total defence R&D in 2007 (EDA, 2008). The major EU defence R&D spending nations in 2007 were the UK, France, Germany, Italy, Spain and Sweden (in rank order: all nations with substantial aerospace industries). Collectively, the top six EU defence R&D spenders in 2007 accounted for some 99% of total EU defence R&D spending but this was only 17% of the US defence R&D spending. Presented differently, the EU defence R&D budget in 2007 was 4.7% of total EU defence expenditure compared with a US share figure of 12.4% of its defence spending. The opportunities for creating a genuine EU collective defence R&D effort are obvious (i.e. creating a single EU defence R&D market).

The impact of defence R&D on industry competitiveness is even more striking. A UK study found a positive relationship between a nation's defence R&D and its equipment

quality (or "time advantage") although the relationship was subject to substantial diminishing returns. In 2001, the USA was at the top of the curve with a time advantage over the UK and France of some 5-6 years and a time advantage over Germany and Sweden of 7+ and 11+ years (DIS, 2005, p39). On this basis, only the UK and France have any reasonable prospect of competing in major systems with the US defence industry. Again, there are no published data on the distribution of European defence R&D between each of the sectors. However, it is reasonable to assume that the military aerospace sector is the most research-intensive group and that this will be reflected in this sector's export performance (the involvement of European states in the US JSF project weakens the EU defence R&D effort).

Exports: The dominant position of the US in international arms trade is mainly due to their share in export of aircraft and missiles. Europe has a comparable position in land systems and a better position in ships. The following table is based on SIPRI data over the period 1998-2007 with export figures expressed in Millions of 1990's US $. The comparison is between the US and the sum of the LOI-6 nations plus The Netherlands, together responsible for the vast majority of EU exports.

Table 2.1 Total export in period 1998-2007 of US compared with LOI-6 nations plus

Category	US		LOI-6 + NL		Delta "EU"–US
	M $	%	M $	%	%
Aircraft	50147	63	15809	25	-38
Armoured Vehicles	3850	5	7664	12	7
Artillery	682	1	1183	2	1
Engines	2651	3	1670	3	-1
Missiles	12814	16	6428	10	-6
Other	555	1	369	1	0
Satellites			50	0	0
Sensors	5148	6	6009	10	3
Ships	3795	5	23301	37	33
Aerospace (Ac+Mi)	62961	79	22237	36	-43
Total	79641		62483		

Of course there are several caveats in this comparison. The most important is the fact that the "EU" data contain also the trade between EU MS. In addition to this one must note the limits to the SIPRI data:

- The data cover only major equipment. This is a little wider than platforms (engines, sensors and missiles are also included - but not C3 systems!);
- The data are based on open sources, mostly defence equipment magazines. It is likely that some receiving countries are more in focus than others
- The monetary values are based on standard figures per type of equipment ("trend values"). It is possible that this inflates values for surplus equipment and deflates for, e.g., US equipment that tends to be particularly expensive per item.

As shown in this chapter, the US has consolidated its defence industry earlier and to a greater extent than the defence industry in the EU. This difference in consolidation together with the much larger defence budgets in the US, form the reasons for the (both perceived and partly true) inefficiency and fragmentation of the EDTIB. However, one

must also consider the following characteristics of the US defence equipment market (DEM):

- It is suggested by the above SIPRI data that US exports are actually quite limited outside of aerospace (there may be a lot of US subsystem content in the most sophisticated European systems).
- The US is actually a very closed DEM. Even if there is internal competition, such a situation seldom helps make industries very cost-efficient.
- In line with this, many find US systems overly sophisticated and very expensive in per item terms.
- Despite all actions to coordinate developments between the services, there are still parallel programmes set up by the services.
- Many programmes are terminated before full development or production.

The high R&D percentage of the US defence budget compared to the figures in European budgets, is indeed a significant contributor to innovation. However, some waste is included.

Concluding this paragraph, in assessing the EDTIB, there are some criteria which can be used to identify both a 'strong' and a 'weak' EDTIB. A strong EDTIB will be characterised by privately-owned firms; by free entry and exit; by sufficient numbers of firms for genuine rivalry (e.g. five or more similar-sized firms); by fixed price contracts which provide hard budget constraints; and by firms earning average or normal profits over the long-run. In contrast, a weak EDTIB will be dominated by state-owned firms; entry and exit barriers (e.g. support for national champions); inefficiencies which lead to losses and hence subsidies resulting in soft budget constraints; by cost-plus contracts which promote inefficiency; and by an absence of capital market pressures where there are no take-overs or bankruptcy (Hartley, 2008). These criteria can be applied to each of the air, land, sea and electronics sectors.

2.3 The aerospace sector

2.3.1 General introduction to the sector

European aerospace is an economically strategic industry characterised by decreasing costs, high R&D intensity and technology spin-offs. It is a leading defence sector in both the EU and the USA and it has made a distinctive contribution to the development of European collaborative defence programmes.

In 2007, the ASD figures showed direct employment in the European Aeronautics and Space sectors of some 473,800 personnel (73% of total Aerospace and Defence Industry employment). However, this total comprises both military and civil sales and employment. Assuming that employment reflects sales, then the total direct employment in Europe's military aerospace sector was some 199,500 personnel in 2007. This estimate is based on ASD data and assumes that labour productivity in the military and civil sectors is identical: an assumption which is unrealistic since civil aerospace is more volume intensive resulting in learning economies leading to higher labour productivity in the civil aerospace sector (e.g. compare the production volumes on Airbus A320 family of 3000+ units compared with Gripen/Rafale output of 200-300 units each and Typhoon planned output of 700+units).Applying the UK ratio of direct to indirect employment of 1.1:1.0 gives a total figure for direct and indirect employment in Europe's military aerospace sector of some 380,300 personnel (DASA, 2008)

More detailed data are available at the company level. For the company analysis, the military aerospace sector is defined to embrace aircraft, helicopters, missiles and space systems. Table 2.2 shows the top European and US aerospace firms in 2006.

Table 2.2 Total export in period 1998-2007 of US compared with LOI-6 nations plus

Company	Country	Sector	Arms sales (US$ millions)	Arms employment	Arms sales as share of total sales (%)
EUROPE					
BAE Systems	UK	Ac,El,Mi, A,MV,SA/A,Sh	24060	84170	95
EADS	W. Eur	Ac, El, Mi, Sp	12600	29203	25
Finmeccanica	Italy	Ac, El, Mi, A, MV, SA/A	8990	33094	57
Thales	France	Mi, El, SA/A	8240	33382	64
MBDA (BAE; EADS; Finmeccanica)	W. Eur	Mi	4140	10400	100
Rolls-Royce	UK	Eng	3960	11400	30
SAFRAN	France	Ac, El, Eng	3780	17181	28
AgustaWestland (Finmeccanica)	Italy	Ac	2820	7298	82
Eurocopter (EADS)	France	Ac	2580	7247	54
Saab	Sweden	Ac, El, Mi	2250	10712	79
Dassault Aviation	France	Ac	1570	4533	38
Alenia Aeronautica (Finmeccanica)	Italy	Ac	1450	7284	60
EADS Astrium (EADS)	France	Sp	1290	3818	32
Cobham	UK	Comp (Ac,El)	1140	5800	61
GKN	UK	Comp (Ac)	740	3612	10
MTU Aero-Engines	Germany	Eng	610	1416	20
RUAG	Switzerland	Ac, Eng,A, SA/A	540	3124	55
Avio	Italy	Eng	500	1355	28
Patria	Finland	Ac, MV, SA/A	480	2083	85
Krongsberg Gruppen	Norway	Mi, El, SA/A	450	1570	43
USA					
Boeing		Ac, El, Mi, Sp	30690	77000	50
Lockheed Martin		Ac, El, Mi, Sp	28120	99400	71
Northrop Grumman		Ac, El, Mi, Sp, Sh	23650	95316	78
Raytheon		Mi, El	19530	76800	96
United Technologies		Eng, El	7650	34320	16
Pratt & Whitney (United Technologies)		Eng	3650	12679	33
General Electric		Eng	3260	6380	2
Textron		Ac, Eng, El,MV	2180	7600	19
Sikorsky (United Technologies)		Ac	1820	6510	57
Goodrich Corp		Comp (Ac)	1470	5850	25
Gencorp		Eng, El	480	2418	77

Source: *SIPRI, 2008*

Notes:

- Ac= aircraft; Eng=engines; Mi=missiles; Sp= space; A=artillery; El=electronics; MV=motor vehicles; SA/A=small arms/ammunition; Sh=ships; Comp=components.
- For Aerospace sector, the aerospace products namely, aircraft, engines, missiles and electronics are shown on the first line. Other non-aerospace defence products are shown on the line below.
- Companies reported are all those in the SIPRI Top 100 with any aerospace products, defined as aircraft, engines, missiles and space plus aircraft component suppliers. Further mergers since 2006 can result in changes to names and rankings.
- Arms employment estimates are derived by applying the arms share of sales to total employment: hence, the figures are broad approximations only. However, where the firm is 100% defence-dependent, the arms employment figures are accurate.
- Company names: where brackets are shown under company name, this shows that it is a subsidiary of the group named in brackets.
- All firms are from the SIPRI Top 100 arms producers in the world, excluding China, 2006.
- Sales in $US millions at current prices and exchange rates.

From table 2.2. we learn that aerospace firms account for 80% of the world's top 10 defence firms. US firms provide the criteria for assessing the competitiveness of the EU firms. There are substantial differences in the average size of EU and US aerospace companies. Typically, the EU is characterised by too many relatively small firms**.** In 2006, the average size of EU aerospace firm in terms of arms sales was $5302million compared with average arms sales of $117,039 million for their US rivals (the EU was defined to exclude non-MS and subsidiaries were excluded from the estimates of average firm size, all based on Table 2.1).For this grouping, the average US aerospace firm was some 22 times larger than the similar top EU aerospace firms. Within the EU, only the privately-owned BAE Systems was of a similar size to the top US military aerospace companies (which were also privately-owned). Thus, there are considerable opportunities for creating more larger EU aerospace firms**.** For example, consider EU the aero-engine sector where both Rolls-Royce and SAFRAN are of similar size in terms of arms sales to their US rivals; but the German and Italian engine companies are 'too small' (MTU and Avio).Of course, this analysis is confined to European aero-engine companies which neglects any opportunities for re-structuring across the defence sectors (i.e with land, sea or electronics firms) or with other civil groups either in Europe or elsewhere in the world (assuming that private capital markets can determine re-structuring). Also, there are further opportunities for re-structuring amongst suppliers. But the published data provide little information on supply chains and mergers amongst suppliers to create larger groups able to undertake more R&D and exploit economies of both scale and scope.

The EU aerospace firms were involved in average of almost three arms products each whilst the US aerospace firms were involved in a similar number of arms products (i.e. almost three per firm) suggesting that the US firms were exploiting greater economies of scale and learning. Interestingly, BAE Systems was unique in being the most multi-product arms firm in both the EU and USA, with 7 arms product groups embracing the air, land, sea and electronics sectors[2]. And BAE has acquired substantial businesses in

[2] In this Chapter, product groups refer to the number of arms sectors in which companies were listed in the SIPRI data base for the Top 100 companies. For example, BAE was listed as involved in seven arms product groups, namely, aircraft, missiles, electronics, artillery, ammunition, vehicles and

the US defence market. The US aerospace firms were also more dependent on defence sales with a median share of 50% compared with a median of 38% for the EU aerospace firms (all based on EU firms and excluding subsidiaries).

The EU position of too many relatively small firms is reinforced and further illustrated by the position of the two aerospace firms in Switzerland and Norway, each of which are amongst the smallest in the top 100 group. The performance of the major European and US aerospace firms is assessed in The EU Defence Industrial Base chapter (see Appendix; section D).

UK aerospace sector

Data on the UK aerospace industry shows the importance of the industry in 2006/07:

- MoD spending on the UK aerospace industry accounted for some 12% of all MoD spending on UK industry.
- It accounted for the largest MoD single defence industry spending (at £1.9 billion).
- The air sector accounted for almost 80% of all UK export orders for defence equipment and services.
- There is excess capacity emerging in the military combat aircraft sector and in the missile sector. In missiles, there is over-capacity in the UK and the wider European market (DIS, 2005, p104).

The aerospace sector in 1990

The trends in the EU and US military aerospace industries can be identified by comparing the industries in 1990 which marked the end of the Cold War, prior to the re-structuring of the 1990s and subsequently. A trend analysis of aerospace is particularly valuable since this sector experienced major and distinctive structural changes after 1990. Table 2.3 shows the major European and US military aerospace firms in 1990.

warships. An arms firm's involvement in other civil markets is indicated by its percentage share of arms in total sales –e.g. a 10% arms share means a 90% share of total sales in civil markets.

Table 2.3. The Top European and US Aerospace Firms 1990

Company	Country	Sector	Arms sales (US$ millions)	Arms employment	Arms sales as share of total sales (%)
EUROPE					
British Aerospace	UK	Ac, Mi, El, A, SA/A	7520	51160	40
Thomson SA	France	Mi, El	5250	40090	38
Daimler Benz	W. Germany	Ac, Eng, El MV, Sh	4020	30144	8
DASA (Daimler Benz)	W. Germany	Ac, Eng, Mi, El	3720	29412	48
Aerospatiale	France	Ac, Mi	2860	16584	44
IRI	Italy	Ac, Eng,El,Sh	2670	132010	36
Dassault Aviation	France	Ac	2260	9685	65
Alenia (IRI)	Italy	Ac, Mi, El	1840	13188	60
Rolls-Royce	UK	Eng	1830	18452	28
SNECMA	France	Eng	1490	9390	34
USA					
McDonnell Douglas		Ac, Mi, El	9020	66660	55
General Dynamics		Ac,Mi,El,MV, Sh	8300	80442	82
Lockheed		Ac	7500	54750	75
General Motors		Ac, Eng, El, Mi	7380	45684	6
Hughes Electronics (General Motors)		Ac, El	6700	54720	57
General Electric		Ac, Eng	6450	32780	11
Raytheon		Mi, El	5500	43719	57
Boeing		Ac, Mi, El	5100	29106	11
Northrop		Ac	4700	32852	86
Martin Marietta		Mi	4600	46500	75
United Technologies		Ac, Mi, El	4100	36594	19
Rockwell International		Ac, Mi, El	4100	33627	33
Grumman		Ac, El	2900	18792	72

Source: SIPRI (1992)
Notes: See Notes to Table 2.2.

Comparing Tables 2.2 and 2.3 shows the changes in rankings reflecting mergers, acquisitions and some exits, especially in the US aerospace industry. In 1990, the top aerospace firms in Europe and the USA were characterised by:

- Aerospace firms accounted for all the top 10 defence firms in the world.
- Three of the top 12 US aerospace firms were single arms product aircraft firms.
- The US military aerospace firms were considerably larger than their European rivals. Comparing the top 8 in Europe and the USA, the US firms were almost twice the size of the corresponding European group.
- There were no major differences in the average number of arms products per firm. The top European and US military aerospace firms averaged some 2.5 arms products per firm (these arms product groups are based on the SIPRI definitions of sectors: see footnote (1)).

- The US firms were more defence-dependent with a median arms share of 56% of total sales compared with a European median of 37%.

The European Aerospace Sector, 2008: conclusions

The European aerospace sector has some distinctive features:

- The sector has considerable experience of international collaborative projects**.** This involves the sharing of total R&D costs and the pooling of production orders between the partner nations. Aerospace has been involved in collaborative programmes for military and civil aircraft, helicopters, missiles and space systems. Some have led to the formation of European companies, namely, Airbus, MBDA, Eurocopter and ESA. Collaborations have ranged from the minimum two nation collaboration (e.g. Anglo-French Jaguar and the helicopter programmes) to 3-4 nations collaborations on advanced combat aircraft (e.g. Tornado; Typhoon) and the 7 European nation collaboration on the A400M airlifter. Collaboration is one of the distinctive features of European defence industrial policy; but it has been mostly confined to the aerospace sector. This reflects the high and rising costs of modern aerospace projects, especially for development (Hartley, 2008).
- Opportunities remain for improving the efficiency of European collaboration on military projects. Typically, work-sharing arrangements and the bureaucracy associated with these projects leads to costs and delays (Hartley, 2006a). Also, there remain opportunities for creating European companies rather than relying on *ad hoc* loose federations of project-specific arrangements for managing such programmes. Airbus in the civil aircraft market shows that international collaboration can be successful.
- Applying the US 'model' shows some of the opportunities for re- structuring the EU military aerospace sector. The USA has three major combat aircraft firms compared with six European firms in this market. Re-structuring also means reductions in excess capacity in the sector. The possible end of future manned combat aircraft and their replacement with UAVs will mean capacity reductions in the military aircraft production sector. For example, the UK expects that the future number of military aircraft plants will fall from four to two (DIS, 2005). However, so long as manned combat aircraft remain in service they will require support and up-grading over their life-cycle: hence, this capability will need to be retained.
- The trend towards internationalisation of the European primes. The major EU aerospace firms are seeking new market opportunities, especially in the US defence market (e.g JSF; BAE; EADS/Airbus; Finmeccanica-AgustaWestland), but also in Asia (through acquisitions, partnerships and joint ventures). Over the longer-term such trends might have implications for employment and security of supply

2.3.2 Capacity

This sector has the **capability** for delivering key military capabilities, providing complex solutions, upgrading platforms and sustaining national sovereignty. But these capabilities are nationally-based (e.g. France; UK) and not necessarily available on an EU-wide basis. Certainly, the sector has the capability of delivering modern combat aircraft (Grippen; Rafale; Typhoon and UAVs); it has a modern missile and helicopter capability; and it has created a European-level strategic airlift capability (A400M airlifter) and air tanker capability. There are gaps in its capability for building modern strategic bombers and inter-continental ballistic missiles and anti-ballistic missile defence systems. But even if there are requirements for these systems, they might be provided through other means, such as membership of NATO.

2.3.3 Competence

The sector is also **competent** and able to deliver cutting-edge technology as demonstrated by its involvement in a complete range of combat aircraft, trainer aircraft, helicopters, missiles, strategic airlifters and air tankers. It has. contacts with universities and is fielding new technologies such as UAVs and new engine technologies with some technologies spinning-off to other sectors (e.g. Formula 1 racing cars: see Hartley, 2006b). There are, though, concerns about the future levels of R&D funding for the military aerospace sector and its continued national rather than EU-focus.

2.3.4 Competitiveness

The sector is **competitive** as reflected in its export performance for combat aircraft (e.g. Grippen; Typhoon), jet trainer aircraft (e.g.Hawk), missiles (MBDA) and helicopters (Eurocopter; AgustaWestland). The industry has some world-class firms (e.g. BAE; Rolls-Royce; SAFRAN;.EADS; MBDA; Finmeccanica; Thales). The sector is also involved in co-operation with non-European partners (e.g. US and the F-35 combat aircraft/JSF). France and the UK dominate this sector and will be influential in determining any allocation of R&D funds to achieve 'appropriate' regional balance of technologies.

2.4 The land equipment sector

2.4.1 General introduction to the sector

The EU land equipment sector is in complete contrast to aerospace. It is smaller, less technically-progressive and lacks European collaborative programmes.

The ASD data show that in 2007, turnover in the EU Land Sector was some Euros 17.5 billion with total direct employment of 106,200 personnel (ASD, 2007). Using the UK ratio of direct to indirect employment of 1.1:1.0 suggest total employment of some 202,500 personnel in the European land sector (DASA, 2008). Compared with the military aerospace sector, land systems are not R&D-intensive, with total R&D for this sector of under Euros1 Billion in 2005 or some 6% of sector sales(compared with 12% for the European aeronautics sector: ASD, 2005). Labour productivity in the combined European land and naval sectors was lower than in the European aeronautics sector at some 87% of the aeronautics level.

The major European land systems firms are BAE Land Systems, Nexter (formerly GIAT), and Krauss-Mafffei Wegmann and Rheinmetall who together produce the German Leopard 2 main battle tank. The main US provider is General Dynamics which supplies the M1 Abrams main battle tank and wheeled vehicles (e.g Stryker) and also has a European presence. BAE Land Systems has operations in the UK, USA (via United Defense and Armor Holdings), South Africa and Sweden. Within the UK, this sector has been the focus of considerable and rapid consolidation. Over the past 10 years, the UK land sector has been reduced from some 5 prime contractors (Alvis; GKN Defence; Vickers Defence Systems; RO Defence; Marconi Defence Systems) to one prime, namely, BAE Land Systems. The factors leading to this industrial consolidation included low profit margins, gaps in work load, a lack of competitive products; a decline in the world export market following the end of the Cold War; and a change in national defence requirements (e.g. reduced demand for tanks). The UK land sector also has considerable experience in supplying components for AFVs, such as tank track and transmissions provided by the William Cook Group, Caterpillar and David Brown

Engineering Ltd (forming part of the UK supply chain for AFVs). UK data for 2006/07 show that MoD purchases of land systems (weapons; ammunition; vehicles) represented some 8% of total MoD purchases from UK industries (the UK is one of the rare examples of a nation which provides data on the relative importance of land systems in total MoD procurement spending: DASA, 2008).

Little is known about defence industry supply chains; but one major study provided insights into the complexity of the supply chain for the UK Warrior AFV. On Warrior, there were over 200 first tier suppliers (selling directly to what was then GKN: now BAE Land Systems), but there was substantial concentration within the supply chain. A total of 10 suppliers accounted for over 70% of the value of GKNs Warrior purchases and the top 42 suppliers accounted for 85%-90% of total GKN purchases. Then, the 207 first level suppliers on Warrior used an average of 18 suppliers (second tier) whilst these second tier firms had an average of 7 suppliers (third tier: Hartley, *et al*, 1997).

For munitions, there is further information on major suppliers. The UK MoD purchases 80% of its munitions from BAE Land Systems. Much of the remaining munitions spending is with 12 suppliers: Chemring Countermeasures; Bofors Defence; PW Defence (UK); NAMNO; Wallop Defence; Austin Hayes; Rheinmettal Waffe Munitions; Troon Investments; General Dynamics; QinetiQ; Nobel Enterprises; and Denis Ferranti Meters Ltd (DIS, 2005, p98).

Table 2.4 shows the major land systems firms in 2006. The following features are identified:

- The average size of US land systems firm was some 1.5 times larger than the average EU land systems firm (excluding RUAG, Switzerland). This suggests opportunities for further industrial re-structuring within the European land sector. There are too many relatively small firms in this sector.
- The EU firms produced an average of three arms products compared with the US average of two arms products. As a result, the larger US firms were achieving greater economies of scale (larger output over fewer products).
- The EU land systems firms were more defence-dependent with a median defence share of 85% compared with the US median share of 66%.Interestingly, the EU land sector contained four firms with 100% dependence on defence. The US land sector did not have any 100% defence-dependent firms.

Table 2.4. EU and US Major Land Systems Firms, 2006

Company	Country	Sector	Arms sales ($ millions)	Arms employment	Arms share of total sales (%)
EUROPE					
BAE Land & Armaments	UK (HQ=USA)	A,MV,SA/A	11280	51700	100
Finmeccanica	Italy	A, MV, SA/A, Ac, El, Mi	8990	33094	57
Thales	France	SA/A, El,Mi	8240	33382	64
Rheinmetall	Germany	A,MV,SA/A,El	1810	7520	40
Krauss-Maffei Wegmann	Germany	MV	1190	2660	95
Nexter (ex-GIAT)	France	A, Mv, SA/A	900	2490	100
Diehl	Germany	SA/A, Mi	850	3341	32
RUAG	Switzerland	A,SA/A, Ac, Eng	540	3124	55
Santa Barbara Sistemas (General Dynamics, USA)	Spain	A, MV, SA/A	500	1980	100
Patria	Finland	MV, SA/A,Ac	480	2083	85
Iveco (Fiat)	Italy	MV	430	980	4
Oto Melara (Finmeccanica)	Italy	A, MV,Mi	430	1360	100
USA					
General Dynamics		A, MV,El, Sh	18770	63180	78
Alliant Techsystems		SA/A	2350	10560	66
Textron		MV, El, Eng, Ac	2180	7600	19
Armor Holdings (now BAE)		MV, Other	1930	6683	82
AM General		MV	1700	Na	Na
Oshkosh Truck		MV	1320	3568	38

***Source**: SIPRI, 2008*

Notes:

- See Table 2.2.
- Some firms are involved in land and other defence business so that the data reflect all their arms sales and employment and not only land systems.
- Land systems are defined as artillery (A); motor vehicles (MV); and small arms and ammunition (SA/A).
- Na= not available.
- BAE Land Systems HQ is based in the USA.

2.4.2 Capacity

The EU land sector has the capability for delivering and sustaining key military capabilities in such areas as main battle tanks and armoured fighting vehicles, as well as being able to sustain and upgrade platforms. Its involvement in the development of modern main battle tanks (UK French Leclerc; German Leopard2; UK Challenger 2) shows its ability to provide complex systems solutions. However, these industrial capabilities are concentrated in few countries, namely, France, Germany and the UK. Also, compared with the USA land sector, the EU has 'too many' producers of main battle tanks (four in EU and one in USA); AFVs (16 in EU and 3 in USA) and 155mm

howitzers (three in EU and one in USA). The sector has developed capabilities in vehicle up-grading and in providing through-life support.

Foreign-ownership has been introduced into the EU and US land sector industries. BAE acquired the Swedish firms of Land Systems Haggulands and Bofors whilst General Dynamics has created a GD European Land Systems company
comprising Steyr-Daimler (Austria), MOWAG (Switzerland), and GD Santa Barbara (Spain) and GD Santa Barbara (Germany). Similarly, BAE has made major acquisitions in the US land sector through its acquisitions of the US Defense Holdings and Armor Holdings companies.

2.4.3 Competence

The land sector is less research-intensive than the military aerospace sector. However, it is interesting to consider whether firms such as BAE Systems involved in aerospace as well as land and sea systems has applied any of its aerospace technologies to its land systems: its organisation allows for the minimisation of any transactions costs between ts different divisions.

There are examples of new technology being applied by land sector firms: examples include new munitions technology; the development of lightweight armour protection; and mine protection technology. The future need for technologically complex AFVs with network enabled capability means that there will be incentives for land sector firms to either merge with or acquire electronics capabilities.

The sector has developed joint ventures and collaborative research with third parties; but it has not developed European collaborative projects of the type which are well-established in the European aerospace sector. For example, Nexter (formerly GIAT, France) has a 50/50 joint venture with BAE Land Systems (CTA International based in France).
The speed of application and fielding of new technologies is dependent on the scale of defence R&D spending which is likely to be under pressure in future defence budgets and remains to be developed at the EU level.

Spin-offs. Compared with aerospace, there are few published examples of technology spin-offs from the land sector. This might mean that either such spin-offs exist but are not publicised or that there are few such spin-offs.

2.4.4 Competitiveness

The land sector has achieved some notable export successes demonstrating its international competitiveness. Examples include the German Leopard tank, the UK armoured vehicles and sales of Thales communications and optronics products to the Middle East and Asia-Pacific region. But there are reservations about the sector's competitiveness. The average EU land sector firm is much smaller than its US rivals. Also, the UK MoD assessment of its land sector raised some major reservations about its international competitiveness. The UK MoD commented on the sector's lack of competitive export products and on the scope for improving BAE Land System's efficiency in general munitions (DIS, 2005, p99). Moreover, it has to be recognised that parts of the EU land sector might be prevented from adjusting to change through the prevalence of state-ownership in some nations (so preventing the operation of capital markets in promoting efficient change).

The UKs Future Rapid Effects System (FRES) is a major AFV requirement for the UKs Armed Forces. The initial vehicles selected for trials by the UK MoD were all foreign, namely, the Boxer (Germany), Piranha (General Dynamics/UK) and VBCI (Nexter, France). The initially planned contract was provisionally awarded to the Piranha supplied by General Dynamics (UK: Piranha was originally developed by the Swiss company, MOWAG which is now owned by General Dynamics). In December 2008, the initial FRES contract had not been confirmed. Note that BAE Systems was not involved in the first batch of vehicle trials, reflecting on its competitiveness. Of course, it might be that future FRES contracts will involve BAE in a joint venture with Nexter (France) and its VCBI vehicle.

2.5 The naval sector

2.5.1 General introduction to the sector

The distinctive features of the EU naval sector are its large number of relatively small firms, excess capacity and a lack of European collaborative programmes.

The ASD data show that in 2007, the European Naval sector had sales of Euros 14.75 billions and employed directly 71,000 personnel which was some 11% of total European employment in its aeronautics and defence industries (ASD, 2007).Estimating for indirect employment (ratio of 1.1:1.0 direct to indirect), gives a total estimate of direct and indirect employment of some 135,350 personnel in the European naval sector. R&D spending in this sector was some 10% of turnover (about Euros 1.6+ billion)which was more research-intensive than the European land sector.

Europe has twelve major warship building companies based mostly in France, Germany, Spain, Italy, the Netherlands and the UK. The USA has two major shipbuilding companies and two firms supplying major sub-systems. Also, there are extensive ship repair facilities throughout Europe and within the USA (DIS, 2005, p73). Within Europe, the major shipyards are DCNS (France); TKMS (Germany); Fincantieri (Italy); Navantia (Spain); and BAE and VT Group (UK).

In the UK there are two warship yards with the capabilities to design and produce complex warships: BAE Systems (Naval Ships and Submarines) and the VT Group. BAE also is the sole UK supplier of nuclear-powered submarines (both attack and nuclear deterrent submarines). The UK has further capacity at Swan Hunter, DML and Babcock Engineering but, together with FSL, these firms specialise in support activities. Other UK firms in the supply chain include BMT, QinetiQ and Three Quays which provide expertise in naval design and systems engineering; Rolls-Royce designs and manufactures nuclear propulsion and marine gas turbines (a spin-off from its aero-engine business); Thales Naval is a combat systems design, engineering and integration company and supplies sonars; Ultra is expert in underwater systems and naval command and control. In the UK warship industry, SMEs are important in providing specialist skills and expertise (DIS, 2005, p73). Similar data on major suppliers is needed for other European warship yards. Overall, in 2006/07, the UK MoD awarded 7% of its total spending on UK defence industries to the shipbuilding industry (DASA, 2008).

For complex warships, the ratio of combat system to platform costs is usually 2:1 and might be 60%-70% for the combat system and 20%-30% for hull costs. The trend over the last decades has been an increase in the budget part devoted to combat system costs.

In contrast, the typical figures for commercial ships are 20% systems and 80% hull construction. So, for warships, more than 50% of the cost lies with firms other than the shipbuilder and many of these firms are SMEs (DIS, 2005, p73). Many of these supplying firms are also active in other sectors (e.g. missile, sensor and C3 suppliers). Despite the larger system costs the platform builder, i.e. the ship yard, acts in most projects still as main contractor and project leader (see also conclusion in the third bullet below).

Table 2.5 on the next page shows the major European and US naval firms in 2006. The conclusions from Table 2.5 on the next page are quite striking:

- Observe the small number of US warship builders in the SIPRI Top 100 companies: three US firms compared with eight European firms.
- The US naval sector firms are considerably larger than their EU rivals. The average US naval firm was some 3.4 times larger than the average EU naval firm.
- There was an interesting contrast between the US naval firms and BAE on the one hand and the remaining European naval firms. BAE and the US naval firms were involved in warship building as multi-product arms firms whereas the other European naval firms were single product arms firms specialising in warship building as arms companies: hence, the European single product specialists would fail to obtain any economies from company R&D in a range of defence activities and they are failing to exploit any economies of scope. In some nations, state-ownership might be a major barrier to firms seeking. methods of minimising their transaction costs (i.e. private capital markets would search for novel solutions to organising warship builders: e.g. the BAE solution with an involvement in military air, land, sea and electronics systems). It is noted that the combination of certain naval activities of Thales with the ship yard DCN in France is already a step in this direction.
- Some of the European single product shipbuilders were highly dependent on defence markets (e.g. 94% to 100%). Typically, the median share figure for the European naval firms was 78% dependency on defence sales and the US naval firms had a similar defence dependency with a median share of 78%.

Table 2.5. Major European and US Naval Firms, 2006

Company	Country	Sector	Arms sales ($US millions)	Arms employment	Arms share of total sales (%)
EUROPE					
BAE Systems	UK	Sh, Ac, El, Mi, A, MV, SA/A	24060	84170	95
DCN	France	Sh	3400	12460	100
ThyssenKrupp	Germany	Sh	1620	5628	3
VT Group	UK	Sh	1400	9800	76
Navantia	Spain	Sh	1110	4390	79
Devonport Management	UK	Sh	780	4880	94
Babcock International Group	UK	Sh, Oth	760	4050	42
Fincantieri	Italy	Sh	660	2070	22
USA					
Northrop Grumman		Sh, Ac, El, Mi, Sp	23650	95316	78
General Dynamics		Sh, El, MV, A	18770	63180	78
Curtis-Wright		Comp(Sh, Ac)	580	2800	45

Source: SIPRI, 2008

Note: See Table 2.4. All firms are from SIPRI Top 100 companies. Naval sector defined as those firms involved in shipbuilding (Sh).

The data for the EU naval shipbuilders is up-dated for 2007 and is shown in Table 2.4. on the next page. The names conceal substantial re-organisation and cross-ownership. In 2008, TKMS undertook internal re-organisation with the creation of three entities and decision to separate its civil and defence activities. TKMS comprises Blohm+Voss (frigates) and HDW (submarines). Further, HDW owns Hellenic Shipyards (Greece) and Kockums (Sweden). DCN of France is now DCNS after DCN acquired all of Thales French naval business whilst Thales acquired a 25% stake in DCN with the newly-merged company known as DCNS. Navantia of Spain was formerly Bazan or Izar and has the capability to build aircraft carriers. Similarly, Fincantieri of Italy has an aircraft carrier capability: it claims that its labour force of almost 9,400 supports a total of 20,000 employees in its supply chain. There are other warship builders in Denmark (Danyard Aalborg/part of Danyard Group); Netherlands (Damen Shipyards: Royal Schelde); and Portugal (ENVC: employment of 900 personnel: Hartley, 2003).

Table 2.6. Major EU Naval Shipbuilders: Size and Ownership, 2007

Company	Country	Sales (Euros, Billions)	Share of arms sales (%)	Employment	Government shareholding (%)
TKMS	Germany	2.02	~70	8300	--
DCNS	France	2.82	>90	12723	75
Fincantieri	Italy	2.67	~20	9358	90
Navantia	Spain	1.34	~80	~5000	100
BVT Surface Fleet	UK	1.28	100	7000	--
BAE Submarines		--	100	3550	--

Notes:

- BVT is a joint venture between BAE and VT to join their surface fleet activities.
- means no state shareholding.
- TKMS is ThyssenKrupp Marine.

2.5.2 Capacity

The EU naval sector has the requisite industrial capabilities to design, develop, produce and maintain modern complex warships over their life-cycle. France and the UK have a complete range of design and support skills for the production of modern aircraft carriers, nuclear-powered submarines and complex warships (e.g. destroyers; frigates). However, the EU has too much capacity operating at a relatively small scale which means a sacrifice of learning economies and the need to spread fixed R&D costs over small production runs (average learning curves for warships are 87%: Hartley, 2003). The result is costly and wasteful duplication of industrial capability using scarce resources with more attractive alternative uses. For example, it has two nuclear-powered submarine industries (France; UK) compared with one US supplier; eleven suppliers of frigates compared with one US supplier; and four suppliers of aircraft carriers compared with a single US supplier. The position of nuclear-powered submarines means that each of France and the UK have to maintain and support a costly

submarine industrial base providing vessels for one customer only in small quantities: this is costly (Hartley, 1999). Elsewhere, TKMS is highly capable in complex warships and is a world market leader in conventional submarines. Also, Kockums has competencies in stealth technologies with the Visby corvette.

The naval sector has only limited experience with European collaboration of the type so prevalent in aerospace (e.g. the Horizon and FREMM frigates of France and Italy, several frigate classes of The Netherlands and Germany). One explanation is that nations value their national warship industry and are willing to pay the price of independence (i.e. the pressures of costly and rising R&D and unit production costs are not sufficiently great to lead to European collaboration, as with the EU land sector). However, there have been recent changes with more national re-structuring and internal rationalisation removing some excess capacity. In France, DCN acquired Thales' France-based naval business with Thales acquiring a 25% interest in DCN creating DCNS. Also, the French Government has acquired a one-third stake in STX Europe's French shipyards (St Nazaire; Lorient).There was an agreement between Finmeccanica, Thales and DCNS on three new joint ventures in the field of underwater warfare. In 2008, Fincantieri acquired the US shipbuilder Manitowoc Marine Group (MMG) which is part of the Lockheed Martin team involved in the LCS programme. The UK warship building industry has also created a new jointly-owned group between BAE and the VT Group which might eventually lead to a merger (VT might exit naval shipbuilding to focus on service/training activities); there is also a consortium of BAE, VT and Babcock to build the UKs two new aircraft carriers. In the UK, once the current surge in warship building ends, then further rationalisation is likely.

2.5.3 Competence

The EU naval sector is capable of delivering cutting-edge technology as demonstrated by its involvement in nuclear-powered submarines, new aircraft carriers, anti-missile destroyers, torpedoes and sonars. However, UK experience shows that often such projects are characterised by substantial cost overruns and delays (e.g. Astute submarines with a 47% cost overrun and a 41 month delay; similarly with Type 45 Destroyers which are some 36 months late with a 29% cost increase). Opportunities exist for technology transfer where naval firms are part of an aerospace group (e.g. BAE) which means that stealth technology is available for application on surface warships. Competence is being further developed through participation of some EU firms in international consortia. Navantia is part of the AFCOM consortium. This is an Advanced Frigate Consortium bringing together Navantia, Lockheed Martin and the North American shipyard Bath Iron Works. Navantia is also part of the Scorpene Consortium which include DCNS aimed at an equal sharing of the definition, building and sale of a third generation frigate.

2.5.4 Competitiveness

Some European nations such as France and Germany, export a significant proportion of their national output (e.g. frigates; diesel submarines from Germany).This reflects the world demand for modestly-priced frigates rather than the advanced, complex and costly warships represented by the UK warship builders. European firms are in the world top four suppliers of warships, comprising France, Germany, the UK and the USA.

In Europe, France and Germany have produced competitive products meeting foreign requirements at 'modest prices.' Often EU naval exports include an offset for the

buying nation. For example, DCNS sales to Pakistan and Singapore; Germany's exports to South Africa where Blohm & Voss used its parent Thyssen and subcontractors to offer a comprehensive range of offsets (SE, 2002). TKMS and DCNS are developing new submarines (Type 210and Andrasta, respectively) whilst DCNS is developing the FM400 and Gowind frigates. These new German and French warships are designed to operate in coastal waters to meet conventional and asymmetric threats. Often, the major EU shipyards are rivals in world export markets. Elsewhere, other EU shipyards focus on supplying their national naval requirements so that there are major doubts about their competitiveness. Also, there are few export markets for the type of warships built in the UK. Limitations include nations which build their own high capability warships (e.g. USA; Canada; France; Germany; Italy; Spain; Australia; Japan; S Korea); and the fact that some nations cannot afford the high capability warships specified for the UK's Navy (SE, 2002).

Future threats to EU warship builders are likely to come from Asian firms such as Hyundai, Daewoo, Samsung and STX and from the US firms of Northrop Grumman and General Dynamics Marine Systems.

Note that some nations, in particular the UK and The Netherlands, have reduced and modernised their fleets and exported their surplus ships.

2.6 Overall conclusions

2.7.1 EDTIB and the Three Cs

At the EU level, the MS have a range of defence industries which have varying degrees of capability, competence and competitiveness which provide the basis for an EDTIB. Much of the Three Cs features are concentrated in the major national defence industries, especially in France, Germany and the UK. These industries also have varying degrees of international competitiveness. Broadly, France and Germany are competitive in land and sea systems whilst the UK is competitive in the aerospace sector. Other EU MS have varying elements of the Three Cs in their national defence industries (e.g. Italy; Spain; Sweden). But the creation of a Three Cs EDTIB needs to address three issues:

- The lack of an EU collective defence R&D effort capable of competing with the US defence R&D spending.
- The massive duplication and excess capacity in the national EU defence industries, reflecting each nations continued commitment to supporting some form of national defence industry, leading to small-scale production for national markets.
- The lack of a reasonable data base on the EUs defence industries. Defence firms and industries need to be defined[3] and there is a need for reliable data on the size of the EUs defence industries (e.g. sales; employment) and their performance (e.g. defence R&D spending; productivity; defence exports by product group; profitability). Data are also needed on Europe's defence industry supply chains, especially where there are key monopoly suppliers which might be at risk of exit (i.e. suppliers needed for appropriate sovereignty and security of supply).

Efforts to measure the Three Cs in the form of a single indicator are fraught with difficulties, reflecting the absence of a measure of defence output and hence of

[3] The definition of defence firms and industries is fraught with problems. For example, what proportion of defence sales in total sales constitutes a defence firm: is it over 50%; but what of firms such as shipping companies and airlines which currently might have zero defence business but which constitute surge capacity in a national emergency?

productivity. National Accounts conventions measure defence output by inputs (outputs = inputs method used in National Accounts). In the absence of a reliable output measure, there are proxies which can be used to assess capability and competence. Two broad indicators of capability and competence which in turn affect competitiveness are available. First, evidence shows that there is a positive relationship between defence R&D spending per nation and equipment capability advantage (expressed as years of advantage) but this relationship shows strong diminishing returns. The USA is at the 'top' of the curve with a 5 year lead over the UK; a 6 year lead over France; an 8 year lead over Germany; and a 12 year lead over Sweden (Italy and Spain are similar and are positioned between Germany and Sweden with possibly a 10 year gap with the USA:DIS, 2005, p39). Second, there are data on annual cost increases for specific weapons (in real terms or constant prices). Such data can be used as an indicator of the technical improvements in defence equipment over the past 10 years (Pugh, 2007). The annual cost increases for major equipments and hence their technical improvements are:

- Sea systems. For major warships including aircraft carriers, air defence vessels and submarines, typical annual cost increases were 2%-3% within a range from 1% to 7%.
- Land systems. Major land systems showed annual cost increases from 3% to 4% within a range from 1% to 6% (comprising main battle tanks; AFVs; multiple rocket launchers). Interestingly, within the bombs and rockets group, annual cost increases were 6% - 9% within a range from 5% to 18%.
- Air systems. This sector showed a typical annual cost increase of 4% within a range from 2% to 10%. UAVs showed annual cost increases of 5% to 6, whilst the corresponding figures for helicopters were 5% within a range from 4% to 6%..
- Missiles with annual cost increases of 5% within a range from 3% to 8% (including ballistic and cruise missiles; SRAAM; torpedoes).
- Electronics systems showed typical annual cost increases of 5% ranging from 2% to 8%.

An alternative indicator of technical capability by country is provided by data on equipment markings which reflect equipment quality (Middleton, Bowns, Hartley and Reid, 2006). These scores show equipment markings for a sample of nations. They rank nations based on their equipment quality. For the sample of nations in 2005, the average score was 126.4. Higher scores show nations with substantially better equipment. The nations were ranked against the UK.

These data for 2005 are:

USA	155.7
UK	141.7
France	132.7
Germany	125.7
Italy	116.7
Spain	112.7
Sweden	109.7

The sector analysis of this Chapter shows that EU policy initiatives by the EC and EDA in relation to the EDEM and EDTIB have to date been mostly ineffective. These policy initiatives have not affected the current size, structure and performance of the EUs defence industries and the policies of national governments. Even major European and international collaborations have reflected budget pressures, rising equipment costs and national support for defence industries (i.e. aerospace industries, often with the aim

of avoiding undue dependence on the USA), rather than EU defence industrial policy. This is not to say that major EU policy initiatives cannot be effective. One obvious example is Article 296 whose abolition would create a genuinely open EU defence equipment market (comparable to the Single Market for civil goods and services and for civil public procurement)

The analysis shows that Europe's defence industries continue to be characterised by too many small firms leading to excess capacity and that considerable opportunities remain for further re-structuring, especially in the land and sea systems sectors. In comparison, the US defence industry has a much smaller number of larger defence firms. The trend towards IT warfare means that there has been and will continue to be an increasing use of electronics in complex weapons systems. However, a sector analysis has its limitations since it tends to focus on re-structuring within each sector and neglects opportunities for re-structuring between sectors. Here, there are two general models of defence firms which represent alternative methods of economising on transaction costs. First, there is the aerospace and defence firm model which is represented by Boeing and EADS where each are large firms with a defence business and a substantial civil aircraft business. Second, there is the large specialist defence firm involved in air, land and/or sea systems as well as defence electronics. Examples are BAE, Lockheed Martin and Northrop Grumman. These are large defence firms able to achieve economies of scale, learning and scope with further potential for technology transfer from, say, aerospace to land and sea systems (e.g. application of stealth technology to tanks, AFVs and warships). Increasingly, defence firms have acquired electronics firms reflecting the greater emphasis on electronics inputs in modern defence equipment.

Initially, industrial re-structuring is most likely within *nation* states and will involve the land and sea sectors. *International re-structuring* is the next development. This might involve the creation of European-wide companies. There are also opportunities for EU collaborative programmes. Here, there are two options. First, *government-led and dominated collaboration* of the type adopted for the EU aerospace industry. Second, *firm-led international collaborations or consortia* where firms make commercial decisions about their partnerships searching for profitable opportunities and seeking to economise on international transaction costs (e.g. naval sector examples of consortia). Where such international collaborations are dominated by private firms they will be based on market judgements, commercial criteria and entrepreneurship reflecting partners seeking to develop mutually-beneficial exchange.

Certainly, there are opportunities for improving the efficiency of such collaborative programmes. Typically, the focus on work-sharing rules results in substantial inefficiencies. Future collaborations might be based around a small number of partners (two partners) with other nations joining the programme as 'associates' with no prior commitment to receiving specific technology and production work packages (c.f. the partnering arrangements for the US JSF/F-35 aircraft).

2.7.2 Drivers for change, the EDEM and the EDTIB

The current size, structure and ownership of the EU defence industries reflects a variety of defence budget, national procurement policy and technology influences. These drivers have determined the current state of the EU defence industry and the potential for the emergence of an EDEM and EDTIB. Overall, the major drivers which have affected the current size, structure and performance of the EUs defence industries have been defence budgets, rising equipment costs, national defence industrial policies and

industry supply side adjustments (via mergers/acquisitions and entry into foreign markets with the example of BAEs entry into the US defence market). These, and related, drivers drivers will be addressed in chapter 3.

2.7.3 Future challenges for the EDEM and EDTIB

The EC and EDA face some major policy challenges in relation to the EDEM and EDTIB. These include:

- *The issue of competition in the EDEM and EDTIB*. Choices are needed either to restrict competition to firms from MS only or whether to allow other firms from the rest of the world to enter EU defence markets (e.g. US defence firms). In the absence of competition, monopoly defence firms will have to be treated as regulated firms with the associated problems of determining prices, efficiency and profitability.
- *Maintaining key specialised defence capabilities during troughs in development and production work*. These are specialist firms with no alternative uses for their plant and human capital but which are needed in the future (e.g. capability in nuclear-powered submarines; main battle tanks; aircraft carriers). Such specialist capabilities might be prime contractors or SMEs in the defence industry supply chain.

3 Drivers for change in the EDTIB

3.1 Introduction

The EDTIB operates in a certain regime, within a specific socio-economic context. This regime is subjected to important drivers for change that will alter the nature of the EDTIB, and its development. This chapter identifies the most important external drivers imposing a pressure for change on the EDTIB. These driving factors will be described according to their origin, their relation to the EDTIB, the range of the potential future evolution and their (general) potential impact on the EDTIB. The driving factors will also serve as the building blocks for the scenarios described in chapter 4. In this next chapter, these drivers will be described in their mutual relation to each other.

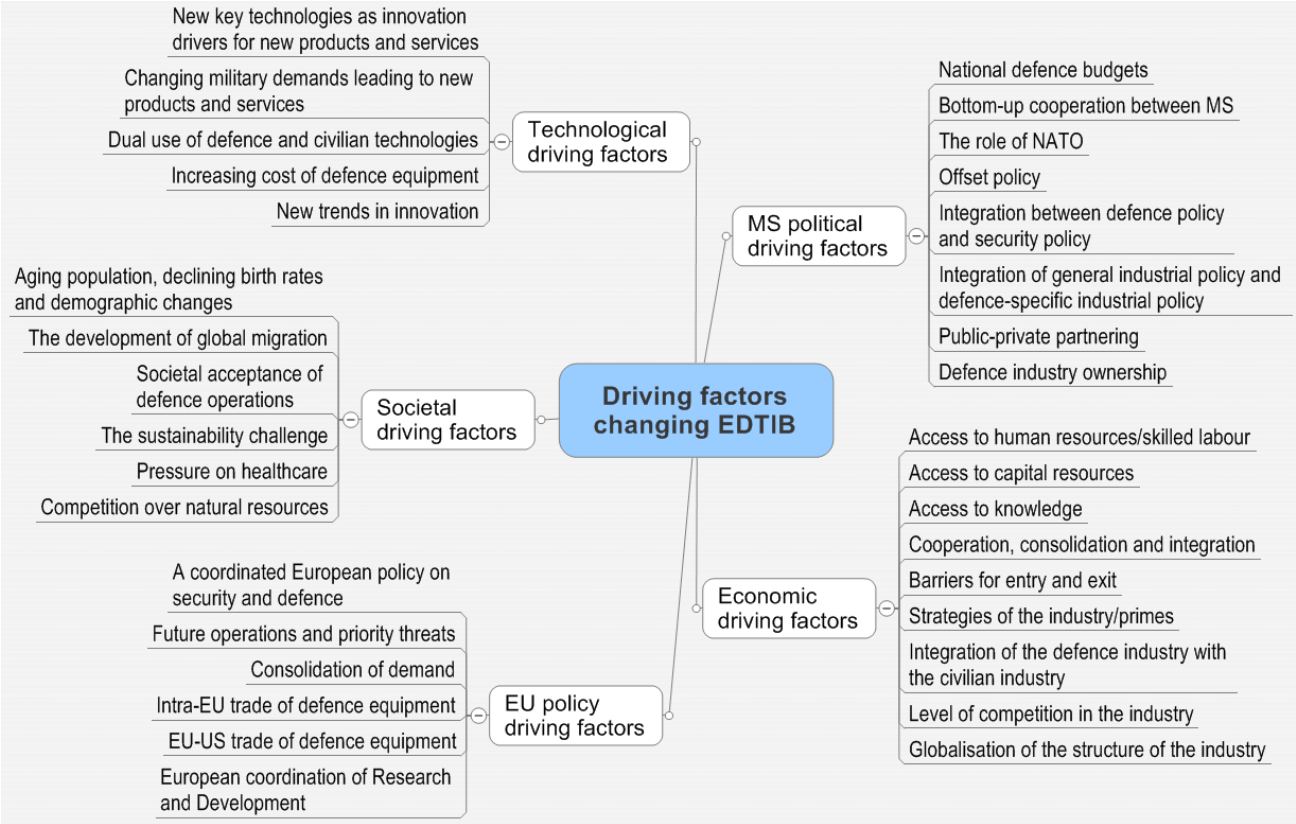
The structure of this chapter follows the model described in chapter 1, distinguishing between**:**

- ***EU policy driving factors***
  These drivers include the policy trends that are developed within the political context of the EU and may impact the structure of the EDTIB. For defence, these are mainly EU policy and the EDA.
- ***National (Member States) political driving factors***
  The EDTIB is currently very much influenced by its national context. That is why this driver category will include the trends that are discussed within the national policy environment. These will mainly comprise national defence policies, but also increasingly the general industry policy.
- ***Economic driving factors***
  The economic drivers for change will include the economic developments that will exert pressure on the EDTIB structure. Here, basic economic characteristics are used, as well as some more defence-oriented factors like dual use and the business strategy of the 'prime'.
- ***Societal driving factors***
  This category includes the changes in societal norms and values, as well as the more structural societal trends which are of importance to the development of the EDTIB. Some of these trends in society are important driving factors for defence.
- ***Technological driving factors***
  One of the core elements of the EDTIB is its technological base. This is highly influenced by developments in science and technology (supply), as well as by changes in the functionalities of the defence equipment needed (demand).

The above categories of driving factors will be discussed in the sections below. At the end of this chapter an overview of the driving factors will be presented, including an indication of their importance to the further development of the EDTIB.

The drivers will be described as follows. First, a short definition and delineation of the factors are given. Each section ends with a description of the factors that may influence these alternatives, and includes a short description of how the driving factor may affect the EDTIB.

An overview of all driving factor catagories and their underlying factors is given in the following overview.



It should be noted that many of the drivers are mutually dependent. As an example, in quite a few drivers 'defence budgets', which is a driver in itself, will reoccur as a factor of influence for that particular driver. Of course, this alignment of drivers helps in envisaging consistent possible futures, and will therefore be reflected in the scenarios.

3.2 EU policy driving factors

3.2.1 Introduction to EU policy

The **EU political** drivers mostly originate from the EC, the European Defence Agency and the Council of the European Union. The major drivers within the EU may be found in the policy papers and related directives such as the European Security and Defence Policy, the Strategy for the European Defence Technological and Industrial Base and are made operational in measures such as included in the recently introduced Defence Package, the Code of Conduct and the Code of Best Practice implemented by the EDA.

These policy papers and directives allow the identification of the following drivers as important pressures on the development of the EDTIB:

- **A coordinated European policy on security and defence**
  The coordination of the policies of the individual MS to a common European security and defence policy will contribute to a clearer articulation of the future requirements. As such, this will enhance the structure and quality of the EDTIB due to the improved efficiency and effectiveness of the industry.

- **Future operations and priority threats**
  The changing nature of the operations due to the changing nature of the threats will call for the adaptation of the industrial and technological base.
- **Consolidation of demand**
  A common European approach to procurement and articulation of future demands will align individual Member State requirements and stimulate the efficiency of the EDTIB.
- **Intra-EU trade of defence equipment**
  This factor concerns the rules and practises of the trade in defence equipment between the different MS, and the improvement of the operation of the European defence equipment market.
- **EU-US trade of defence equipment**
  Being an important market (demand and supply), the enhancement of the trade between Europe and the US will have a strong impact on the EDTIB.
- **European coordination of Research and Development**
  Being an important driver for innovation, the improvement of the R&D coordination will change the innovativeness of the EDTIB.

3.2.2 A coordinated European policy on security and defence

Definition. This factor applies to the establishment of a common European security and defence policy, leading to a coordination of MS activities.

Description. At present, a common European view on security and defence is institutionalised through the European Security and Defence Policy (ESDP). This is the EU policy domain covering defence and other military aspects, being the successor to the European Security and Defence Identity under NATO. Formally, the European Security and Defence Policy is the domain of the Council of the European Union, in which the MS are represented. However, the High Representative of the Common Foreign and Security Policy also plays an important role. In his position as Secretary General of the Council, he prepares and examines the decisions to be made before they are brought to the Council. He is based at and supported by the General Secretariat of the Council of the European Union.

The European Security and Defence Policy (ESDP) has its early roots in the 1997 Amsterdam Treaty. This gangling intergovernment project has a multipurpose perspective that took its individual MS years to assemble on a national level. The potential benefits, if not necessity, of a common European policy are understood and underwritten by most (CSIS, 2005). Also, the EU can offer a viable complement to other organisations dealing with defence and security, such as NATO and UN. The advantage of the EU over NATO is the availability of both civil capacities (first pillar) and intergovernment military cooperation options (second pillar). These may be combined in integrated security operations, albeit currently rather on paper than in actual operations.

Although the ESDP is supported by the MS, its actual influence is still limited. The aim is to have a European army capable of, among other things, deploying 60,000 troops within 60 days for a major operation. This Rapid Reaction Force remains hypothetical, however, and in recent years EU governments have focused on the smaller Battlegroup initiative as something more achievable in the near future. Battlegroups are forces of around 1,500 troops, some provided by individual states, some multinational. At any

one time, two are ready to be deployed within 10 days. They have been fully operational since January 2007.

Still, the coordinated European procurement of defence equipment is still lagging behind, many MS organising their procurement on a national level.

Factors of influence. The long-term trend in ESDP is unmistakably upward, but the actual implementation is a difficult process. In the coming years the ESDP could migrate to a truly common policy (CSDP) in the wake of a European 'constitution' of sorts and become organisationally embedded within the EU. However, incidents like the Irish 'no' to the Lisbon Treaty constitute a watershed (cf. Witney 2008), meaning that ESDP progress could get stalled for a longer period. Realising this, EU MS may be forced to rethink their own foreign and defence policies, and no common policy will be established[4].

A powerful new impetus for ESDP could come from France and the UK settling their differences on defence strategies. While the Saint Malo Declaration (1998) signified an important conceptual step toward a common security and defence policy, its actual implementation has so far been limited. With France's anticipated return into NATO's military structure, a revival of the declared intentions may materialise. A mutual understanding between France and the UK may trigger other countries, in particular Germany, to take a more European stance as well (IIS, 2008)[5]. Germany, for historical reasons, lacks a powerful strategic vision on defence, and is primarily driven by economic considerations. Having a fair share in a 'Europeanised' defence industry could provide a good alternative to the current renationalisation tendency in German material programmes. The acknowledgement of Poland as a major player in the European defence landscape[6] will be instrumental in securing Polish support for common defence initiatives.

The more negative alternative is fuelled by the problem of free riders in the ESDP, with only 7 (of which 5 EU MS) out of 26 NATO countries meeting the NATO goal of spending 2% of their GDP on defence. The gap in spending between France and the UK and other EU countries has been widening. Italy and Germany, for instance, are spending considerably less then 2% of their GDP on defence.

Impact on the EDTIB. A strong common defence policy is an important condition for the consolidation process in the EDTIB. If the ESDP will be made fully operational, the coordination in research, and the alignment of products and services will lead to a more efficient and effective EDTIB that will provide more competitive products. Also, innovation will be more efficient, as international cooperation will be ensured. On the other hand, the national influence of the MS on R&D and production will be less, leading to a decrease in the availability of country-specific variations of products and services.

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[4] Ref. e.g. president Sarkozy's recent proposal to create an elite European defence group of the six largest EU countries and a 'European pillar' within NATO.

[5] "Any moves to enhance European military capacity requires cooperation between France and the UK, despite the ambitions of some leaders to develop a strategy to orchestrate autonomous EU operations", according to the International Institute for Strategic Studies (IISS) report European Military Capabilities, July 2008 (cited on EUObserver.com on July 10, 2008).

[6] In terms of the 2007 defence budget, Poland occupies position 8, behind France, the UK, Germany, Italy, Spain, the Netherlands and Greece.

3.2.3 Future operations and priority threats

Definition. This factor is about the future character of operations vis-à-vis the priority threats.

Description. The traditional military threat to Europe originates from the Cold War. However, in the last decade this has changed, as the number of engagements by forces in low-intensity conflicts around the world[7] is strongly increasing. The US, NATO, the EU, the UN, the African Union and other organisations and nations all have significant active missions to address these low-intensity threats. It is likely that sustained expeditionary operations will remain the main burden for Western military organisations in the decade ahead.

Another element of future operations is the link with humanitarian aid. Looking at recent developments in Afghanistan, it is clear that a military operation alone is not enough to achieve the set aim. On the other hand, in such areas a purely humanitarian operation is likewise impossible, due to the local security threats. The same applies to other regions such as Darfur and Congo/Zaire. One may expect this combination of humanitarian and security/military operations to occur more often in the future.

Also the operations predominantly organised by Europe as stated in earlier political agreements around the ESDP can be made fully operational. Its unclear tasks and demands for products and services can change the shape of the technological and industrial base.

Factors of influence. This driver is mostly influenced by the most likely types of military operations that are anticipated for the coming years. An agreement on the tasks of a European army corps, European coordinated operations and the future threat priority will have much influence on the demand (including the increased need for interoperability and possibly common equipment). If the coordination at the EU level does not improve, the response to future threats will not be different from from the present situation. It will still be organised on a fragmented national level.

Impact on the EDTIB. The shape of the EDTIB depends on the degree in which these trends are reflected in the capability requirements for investments. The more alternative A becomes reality, the more opportunities are to be expected for new entrants on the market offering innovative new solutions, thus enhancing the efficiency and effectiveness of the EDTIB for the support of the future operations.

3.2.4 Consolidation of demand and national procurement

Definition. This factor aims at the coordinated procurement and, if so required, the development of defence products across the MS to enhance interoperability and economy of scale.

Driver description. Aligning and combining the future materiel needs of the European armed forces has been long advocated, but seldom achieved. EDA's Capability Development Plan (CDP), the initial version of which was presented on July 8th, 2008,

[7] Low-intensity conflict or LIC is the current US term for what used to be called 'military operations other than war' or MOOTW. LIC includes such missions as peacekeeping, counter-insurgency, stabilisation and reconstruction, enforcing boycotts and controlling piracy, security sector reform, disaster relief and humanitarian aid. It should be noted that, despite the name, local and temporal high-violence situations may indeed occur in such operations.

may play a facilitating role in the teaming of MS to simultaneously procure the same capability. However, effective national processes are required to ensure that collaborative programmes actually become a viable alternative to national programmes, not only for new developments, but also for off-the-shelf purchases and all aspects of in-service support. On paper, many countries adhere to the principle of alignment of requirements. Many MS have, as member states of NATO, been active in requirement alignment, standardisation and consolidation of demand. But even in NATO the success of these processes has been limited.

Differences in procurement

France, for instance, wants to stimulate industrial cooperation in Europe through "Pursuing joint analysis of military requirements" and "Defining joint rules for defence procurement". However, there are various areas in which the larger nations want their national independence to be ensured. In effect, these areas are excluded from overseas competition and hence from the EDEM: they are Article 296 products. For France these critical sectors include: nuclear deterrence, ballistic missiles, nuclear submarines and information system security. For the UK they include: nuclear submarines, core warship building, ammunition and cryptography. In addition, support capabilities will be retained for fixed wing combat aircraft (Typhoon, F-35), helicopters and armoured fighting vehicles. Germany is less specific. The 2006 White Paper states: "The political leadership and industry must jointly define the strategic positioning of German defence technology in Europe. The Federal Governments will try to preserve a balanced mix of defence technology, including its high-technology areas, in Germany." The criterion here is economics, not strategy.

The directive on procurement in the defence adapts the Community legislative framework for defence procurement, thus reducing the attractiveness of recourse to Article 296 TEC for MS and aims at facilitating MS in their procurement by giving them an alternative to either regular procurement case law or Article 296.

Also, the consolidation of demand may look good on paper, but seldom works in practice, because all the potential partners want their particular requirements to be the standard for all. Sometimes the result is a programme that is burdened with a set of requirements that is the least common multiple of the requirements of the individual partners. Past experience shows that such programmes often derail through severe overruns in budget and time, whereas the end products do not live up to expectations.

One can say, however, that the EU initiatives point in the right direction, even though there is still a long road ahead. As EDA puts it: "The CDP is significant and unique but must be considered only as a starting point, to be further refined and regularly reassessed to ensure it remains pertinent and useful." (EDA 2008) All other things being equal, a stronger form of persuasion than intergovernmental 'peer pressure' will be needed to really make substantial steps in a relatively short period of time.

Until then, EU nations with a national defence industry are likely to adopt a defence industry strategy that seeks to retain key defence industrial capabilities within the nation state. By definition, such national policies will affect the future development of the EDEM and EDTIB. The retention of key defence industrial capabilities means that such capabilities cannot be opened to the EDEM, whereas such capabilities form the basis of the EDTIB. Capabilities which are not part of the key capabilities which a nation wishes to retain provide opportunities for developing the EDEM. National procurement policies also affect competitiveness through their pricing (e.g. fixed price versus cost-plus contracts), efficiency incentives and profitability awards (e.g. for non-competitive contracts). Furthermore, national procurement policies determine whether there will be entry barriers to national defence markets (a national policy choice), these barriers representing a major obstacle to the formation of the EDEM. Finally, within a national defence industrial strategy, ownership issues arise. Some nations have already moved to the privatisation of their state-owned national defence industries (e.g. UK) and others might follow in the future. Privately-owned defence firms are one of the features of a strong EDTIB.

Factors of influence. In conjunction with a strong consensus on the ESDP, additional 'forceful' measures may be adopted and, more importantly, MS will actually implement with some vigour the measures they have already agreed upon. It must be kept in mind, however, that even in an optimistic scenario the timeframes are quite long. The defence markets could, however, also basically remain government-regulated markets where only a limited number of market rules/mechanisms apply or can be realistically implemented and enforced. In fact, governments *are* the market and use their buying power to determine the size, structure, conduct, performance and ownership of their national defence industries.

As stated, a decisive point is whether MS "put their money where their mouth is", meaning that they will truly live up to the spirit of the already approved EU initiatives. This would most likely coincide with a strong MS support of the ESDP. A reduction of costs being one of the benefits of joint procurement (both R&D and product cost), reduced national defence budgets will stimulate the realisation of the consolidation of demand. Also, further joint operations and the increased reliance on ICT will stimulate consolidation, due to operational and technical requirements.

Impact on the EDTIB. The economic impact of the directive on defence procurement may well be particularly high in the market for sensitive non-military equipment. Since the latter are often applications from defence products, they involve lower R&D costs and may be considered as less sensitive than their defence counterparts. With regard to high-end technology, the directive will probably be used in non-producing countries rather than in producing countries, since the producing countries may in specific cases choose not to compete in order to maintain industrial capacities they consider as essential for their security interests. This is further strengthened by 'winner takes all' competitions for large projects involving protracted development processes and long life cycles. The losers in these competitions are at a distinct disadvantage, since without adjacent and related markets they will eventually exit the industry (either by direct exit or as the result of a take-over). In this respect, popular opinion has it that such firms might survive if they were part of a larger group with extensive civil markets, so in essence diversify their risks. However, privately owned firms will only enter other markets if their top managers are able to identify such markets and if these are regarded as potentially profitable. Defence markets which are regarded as high-risk low-profit opportunities will not be attractive.

3.2.5 Intra-EU trade of defence products

Definition. This factor describes the development of a more open EU market, where national firms are part of an intra-EU market.

The Defence Package

In December 2007 the Defence Package was published and recently adopted by the European parliament. This package consists of a vision and two directive proposals. The latter aim at, firstly, adapting the Community legislative framework for defence procurement, thus reducing the attractiveness of recourse to Article 296 for MS and, secondly, facilitating intra-EU transfers of defence goods (by simplification and approximation of national licensing schemes), thus allowing the development of a truly European market.

Driver description. European defence markets are fragmented because of protectionism based on Article 296 of the EC Treaty, the controls on the transfer of defence equipment, the national controls on strategic defence assets and the national specifications for defence requirements. Further distortions of the market are created by offsets, monopoly and subsidised state-owned enterprises

with barriers to entry and exit, firms receiving cost-plus contracts, and the absence of a genuine capital market for Europe's defence industries which would allow take-overs of defence companies. EU defence industries and markets are therefore inefficient and intra-EU trade is severely hampered. On average, MS spend some 85% of their procurement budgets within their nation state. This has resulted in 89 different weapons (mostly national) programmes compared to only 27 in the US (European Commission, 2007).

The EDA has taken initiatives aimed at the supply side and the functioning of the market mechanism, particularly in cases where MS invoke Article 296. The EDTIB strategy adopted in 2007 provides overarching guidelines. More specific initiatives include the Code of Conduct on Defence Procurement and the Code of Best Practice in the Supply Chain. A Code of Conduct on Offsets has been adopted to take effect from July 2009. In recent years, the EC has also made considerable progress, starting with the communication 'European Defence Industrial and Market Issues – Towards an EU Defence Equipment Policy' in 2003 and the consultation process initiated by the Green Paper in 2004. The interpretative communication of 2006 specified and limited the area of application of Article 296.

Developments in the Big Three markets (UK, FR and DE) in terms of access for foreign companies (with both formal and informal restrictions) is improving, but progress is slow. Germany's defence industry policy puts emphasis on maintaining a national industrial base. France has become slightly more liberal, but access to the home market remains quite closed throughout the supply chain. However, foreign participation in export programmes is possible. The UK has opened up to some extent, with good positions – mostly through subsidiaries within the UK itself[8] – for e.g. Thales and Finmeccanica in addition to US firms. The 2006 Defence Industry Strategy, however, marks a shift from a competitive procurement policy to a protectionist policy (UK MoD, 2005). The UK's key defence industrial capabilities will be retained through MoD offering protected and guaranteed markets to preferred suppliers based on long-term partnering agreements. It is believed that a major driver for this change was pressure from BAE Systems, which had incurred losses on a number of major fixed price defence projects (Astute submarines; Nimrod MR4 aircraft). Indeed, the European share of imports of EU MS has increased, but with UK, IT and NL lagging behind (Eriksson, 2007).

The Finmeccanica Group

An example is Italy with the Finmeccanica Group. This conglomerate represents some 80% of the overall Italian defence industrial base. In such a situation, a national monopoly is close and pressures for the protection of the national industrial base are strong. Finmeccanica is increasingly operating internationally with a multidomestic strategy based on Italy and the UK, whilst also trying to develop activities in the US. Therefore Finmeccanica has an interest in European and wider international collaboration. In fact Italy does participate in many international programmes.

Factors of influence. The cautious trend towards more open intra-EU defence markets, strongly favoured by the (larger) European countries that have a substantial defence industry, may be followed through to a considerable extent across the EU27 in the next decade. Article 296 is increasingly only used as intended by the Defence Package. If, however, some MS keep cherishing the transatlantic bond and others will let operational quality decide, one may once again end up with non-European companies offering a

[8] It should be noted that allowing foreign ownership within the UK domestic defence sector is different from opening up the market to direct imports.

superior price-performance ratio. The larger MS with competitive primes at the system level will be compelled to protect these.

Clearly, the evolution is fully dependent on the evolution of the national industry policies of the MS as well as on the practical implementation (or lack of it) of EU policy initiatives to stimulate open markets. In practice, a mix may be expected. Such a mix of both pressure for national solutions and international collaboration can be found in many MS (openness is seen as creating opportunities as well as risks). The factors driving an intra-EU trade are the opportunities to benefit from cost-effective solutions, in the presence of a national security of supply. The high competencies in complementary technologies and a well-coordinated European research policy may also act as stimulating factors.

Impact on the EDTIB. The efficiency, and as a result of this, the competiveness of the EDTIB are at stake, certainly in the long run. Due to the economy of scale, the European Midcap firms and SMEs will be limited in their development. The primes will have no real problems, due to their present multidomestic focus and organisation. In Alternative A, consolidation may have a negative impact on operational sovereignty and security of supply, regional distribution and employment, which may become critical issues.

3.2.6 EU-US trade of defence goods

Definition. The transatlantic EU-US market being open for trade of defence products and services, including cooperation in defence R&D.

Driver description. The ITAR rules form an obstacle to ensuring security of supply for products that EU governments may want to procure from the US, probably at the system level and certainly at the components and subsystems level (Hale, 2008). A large part of this consideration is linked to the unpredictability of the licensing process, in terms of result and duration.

The aim of most European firms, especially primes, is to maintain a high level of activity in the domestic markets, and at the same time expand and extend their defence business into the US defence market, because the US is by far the most lucrative defence market. British companies have a vast advantage in creating transatlantic business because of the intimate military relations between the US and the UK. When and if European companies receive a US order, these orders often have to be produced under license in the US. It is generally an implicit obligation for the contractor to create a production facility in the US, which is seen by decision-makers (not least in Congress) as favourable to the 'US national interest'. Therefore, an order from the US may not result in much European production, meaning that it will not create supply chain repercussions in Europe. US companies do certainly acquire state-of-the-art subsystems from European manufacturers, which can be produced in Europe. For the most part, these will be systems that have a broader scope of use, e.g. specialised aerospace subsystems. A further opening of the EU and US markets would stimulate trade between the two regions. In that case EU national firms will also gain access to the US market (and vice versa), potentially leading to improved quality and less cost. The UK-U.S. Defence Trade Cooperation Treaty could serve as a blueprint for more open transatlantic trade.

The current EDTIB has found the following four ways to circumvent trade barriers:

- Participation in international development programmes, the larger ones typically US-led, with the JSF programme as the quintessential example.
- Foreign production facilities (e.g. the successful protective clothing factory of the Dutch company Ten Cate in the US).
- High-quality products in 'depolitised' niche markets at subsystem and component level. Niche players will be allowed access to foreign markets more easily than the big players operating at system level.
- Offset policy, which is discussed in section 3.3.5 (Eriksson, 2007).

Factors of influence. Europe may succeed in its efforts to free itself from the dependency on ITAR-regulated products, wherever justifiable on economic and political grounds ('ITAR-free' policy). The security of supply arrangements of the US with the UK, IT, NL and SE can also be regarded as viable steps towards this option.[9] Another stimulus is that, despite initial opposition, on December 10, 2008 the MS have adopted a 'Council Common Position' defining common rules governing the control of exports of military technology and equipment. This code is a legally binding code, even if export controls will remain a national responsibility. Here, a combination formed by transatlantic security cooperation, featuring the role of NATO, and economic policies is the decisive factor.

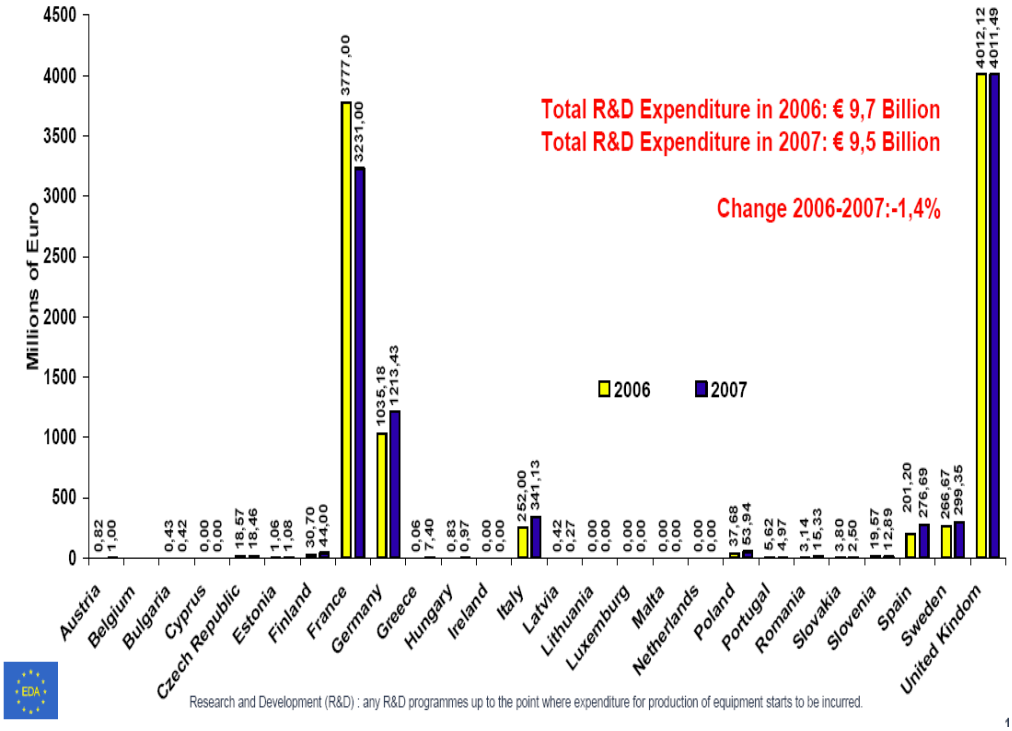
Impact on the EDTIB. If the trade barriers between US and EU would be reduced, the EDTIB would change significantly. An open market would create more competition, also for Midcap firms and SMEs. The pressure on cost would increase, but because the economies of scale would be higher most firms would be able to adjust to this new situation. This would also force firms to improve collaboration with other firms and research organisations. Furthermore, the nature of innovation would change. Due to the stronger competition innovation would pick up pace, leading to more efficient research, but also less radical innovations (these need a more secure development environment). Linkups with civilian-oriented firms and research organisations would be enhanced. The downside is that the overall capacity of the EDTIB will be reduced. In the competitive environment of an open market some capabilities will prove to be less viable.

3.2.7 European coordination on Research and Development

Definition. This driving factor is about the further development of a coordinating mechanism for R&D in Europe on a European level.

[9] See http://www.acq.osd.mil/ip/security_of_supply.html

Driver description. The amount and quality of defence R&D affect the EDTIB in terms of the three Cs: capability, competence and competitiveness. Today, almost all R&D in the defence domain is organised on a national level. In total, the 27 MS invested some € 9.5 billion (2007). To put this figure into perspective, the annual budget of the EU Seventh Framework Programme is about the same order of magnitude and one may expect the total of all R&D expenditures of the MS to be tenfold.



Total EU defence R&D spending in 2007 was a mere 15% of the corresponding US investments. This situation is further aggravated by the severe fragmentation of these budgets and duplication of R&D across the EU-27. The United Kingdom, France and Germany were responsible for about 90% of all expenditures (2007), where the primes receive much of the funding. It can be said that the overall trend in defence R&D budgets is declining.

On the other hand, generic R&D investments in Europe are more or less stable (1.83% of the GDP), or even increasing in an absolute sense (www.eurostat.eu). The FP7, compared to the FP6 has seen a significant increase in budgets.

Between the different MS there is little coordination on R&D investments (including R&T). At the European level, the EDA now also has a relatively small budget for defence R&D (about € 55 million (Joint Investment Programme, 2006)). However, in the big scheme of things this is a very limited amount of money, meaning that it remains to be seen at what pace the EDA will be able to expand its activities (and budget). Although it is Europe's intention to increase collaborative R&T spending from 10% to 20%, there is no set time limit to that ambition. As a result, the coordination in research activities and efficient use of new technologies is limited, especially its use by Midcap organisations and SMEs. The broad innovative drive from R&D could be improved by coordination. Projects for defence research are currently not possible

under the Framework Programme. However, the opening for security under Framework Programme 7 is a positive step with important implications for the EDTIB. In a similar vein, the EDTIB stands to benefit from opening up the ESA programme for defence-related space activities.

Factors of influence. It is conceivable that the vision of MS developing their own niche expertises in RTD as well as on the industrial side, with a European infrastructure of regionally distributed centres of excellence (CoEs), becomes reality.[10] A crucial stepping stone would be the intensified cooperation within a core or pioneer group centred round the LOI 6 (accounting for well over 90% of the defence R&D spending in Europe). Opening up of the Framework Programme and the ESA programme for defence-related activities will fit in this alternative. It could, however, also happen that the current practice of MS coming together for research and technology projects on a case by case basis, will not be replaced by a structural, broad commitment to close international RTD cooperation.

Community policies like the Framework Programmes positively affect the coordination of research, as these require multinational cooperation between firms. Also the linkup with the civilian domain may be beneficial, in view of the increasing general trend towards dual use. On the other hand, since national support of defence research is heterogeneous, an evolution towards more coordinated research will only be in the interest of the relevant MS if this will lead to more efficiency and still serves the national interests. It is important that the defence research budgets of MS that are not contributing to the overall budget at present will be increased. An important driving factor would be the identification of certain areas were cooperation is crucial due to lack of critical mass, or areas where multinational cooperation is required because of the complexity of a project. In the end, the coordination of the EDA is crucial, due to the vested interest of individual MS.

Impact on the EDTIB. R&D investments highly influence the EDTIB. As budgets are expected to be under pressure, efficiency and effectiveness of research need to be improved. If the reduction of budgets is not countered by improved efficiency, the innovative and competitive capabilities of the industry will surely be reduced. The defence sector is after all a high-tech industry. Coordination of research can also increase cooperation between firms and strengthen the linkages to research in the civilian domain, leading to a better EDTIB (3Cs). But better coordination can also lead to a decrease of fragmentation, and lower redundancy of research within the EU. This would lead to a decrease of high-value employment (researchers).

3.2.8 Future EU enlargement

Definition. The further expansion of the EU with new MS like Turkey and Iceland, Ukraine and Georgia are possible in the long term, which would have an impact on the EDTIB.

Description. The EU has grown from its original 6 founding members to the 27 MS of today. However, this enlargement of the EU is a continuing process. In 2004, the EU had his largest single expansion, when 10 new accession countries joined, recently followed by Bulgaria and Romania. At present, countries like Turkey, Macedonia,

[10] Note that the EDTIB CoEs are supposed to emerge 'as an industry-driven process'.

Switzerland, Croatia, Iceland and Norway are still in the process of negotiations or otherwise considering to join the EU.

This future enlargement may also have an impact on the future shape of the EDTIB. Being part of the EU, these new countries will both add to the industrial base and to the European demand for products and services. Also, defence R&D will be increased. Looking at the potential new MS, the industrial capacity will be increased, although this is going to be limited due to the existing industrial base in these countries. Turkey is an important contributor and only has a limited number of firms that are 500+. The demand side, on the other hand, may become a significant addition to the market. Again, Turkey has a significant defence budget, but other new MS contributions will be limited.

Turkey as a new Member State

Looking at Turkey, the EDTIB would be increased with some interesting firms like TAI, which has annual revenues in the field of Aerospace of 200 million dollars and often participating in the JSF programme. Also annual expenditure to defence research is considerable, with some 125 million dollars (2007). Turkey places greater emphasis on R&D for developing original defence technology aiming to possess the most rapidly developing defence system of the Middle East and Europe starting in 2010.

On the other hand, Turkey's domestic demand is significant as well, with an annual expenditure of almost 10 billion dollars. Turkey has one of the biggest militaries in the Middle East and spends on average $3.5 billion annually for procuring new defence systems.

The Undersecretariat for the Defence Industry (SSM) is sponsoring 176 projects for developing land, marine and aerial vehicles and detectors, rocket and missile warheads, electronic communications and information systems, including R&D projects (Today's Zaman Ankara, 2007).

Factors of influence. If the enlargement of the European Union will continue, this is likely to lead to a small but significant increase in defence industry and national defence budgets. However, it is also possible that the recent problems with enlargement will continue.

The societal and political atmosphere regarding the EU enlargement is very important, as is the ability of the potential new MS to meet the EU requirements. The credit crisis will surely not help them to make the changes needed for joining the EU.

Impact on the EDTIB. If the new MS will join the EU, some minor, but significant changes may be expected. Since the relevant businesses in the new MS often address international markets, these linkups are useful for the further globalisation of the EDTIB. The capabilities addressed by these new firms are probably not fundamentally new, being already covered by the present EDTIB, but their mainstream products and services may prove to be an added value. It is important to note that the enlargement will also make further coordination more difficult, as recent experiences have shown. This may lead to a less efficient and effective EDTIB.

3.3 National policy drivers

3.3.1 Introduction to national policy

At this moment, the defence industry is highly influenced by the national policies of the individual MS, as e.g. stated by Nick Witney in his well-known paper to revitalise Europe's security and defence policy. Although the Council agreed to further strengthen the European coordination on defence and security policy at the Helsinki Summit of 1999, little has been accomplished so far, and national policy is still dominant. Although some trends signal that this may change in the future, it is still necessary to discuss the driving factors seen in national policy.

National policy is the domain of governments and politics. Within this system, traditionally some core pressures can be identified that influence the structure of an industry like the EDTIB: 1) Defence and security policy (including budgets); 2) Industrial policy; 3) Research and innovation policy; 4) Defence policy instruments and regulation.

Citations from national strategy papers

From the German 2006 Defence White Paper: "A modern Bundeswehr requires an efficient and sustainable defence industry base. This will need to be defined increasingly in a European context, given the limited national resources and restrained national demand. Political, military and economic aspects make in-depth cooperation highly important for the EU MS to meet the materiel requirements of their armed forces. For this reason, the development of a European armaments policy is a central goal in establishing and expanding the European Security and Defence Policy. It means having indigenous defence technology capabilities in order to co-shape the European integration process in the armaments sector. These will guarantee cooperability and assure an influence in the development, procurement and operation of critical military systems. Only MS with a strong defence industry have the appropriate clout in Alliance decisions. The political leadership and industry must jointly define the strategic positioning of German defence technology in Europe. The Federal Government will do its utmost in this regard to preserve a balanced mix of defence technology, including its high-technology areas, in Germany. National consolidation, such as is taking place in the shipbuilding industry, is preparing Germany's defence technology enterprises to suitably position themselves for the restructuring process in Europe. By developing interministerial strategies and continuing our dialogue with the industry, we are looking to preserve competitive industrial capabilities in key technology areas of the German defence industry as part of a balanced European partnership."

From the UK DIS: "Strategic industrial influence. Without an onshore candidate platform systems engineer, our negotiating leverage in procuring equipment competitively in the global market would be markedly reduced and we could be exposed to overseas monopolies. And in cooperative programmes, it is important to be able to participate meaningfully on an equal or near-equal footing with international partners." And: "National provision. In some areas, overseas sourcing is impossible, for legal or security reasons."

From the French White Paper: "Defence industry must be European in order for its companies to become competitive worldwide. Individual European countries can no longer master every technology and capability at national level. France must retain its areas of sovereignty, concentrated on the capability necessary for the maintenance of the strategic and political autonomy of the nation: nuclear deterrence, ballistic missiles, SSNs, and cybersecurity are amongst the priorities."

Looking at these (sub)categories, the following drivers were identified that have a strong influence on the developments in the EDTIB:

- **National defence budgets**
  An influential changing factor is the further development of the national budgets for defence, both R&D and other expenditures.
- **Bottom-up cooperation between MS**
  Cooperation can be organised on a European level, but MS can also take the initiative to organise cooperation between individual nations.
- **The role of NATO**
  Being an important international defence organisation structure, the strength and role of NATO can also have an impact on the strength of the EDTIB.
- **Offset policy**
  One of the main mechanisms for cooperation between US and EU are the offset agreements, connecting national procurement to industrial orders.

- **Integration between defence policy and security policy**
  The link between defence and security is becoming so strong that a distinction can not be made with ease. This also will have its effect on the industrial and technological base.
- **Integration of general industrial policy and defence-specific industrial policy**
  Traditionally, the defence industrial policy stands apart from the more generic industrial policy (due to the special role of government). The opening of markets and the further increase of interlinkages will also help to integrate both policies.
- **Public-private partnering**
  In the past, the organisation of defence operations was exclusive government business. A trend is to be seen towards increased servicing of goods (e.g. leasing of products).
- **Defence industry ownership**
  In some MS a significant part of the national defence industry is owned by the government. This is an important factor that stimulates national procurement and may be an impediment to the creation of multinational firms.

These factors will be further described in the following sections.

3.3.2 National defence budgets

Definition. This factor includes the development of national defence budgets, being an important demand condition for firms.

Driver description. Since the European army is still limited in size, the defence expenditures of the European Union are still a national matter. Following the end of the Cold War, the defence budgets in the EU were either reduced or kept broadly constant in real terms (the size of defence budget is a political choice reflecting voter preferences between defence and social welfare spending). The defence budgets of the UK, FR and DE in 2007 amounted to some 60% of the overall defence budget of the EU27 (2007: € 200 billion). These three nations account for 68% of defence investments (defined as equipment procurement plus R&D). The tendency in the Big Three is flat or slightly increasing budgets. Within these budgets, more room is being created for investments in expeditionary, network-enabled, well-equipped and more specialised forces. The recent French White Paper projects that as of 2012 the defence budget "will rise by 1% per year above inflation, with the priority going to procurement." (Défense et Sécurité Nationale, 2008). The latter is exemplified by the reduction in personnel, from the current 270,000 to 225,000 by 2015-2016. Compared to the US, the EU expenditures are limited. The overall expenditures of the US in 2007 were almost € 500 billion, being 4.5% of the GDP; the EU expenditure is 1.7% of the GDP. For the EDTIB another telltale indicator is that the expenditure of products and services in the EU per military is about 20% of that of the US. Also, the budget for R&D in the US is almost six times that of the EU. These budget trends and the rising cost of equipment meant that defence planners were forced to make difficult choices. These choices have included major revisions in the defence policy, being reflected in smaller forces and reduced equipment orders, cancellations of major programmes and a reduced willingness to pay for costly nationally produced equipment: hence, more willingness to import foreign defence equipment. Typically, imports of defence equipment have been associated with offsets. The 2008/09 economic and financial crisis is likely to place even greater pressure on national defence budgets leading to further force reductions, fewer new equipment orders and an even greater willingness to buy equipment 'off-the-shelf' with associated offsets. In *A Strategy for the European Defence Technological and Industrial Base*

(EDA, 2007) key government actions are described to strengthen the EDTIB. Legislative (e.g. the defence package) and other actions (i.e. the Codes of Conduct of EDA and the EDA electronic bulletin boards) are undertaken. The effects these actions will have will show themselves in the years to come.

The biggest LOI6 Countries and the EDTIB

This box identifies the most important differences between the strategies of the largest LOI countries and the EDTIB strategy of 2007. On Key Government Action (KGA) of the EDTIB strategy, clarifying priorities, France, Germany and the UK see the necessity of adapting their defence to new challenges and include new priorities focusing on protection, preventative measures, the 'global war on terror' (GWOT) and surveillance. France considers nuclear deterrence as an essential part of national security. Germany on the other hand especially mentions peacekeeping and humanitarian operations. The EDTIB strategy paper calls for more, better and more cooperative spending on Defence R&T, i.e. increasing investments. Especially Germany faces restraints in defence budgets and budgets for defence-related R&D, whereas the situation in France and the UK looks more favourable, at least without decreases. Therefore, especially Germany welcomes more European cooperation. In regard to demand consolidation, France is largely self-sufficient in military supply according to the Jane's Defence Industry report from 2007. Germany faces more difficulties and is even considering outsourcing part of its defence logistics to private companies. With relation to increasing competition and cooperation, especially France and the UK, but also Germany want to keep their strong and leading position in their key defence industry sectors and technologies. France and UK explicitly state in their defence white papers to nationally retain certain technologies like nuclear submarines and exclude them from foreign competition. At the same time all countries, including France and the UK mention that in certain areas specific capabilities cannot be mastered on the national level. In order to ensure security of supply, procurement policy must also include the options for more openness and cooperation. In regard to offset-policies, Germany is the only country of the three that officially regards offset policies as economically counterproductive. In general there seem to be two major conflicting forces at play: the need for cost reduction through more open procurement and competition on the one hand, while protecting one's own leadership in key positions on the other.

(More detailed information per LOI3 member state is provided in the Annex B).

Factors of influence. A strong increase in budgets is not to be expected, unless the security situation would deteriorate dramatically. The present economic slump makes overall cuts in defence budgets more likely.

Security and defence are certainly on the political agenda, but this does not lead to strong public and political support for a sizable increase of defence budgets. In the short run, the economic crisis does not leave much room for increasing defence budgets. If the credit crisis will increase, budgets will even become tighter, although employment considerations may prevent governments from restructuring their industries. The pressure can even be increased due to other political issues, like the sustainability challenge and the pressure on the healthcare system (see relevant sections). Shocks in the security environment and/or an increased and shared sense of urgency (change of perception) may lead to growing budgets. Looking at 9/11, it is clear that any similar event will put further developments in a different perspective.

Impact on the EDTIB. National defence budgets may well be the driver that has the single most important influence on the performance of the EDTIB. Higher budgets with a surplus spent on modernisation clearly stimulate a vital EDTIB, although it may also bring about inefficiencies on the market. On the other hand, budget pressures have led

and will continue to lead to defence firms moving into the wider security sector (compared with the narrow defence sector). European defence budget pressures will also stimulate defence firms to search for new export markets in the rest of the world.

3.3.3 Bottom-up cooperation between Member States (MS)

Definition. This driver may be described as the bottom-up organisation of cooperation between individual Member States (MS), concerning either procurement, or research or any other defence-related activity.

> Dutch/Belgium bottom-up cooperation
> Since 1996 the navies of Belgium and the Netherlands operate in a fully integrated operational staff. Operational and logistics education and training programmes have also been integrated. The Netherlands-Belgium squadron consists of four Dutch air-defence (AD) frigates, two Dutch multipurpose (M) frigates and two Belgium M frigates. The latter have been purchased from the Dutch. The maintenance of the M frigates is shared and all vessels go through the same modification programme. Furthermore, the Netherlands and Belgium both will obtain the same 'navy' (NFH) configuration of the new NH-90 helicopter that, from 2011 onwards, will be able to operate from the frigates. All in all, a very substantial and real technical, logistical and operational collaboration has been established.
>
> The second example is the way the Netherlands deals with the 'capability gap' in strategic airlift. First of all, the Netherlands, with a number of other countries, participates in NATO's Strategic Airlift Capability C-17. This is a rather unusual project, because the MoD invests without becoming the owner of the acquired platforms, but rather obtains 'drawing rights' on a number (500) of 'flying hours'. In effect, the Dutch armed forces obtain a (future) service. For the remainder of the anticipated demand in strategic airlift a public-private partnership (PPP) construction is being negotiated. A number of private investors is willing to invest in strategic airlift capacity that, as a daily business, is for offer on the commercial market. However, in lieu for an upfront investment from the MoD, the capability satisfies certain military requirements and is available, if need be on relatively short notice, for the transport of military materiel to mission areas.

Description. The present European defence cooperation policy can be characterised by its top-down approach. However, in the years ahead the organisation of procurement, research and other cooperation may well acquire a bottom-up character. This would mean that the individual MS will develop new bilateral or multilateral cooperation on an ad hoc basis, meaning that the role of the EU will be limited. The bottom-up interdependency created in this manner forms a strong incentive, if not driver, for political convergence. If we would take e.g. the existing BE-NL cooperation one step further, it is conceivable that BE and NL will regularly provide escorts for FR and/or UK aircraft carriers. These bottom-up initiatives will be less difficult to establish, due to a less complicated political process that underlies it. Also, the ad hoc character will help to reduce complications in the political process, due to limited structural effects. On the other hand, this bottom-up approach may reduce long-term efficiency, due to 'subsystem optimisation'. Also, the actual effectiveness strongly depends on the bilateral relations. This driving factor will also have an impact on the EDTIB, as it may be accompanied by bottom-up cooperation for procurement, research and other initiatives that influence the development of the EDTIB.

Factors of influence. The rather isolated and often ad hoc initiatives could either lead to a real successful structural and active cooperation between EU MS, including an optimal division of labour (task specialisation according to a shared blueprint) or just remain a patchwork of cooperation structures that are not fully embedded in the defence policy of most MS.

Due to budget reductions and cost increases, most EU MS are experiencing a situation where they cannot afford to cover the broad toolbox of military capabilities required to adequately deal with the broadened mission set of today's expeditionary world[11]. Such a situation provides an incentive for cooperation with other partners who will share the costs. This is enhanced by the fact that at the national level either capabilities have to be disposed of or are spread so thin that critical mass and economy of scale issues become unfavourable. In many cases, international cooperation, expressed in a wide range of combined structures and units, resource pooling and means/task specialisation, is an option to retain (access to) a vital set of capabilities in a cost-effective way. Another important driver for bottom-up cooperation is the active engagement of EU MS in demanding multinational operations, such as ISAF[12]. Casualties put pressure on national politicians to share the burden, as well as establishing clear 'rules of engagement' between partners. On the other hand, these bottom-up initiatives require the synchronisation of systems and operations, which will provide a barrier for actual cooperation. Future technological and organisational developments, where alignment problems are reduced, will have a positive effect on the actual development.

Impact on the EDTIB. A bottom-up cooperation between individual MS will improve the efficiency of the EDTIB, but this will be limited because of its ad hoc character. Also, the nature is (in principle) bilateral, which is not the same as an efficient organisation from the point of view of the EU industry. On the other hand, it may lead the initiation of new joint ventures, where critical mass is established, providing the start of multinational initiatives. In conclusion it may be said that although the direct effects are limited, the indirect effect may be the start-up of broader initiatives.

3.3.4 The role of NATO

Definition. NATO is the international military treaty organising cooperation between the armies of the different members in military operations.

Description. Most EU MS are also member of NATO. For many of these nations NATO constitutes an important framework for force development objectives as well as actual operations. The 'hard' security provided by NATO may be complemented by the 'soft' security provided by the EU. For NATO, the EU can be – and indeed is[13] - an essential partner in providing an exit strategy for NATO operations. However, if NATO degrades to an 'old boys lounge' organisation[14], an important cornerstone for Europe's security crumbles away.

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[11] During the Cold War many small (West) European countries had 'natural' niches and no reason to have the broad toolbox that is useful in today's security landscape.

[12] With a series of casualties for the UK (91), Germany (25), Spain (23), the Netherlands (14), France (12) and Italy (12) in the period October 2001 - March 2008 (based upon The Afghanistan conflict Monitor of the Human Security Report Project, www.afghanconflictmonitor.org/military_casualties/index.html).

[13] In Afghanistan, the EU is one of the biggest donors for the reconstruction effort and supplies a (albeit limited) police training mission. In Kosovo a mutual dependency exists between NATO's KFOR and the EU mission EULEX.

[14] The phrase is used to depict a totally inadequate future Alliance (from Stephan de Spiegeleire et al., CCSS Report 05-003, NATO Future Worlds. An Input into NATO's Long Term Requirements Study, September 2005).

Since the end of the Cold War, NATO has struggled with the demise of its raison d'être, the Soviet Union, to the point where serious questions were raised whether NATO should even continue to exist. NATO is facing obvious problems, ranging from MS having different perspectives on the security challenges via uneven burden-sharing to an inadequate force generation process for the ISAF mission in Afghanistan.

Factors of influence. A new consensus over the role of NATO may emerge, meaning that the world's most powerful military alliance will continue to lead the military trends that shape the world. But the future for an effective Alliance may also become debatable. There is every sign that the Obama administration is aiming at reinstating its European partners as key allies in global security. An effective NATO would suit this policy. Another important driver would be a shared sense of urgency and (perceived) common threat, within Europe and across the Atlantic. On the other hand, a number of trends that were weakening the Alliance have been reversed:

- Russian belligerence is on the rise. Especially the new NATO members Estonia, Latvia, Lithuania, Poland, Slovakia, Slovenia, Hungary, Bulgaria and Romania – all former Warsaw Pact or Soviet Union states – are extremely concerned about the potential dangers involved.
- A nuclear-armed Iran, with Europe already increasingly within range of Tehran's ballistic missile arsenal, is widely perceived as a threat.
- The two powerhouses of continental Europe, DE and FR, have reinstated NATO as the pre-eminent military tool for European foreign policy. FR has drawn closer to the US on foreign policy issues – with the imminent reintegration in the military structure of NATO as a result.
- The US will slowly disengage from Iraq. It now can direct more of its attention back to its European allies and NATO.

Impact on the EDTIB. A coherent NATO emphasises standardisation and interoperability, and possibly also common programmes. For many (particularly 'warfighting') capabilities US (technological) leadership will set the norm. This would also sets requirements for the interoperability of the products and services to be provided by the EDTIB, enforcing cooperation or at least alignment. Also, the cooperation and synchronisation between EU and US may receive a further boost.

3.3.5 Offset policy

Definition: A national government as buyer of defence equipment has the choice whether, as a policy, to demand, accept or not accept compensations, i.e. offsets, offered by the seller.

Description. The practice of demanding or otherwise accepting offset is something that typically happens when country A buys already developed equipment from country B. Hence offset can be seen as an off-the-shelf counterpart of 'juste retour' arrangements in collaborative development projects. There exist many alternative concepts like Industrial Cooperation and Industrial Participation. Offsets are seen as practices that distort the market, and they are generally banned in public procurement by WTO and EU regulations. Defence is, however, exempt – in the case of the European Community by the famous Article 296 (TEC).[15] On the other hand, some claim that offset is "the

[15] As a general reference on offset, see Eriksson E.A. et al., Study on the effects of offset on the Development of a European Defence Industry and Market, 2007 (a study by FOI and SCS for EDA).

most liberal instrument in an essentially closed market".[16] Offset may be used as a stepping stone for a structural market approach. It offers companies down the supply chain opportunities to enter an otherwise impenetrable supply chain with high-quality products.

France, which does not have a formal offset policy and Germany which does not accept offsets as a matter of policy – together with the EC – emphasise the negative economic effects of offsets. Other MS do accept, and in many cases (effectively) request, them. Offset patterns vary considerably:

- MS who are net defence equipment exporters but also considerable importers – IT, NL, SW and UK – tend to prefer indirect military offset, i.e. export of one type of equipment is counted as offset for the import of mostly a completely different type of equipment. This practice, many argue, can help reduce fragmentation in the market and stimulate specialisation.
- MS who are big importers and have the ambition to develop their domestic DTIBs – e.g. EL, ES, FI, PL – tend to prefer direct military offset, i.e. business related to the particular equipment they are buying like manufacturing of subsystems or final assembly. As mentioned, this practice is intended to develop a DTIB but runs the risk of adding to duplications of competencies at European level. This practice may also render defence supply chains less cost-efficient than comparable ones in commercial industries, with typically more stable business relationship between prime and suppliers. For this reason, this type of offset is normally the most expensive for the selling companies and will generally incur a price mark-up.
- Most other MS are small actors both in terms of export, import and manufacturing. They tend to prefer indirect civil offsets, which have as it seems very limited effects, either positive or negative.

Factors of influence. The European defence equipment buyers can agree to progressively downsize offsets, as other more efficient instruments are put in place for opening up defence equipment markets and defence industrial supply chains. The main issue here is whether big buyers find asking for offset worthwhile or are in a position to find better alternatives. The possibility of someone legally challenging offset can be seen as a wildcard.

Impact on the EDTIB. Offsets generally hamper efficiency, but can under certain conditions – e.g. irrational preference for domestic suppliers – also lead to certain efficiency improvements. A regime in which offsets are eliminated step by step, simultaneously introducing more effective policies to achieve their positive effects would clearly render the EDTIB more efficient.

3.3.6 Integration of defence policy and security policy

Definition. This factor aims at the integration of policies on both defence and security activities on a national level.

Description. The dominant characteristics of applying military force have changed significantly and there is a general tendency towards a stronger embeddedness of the defence policy in a wider national security policy. Traditionally, the Ministry of Defence only focuses on military affairs, but the distinction between military operations and e.g. homeland security is blurring. Terrorist attacks can be seen as including a

[16] Interview with Cent van Vliet, director of the Dutch Defence and Security Industry Association NIDV, 19 June 2008.

military aspect, but it is clear that it also has links to homeland security. In a combined approach, the use of military assets to support civil authorities in emergency response, crisis management and disaster relief (civil assistance) is an essential element. Some used terms are *All-of-government Approach*, *Comprehensive Approach* and the 3D Approach (*Defence, Development & Diplomacy*). In these approaches, several Ministries are cooperating, namely Defence, Economic Affairs, Internal Affairs, Development Cooperation and Foreign Affairs. Joining and aligning the separate activities will enhance the overall efficiency and effectiveness of operations. More or less four different areas can be distinguished that are relevant for this integrated domain: 1) Internal and external threats; 2) Crisis management; 3) Vital infrastructure; 4) Technology development.

Many countries are experiencing this trend and take action to develop the integrated role of defence and security. This is explicitly the case in, for example, FR, DE, the UK, SW and the NL. Especially the French 2008 White Paper stresses the importance of civilian and civil-military crisis management operations. The Dutch Ministry of Defence has made 25% of its forces available for this new role as security partner.

However, the integration of defence and security is not easy. There are not only organisational issues to address, but also the further development of new products and services. The synchronisation of communication between the police, fire departments, medical care, defence, etc. But also the more political aspects of an integrated approach need to be addressed: Who is taking coordination? How do we organise this politically? This organisation of the public administration over all levels (European, national, regional, local) is a crucial issue, involving implications for all products and services to be applied.

Factors of influence. This driver is highly influenced by public opinion. Historically, the public perception towards defence has been shifting from highly positive (just after the Second World War), to somewhat problematic. Although the public position towards defence operations is positive, it is under pressure. A stronger bond between defence and increased internal security will increase the commitment to defence. Directly linked to this are the internal domestic security issues that are a priority. Increasing the role of the armed forces when handling these security issues will contribute to a conscious policy of MoDs to become more visible to ‘the tax-payer’.

However, in the end the main influence controlling the evolution of this factor is formed by the ability and willingness of politicians to solve issues on the restructuring of government tasks to an integrated approach on defence and security.

Impact on the EDTIB. A further integration of defence and security will have some potential impact on the structure of the industry, but this is limited to specific areas. Especially communication is a domain where the integration will surely have some effect. The current capabilities for civil assistance differ from traditional ‘warfighting’ capabilities. If investments in the latter are reduced to benefit the former, this will impact the EDTIB. A second element is that there may be a shift in national defence budgets towards more security operations. This could have an impact on the EDTIB, reducing demand for specific military products and services, while increasing the demand for more dual-use, or integrated products and services.

3.3.7 Integration of general industrial policy and defence-specific industrial policy

Definition. The traditional separation between generic industrial policy and the defence-specific industrial policy is decreasing, integrating both perspectives.

Description. In many countries a clear distinction is made between defence industrial policy and generic industrial policy, the reason often being the government acting as the lead demand side of the market. Also, there are specific security considerations requiring another approach to the funding of research, development and innovation. A third important difference is that the innovation cycle of 'normal' innovation processes fundamentally differs from 'defence' innovation processes, like the very high requirements on quality to ensure the safety of the user.

However, some trends show that this policy of separation is becoming increasingly integrated. An example is the FP7 Theme on Security, where the difference with defence is becoming rather blurred. But also in the US, National security is (becoming) aligned with defence operations. Also, the combined humanitarian/military operations in Afghanistan often entail joining the defence operations with development policy. The recent Dutch Defence Industry Strategy is a joint venture including both the Ministry of Defence and the Ministry of Economic Affairs, resulting in a joint economic/defence industrial policy (TNO, 2006).

Core to these trends are the changing profiles of defence industry and generic industry policy, which is reflected in the dual-use activities, R&D and products. Traditional defence companies now also partly focus on the civilian markets. In the future, the EDTIB may show increasing integration into the wider industrial base[17], but it is not immediately clear to what extent. This dynamic process is also happening within the industry itself. For many if not most companies in the EDTIB, the MoDs and armed forces are a valuable, even important, but not dominant customer[18]. The optimal use of the innovative capacities of firms and research organisations calls for a combined industrial policy, so sharing resources and knowledge will increase the efficiency of the EDTIB.

Factors of influence. Generic innovation policy measures and defence policy measures may become aligned to a considerable extent, but there is also a possibility that there will remain a rather clear distinction between 'defence' and 'security'.

Important drivers for the integration of the policies are the pressures on defence budgets and higher programme development costs. These will stimulate defence policy-makers to find alternative funding to support the defence industry in innovation. On the other hand, the defence industry is a high-tech industry, which will be able to initiate high-quality research. Another driver is formed by the additional opportunities of defence research for civilian innovations. This dual use will stimulate defence-oriented firms and research organisations to get involved in the civilian research. Also the trend that civilian technologies are increasingly being used in defence innovations will stimulate integration. From a political perspective, the further increased attention for security may

[17] As a case in point: 'homeland security' / 'homeland defence' was the focal theme of Eurosatory 2008.

[18] As an example, the following statistics, taken from a May 2008 update on the quantitative characteristics of the Dutch defence-related industry: "The number of companies having defence-related activities in the Netherlands is some 290 (January 2007). For the vast majority these defence-related activities constitute a side activity, which is made clear by the fact that the 2006 defence-related turnover of 3.56 billion Euros is just 4% of the total turnover of these companies."

act as a stimulant for integration, as in some areas it is the lynchpin between defence and civilian innovations.

Impact on the EDTIB. The integration of policies may lead to less barriers to entry for defence firms to the EDTIB, more or less the way civilian innovations can have defence characteristics. Also, new innovation networks (essential for innovation) are more likely to be initiated in this case. Refarding the budgets, the funding for new innovations will become more easy for the EDTIB (access to new funding and increased general funding), but on the other hand there is a significant risk that defence budgets on innovation will be reduced. For 'economic' policy-makers, an integrated policy is interesting, because there will be relatively higher budgets, and also defence firms do have a certain status. For SMEs and Midcap firms, the broader instrumental portfolio of a civilian innovation policy will provide more opportunities. The concluding remark is that there is the risk that possible funding for defence specific innovations will be reduced, which will degrade the EDTIB.

3.3.8 Public/private partnering

Definition. As a rule, defence products are 'bought' by the government. This factor describes the trend towards a public-private partnership in defence products, e.g. the leasing of specific goods.

Description. All non-core tasks traditionally performed by military organisations are increasingly open to outsourcing. The pace is set by the US military, that has been trying to outsource all non-military activities since the eighties, including peacekeeping missions, security guards and armed guards to protect staff engaged in dangerous missions across the world. Private Military/Security Companies (PMCs / PSCs)[19] now form a substantial economic subsector, particularly in the US with firms like Blackwater, Executive Outcomes, Sandline and DynCorp, with an estimated turnover of between 20-30 and 100 million US$ in 2005, depending on the definition of the services included (Chapman, 2006)[20].

Although EU MS are less inclined to outsource 'active' tasks in-theatre, it is quite likely that an increasing number of services traditionally performed in-house will be bought from the market. Such services include: administrative services (e.g. Enterprise Resource Planning), maintenance, repair & overhaul, logistics services (e.g. strategic or even tactical (in-theatre) transport, communication and information services, satellite imagery, monitoring, surveillance and protection services, knowledge functions, education and (other than equipment-specific) training.

[19] Many firms prefer to distinguish between 'active', or offensive military providers, and 'passive', or defensive security providers. This distinction is not always clear in practice, however. Even unarmed contractors may still perform a military function, and companies engaging in front-line combat may not be officially employed in that capacity. Furthermore, many civil companies that are hired within the context of military operations don't consider themselves PMCs or PSCs, such as fuel providers or camp constructors. Brookings Institution author Peter W. Singer distinguishes between companies that predominantly operate in front-line command and combat operations, training and advisory programmes, and logistics support services. Since many companies operate in overlapping zones and provide a variety of services depending on the needs of their clients, these classifications may be applied on a contract-by-contract basis (Singer, 2003).

[20] The US have recently established a separate Command for dealing with PMCs (Defense News, March 3, 2008). The NATO Supply Agency (NAMSA) facilitates the hiring of private companies for the participants of the ISAF mission in Afghanistan.

Factors of influence. If governments are reluctant to shift or even share responsibility for the goods, the number of public-private partnerships may remain low and restricted to non-critical goods. But it is also possible that ultimately even some combat tasks will be outsourced.[21] Intermediate solutions are equally possible, e.g. when countries pool their means and private contractors organise the maintenance and deployment of those means.

Most of the benefits that apply in the civil sector (more efficient use of resources, better quality and faster innovation, more focus on core competencies etc.) are also valid in the military domain. If MS favour this economic rationale in the trade-off with e.g. security of supply, public-private partnerships become more likely. However, this depends very much on the actual quality and reduced risks of this concept. Experience needs to be gained, as well as the development of high-quality services. Also, the actual reduction of cost versus pressure on defence budgets is crucial.

Impact on the EDTIB. With increased outsourcing comes a shift between capital investments in means – e.g. buying a transport helicopter – and services-oriented running costs – e.g. obtaining a transport service. Deployment of this concept will develop a whole new business of PMCs/PSCs and is destined have a huge impact on the EDTIB. But it will also create new business models and new business behaviour of firms, and more civilian purely commercial firms are bound to step in.

3.3.9 Defence industry ownership

Definition. This factor is about the ownership of defence firms shifting from governments to private organisations and the stock market.

Description. Many of the present primes and other defence firms are partly owned by government, having a golden share. However, the ownership of the firms is changing. Traditionally, US firms often are privatised and some European firms have even established a presence in the US defence market (especially BAE, AgustaWestland and EADS). In the EU and Eastern European countries the governments are still deeply involved in the defence industries. The arguments against the privatisation of defence firms are that they will be less attractive to investors. Also the level of confidentiality of products and services is high and as governments are often sole customers, there is often a strong link between the government and defence companies from the innovation perspective (continuous interaction on requirements). On the other hand, arguments in favour of privatisation are that the efficiency and competitiveness of any firm will benefit from a fully privatised organisation. Also, benefits from commercial activities can be drawn to the defence side.

Ownership in France

In France, the national defence industry policy includes obtaining and/or maintaining certain share percentages in companies which reflects that minority and majority shareholders achieve certain strategic advantages and rights when they exceed certain levels. They may e.g. have the right to appoint representatives of the board, and with higher percentages even the CEO. In all French defence industry restructuring, there is always some part of government orchestration and consent, which is not a hidden agenda; it is clear government policy. The French government holds 27 % in Thales, 31 % of Safran, 75 % of DCNS, 100% of Nexter, and 15 % of EADS.

In several countries public ownership still dominates, but as a result of the trend towards liberalisation, the state ownerships in defence firms are declining. This

[21] PMCs in combat operations raise different economic issues compared with PMCs in support operations. The nature of contracts will, for instance, differ due to uncertainties involved in combat.

essentially means that private funds and other actors have entered the sector. US companies have also increased their presence in Europe through acquisitions (mainly in the United Kingdom, Germany and Sweden). However, in France, Italy and Spain, governments are still reluctant to sell their majority stakes in defence companies (the current financial crisis furthermore does not stimulate the sale of such companies).

Factors of influence. Ownership (whole or partial) of defence industries is an important factor to ensure the security of supply, while generating the means for operational sovereignty. Especially when it comes to the systems which are indispensable for the maintenance of national capabilities (see the FR and UK strategies), ownership contributes to the desired independence. It also gives the government an option to support employment via national procurement.

On the other hand, the same factors form a limit to cooperation, the set-up of multinational programmes and above all the creation of multinational firms, all of which are needed for a stronger EDTIB. Government ownership, or other forms of government-industry relationships, may be considered as one of the sources of the current fragmentation and duplication within the EDTIB.

Private ownership and operation on the stock market will create pressures for further restructuring actions to improve competitiveness and financial performance.

Impact on the EDTIB. Less government ownership and more private ownership may lead to increased efficiency and will make it easier to create larger multinational firms that strengthen the EDTIB. However, it will decrease the control of governments over the factors they consider to be of primary importance for their national security. FR and UK have clearly defined these capabilities and systems in their recent strategies. By doing so, they also indicated where multinational cooperation will be easier to implement.

3.4 Economic driving factors

3.4.1 Introduction to economic pressures on the defence industry

This category of driving factors includes the pressures from the economic environment of the innovative defence industry. It is clear that these changes in the economic environment are essential for the further development of the EDTIB. An example of an important driving factor is the current credit crisis, which will limit the availability of financial capital for both research and production. It will also affect government support for defence budgets. At the same time, the future strategy of the industry itself will have a major impact on the structure, conduct and performance of EDTIB.

There are many ways to assess the economic environment, from neoclassical theories to evolutionary economic theories. The so-called Porter ‘diamond analysis’ is a well-known and often used model for industry analysis at a national level (Porter, 1990). For this reason, the researchers have chosen this approach to assess the economic change drivers (see also Appendix: The EU Defence Industrial Base). This approach makes a distinction between four dimensions of drivers that determine the innovativeness and economic position of a sector/nation:

1. Factor conditions
2. Demand conditions
3. Related and supporting industries

4. Strategy and rivalry

The *factor conditions* constitute the first dimension. These are human resources, physical resources, capital resources, knowledge resources and infrastructure. Looking at the development of the EDTIB and the discussions in the various reports and papers, the following important uncertain driving factors are identified:

- **Access to human resources/skilled labour**
  This factor includes the essential elements from the labour market, like the quantity, skills and cost of personnel.
- **Access to capital resources**
  Being an important factor in the actual industrial activity, access of the defence industry to financial capital for investments and other aspects are described.
- **Access to knowledge**
  A third production factor is access to knowledge on scientific insights and technologies. Being a high-tech industry, this is crucial for performance.

The second dimension consists of the *demand conditions*. Usually, these include the home market demand for products and services (in this case the European defence market), but also the demand from outside the home market. Since the defence industry is very much dominated by government demand, this dimension is covered by the driving factors for change described in the previous sections on 'EU policy driving factors' and 'National policy driving factors'. However, we will pay attention to the demand outside Europe under 'Globalisation'.

The third dimension of the assessment of the economic environment focuses on *related and supporting industries*. Here the link to suppliers in the value chain and to the related industries (such as ICT), the international character of the industries and the networks in the industry are important determinants for success. Looking at the EDTIB, the following driving factors are identified as being essential for the future development of the sector:

- **Cooperation, consolidation and integration**
  Need for cooperation/consolidation within the defence sector and the integration and/or linkup with other industries.
- **Barriers for entry and exit**
  How difficult is it for newcomers to the defence industry to enter the market, or for firms wanting to get out of the market?

The last dimension that influences the development of the EDTIB is formed by *firm strategies and rivalry*. These are the predominantly cultural and strategic characteristics of the firms. They include aspects like the way firms want (or need) to compete (e.g. through cost or quality), their international orientation, their approach towards cooperation. The following defence-specific driving factors are identified:

- **Strategies of the industry/primes**
  What are the main strategies of firms, and especially primes, to compete on the market?
- **Integration of the defence industry with the civilian industry**
  Is the industry exclusively focused on defence, or does it also produce to satisfy the civilian demand?
- **Level of competition in the industry**
  What is the level of competition in the defence market. Cost-focused, quality-oriented, opportunities for investments, etc.

- **Globalisation of the structure of the industry**
  Is the industry organised in a multinational way, with strong global ties?

These driving factors, their potential evolution and effects will be discussed in the following sections.

3.4.2 Access to skilled labour

Definition. In the industry, skilled workers are important assets. This factor describes the access the defence industry has to skilled labour.

Description. The EDTIB is a knowledge-intensive industry. This implies that a strong EDTIB needs access to a substantial highly skilled workforce. However, due to restructuring of the EDTIB, the skill base (employment) in terms of numbers has decreased over the past decade to some 1.6 million people working for the EDTIB (primes, 1st tier and 2nd tier companies, both in their defence as well as their civilian sections). But the rate of decrease has slowed down in recent years and is now mainly driven by efficiency gains. On the other hand, due to the increasing level of complexity of the technology base of EDTIB, the workforce of the (future) EDTIB will be increasingly needing even more sophisticated and special skills. Indeed, skill shortages are beginning to develop notably in Eastern European countries, due to aging and emigration patterns (Anticipating, 2008). The search for these skills will extend to overseas locations (e.g. China, Japan, South Korea) through outsourcing of work to these countries. Furthermore, skilled labour shortages will lead to the substitution of capital (and new technology) for skilled labour (machines replacing workers). The United Kingdom, France and Germany are already having difficulties recruiting engineers specialised in electronic/electrical segments and programme managers.

Skills can be accessed/developed by training the *existing* workforce, by educating the potential *new* workforce and/or by hiring human resources from the competition or from outside the industry. These labour market considerations are influenced by the stage of the value chain. EDTIB suppliers that work upstream have different labour challenges than those working downstream (for instance, in the downstream part of the value chain, security considerations are a major factor of influence). Labour market issues also involve employer attractiveness.

Factors of influence. Access to skilled labour is influenced by the need for certain skills (for instance, if integrated services[22] are added to the value chain, this requires a complete new set of skills), the supply of skilled labour through universities and colleges (also influenced by the training these universities offer; i.e. the training has to comply with the EDTIB demand), the availability of skilled labour (influenced by aging populations and migration patterns), mobility barriers which are relatively high for a number of skills in the EDTIB, the price of the skilled labour, the comparatively low attractiveness of the EDTIB for young graduates (not only compared to e.g. civilian aerospace and shipbuilding but also even with the service sector).

Impact on the EDTIB. Because of aging, the continuous restructuring (downsizing) of the European defence industry and less attractiveness as an employer, the available skilled labour pool will probably decrease. However, there is a need for certain qualified skills which may then be sought elsewhere in the world. On the other hand, a number of categories of upstream companies (i.e. new materials, biotechnology, ICT,

[22] If customers want services instead of products, if their need shifts from new development to maintenance, this has an impact on the required skill base.

nanotechnology), companies that also do non-defence-related work or are predominantly involved in the security industry (in a wide sense) or operate on the cutting edge of technology could attract bright new employees.

The required quality and quantity of skilled labour has a major impact on the EDTIB. Without high-quality personnel, an industry can not function properly. Since the EDTIB depends very much on R&D, any shortage of skilled personnel will increase the problems. The availability of such skills is a major determinant of the direction in which the EDTIB can evolve. If there is a shortage, the competitiveness will decrease. Also, the desired capabilities cannot be produced, especially long-term capabilities.

3.4.3 Access to capital resources

Definition. This factor describes the access of the industry to the financial capital needed for investments in new technologies and innovations.

Financial crisis

At the moment of writing this report, a global financial crisis is developing. Governments are pumping 100s of billions of dollars and euros in the economy, specifically the financial sector and in some cases other economic sectors as well (i.e. the automotive sector in the US and France). In allocating funds, governments will be led by considerations with regard to the importance of the role of the sector for the functioning of the whole economy (financial sector), its role in terms of employment (e.g. the automotive sector) and/or the favourable perception of the public of the sector (healthcare; a clear and direct link to well-being).

From this perspective it seems rather unlikely that the defence industry will be a benefactor of such funds. However, at this moment any detailed prediction on the consequences of the financial crisis on the EDTIB is hard to make, but a significant impact is to be expected.

Description. Capital resources are defined as the amount and cost of capital available to finance the (defence) industry. The need for capital varies from financing operations and programmes to financing R&D (where R&D is basically financed by governments). The defence industries needs for capital are rather specific because of the nature of their markets (programme- driven, large cost, and sometimes long intervals between programmes/revenues). Governments are often the supplier of capital and pre-investment is only limited.

There are different types of capital available, varying from equity and stocks to venture capital (often related to start-ups). The available amount of capital in a country is affected by its GDP and its national rate of savings. Also, the availability of capital for specific investments in healthcare, education, defence, etc. is a political choice, largely dependent on the preferences of the constituents (the ruling parties). Of course, due to the globalisation capital increasingly becomes available outside the home country. In some European countries defence capital markets operate more like ‘normal’ capital markets. In the UK, Qinetiq, considered to be a vital element of the UK DTIB, first was privatised in order to be able to also operate on the civilian market. Then QinitiQ was bought by the Carlyle investment group which proceeded to sell Qinetiq a short while later.

A second characteristic of capital resources is the capital market structure that makes these resources available. R&D capital for the defence market mainly becomes available through (national) government funding. R&D expenditure (including R&T) amounted to € 9.6 billion in 2006[23] (1/6th of US R&D expenditure). On average the EU MS allocate 1,14% of their military budget (which is in turn dependent on their GDP) to

[23] In 2007 the R&D expenditure decreased with 1.14% to € 9.5 billion (EDA, website).

RTD expenditures as compared with 3,31% in the US (but still much more than non-European nations combined).

Factors of influence. Under pressure of political considerations, the privatisation of state-owned companies may continue (although the financial crisis that started in 2008 will slow down this trend). The stock could end up with private investors when defence industry companies become more attractive for investments because of a better risk-return rate. The availability/access to both governmental/public as well as private capital could also become less because of the financial crisis.

The risk-return rate of investments in the EDTIB, be it in R&D programmes or financing operations and programmes, vis-à-vis alternatives in the capital market is an important factor. However, this only holds for privately owned companies. On non-competitive contracts, governments usually award a government-determined profit rate. Take, for example, the UK non-competitive contracts, which have a profit rate similar to the average return for the UK industry. State-owned firms are not subject to capital market pressures (one of the major challenges in EDTIB). The availability of capital for defence RTD and defence programmes by EU governments is another factor of influence. This in turn depends on the development of the GDP of the MS and is actually decreasing. Also, the need for capital can change. For instance, military service providers have a different risk-return profile. The public opinion on the defence industry (including ethical considerations) can also exert great influence on the access to financial capital. For instance, in the Netherlands the pension funds (the largest investors in the market), no longer invest in firms developing specific weapons products (i.e. cluster bombs and land mines). Last but not least, the current financial crisis limits the banks in their lending and investing activities.

Impact on the EDTIB. Since the EDTIB is a capital-intensive industry with a rate of return that does not leave much room for investments, it requires external financing in order to grow. Insufficient availability of capital will hamper the development of the EDTIB. Governments fund defence-specific R&D. The current crisis may lead to less government funding for defence R&D and more incentives to buy off-the-shelf, with will have an impact on the EDTIB. On the other hand, being mainly funded by governments also feeds a trend to keep investments on track in the short term. But there is a risk that in the longer term governments will make budgetary cuts. However, for Midcaps and SMEs, the situation may be more difficult, since these firms will be more indirectly linked to governmental funding. Also, companies that have a dual-use character, may suffer from the present crisis and in general are very dependent on access to financial capital.

3.4.4 Access to knowledge

Definition. This driver refers to the (EU-wide) availability of scientific, technical and market knowledge on goods and services.

Description. The defence industry is a knowledge-intensive industry. This knowledge resides in universities, research centres, government research institutions, research & technology organisations (RTO's) and the R&D departments of companies. A characteristic of the EDTIB knowledge infrastructure is that defence R&D still remains embedded in *national* R&D systems, thus limiting access to relevant knowledge (Hartley, 2008).

Examples of centres of excellence

NATO Centres of Excellence (CoE)

- The Centre for Analysis & Simulation for the Preparation of Air Operations (CASPOA) COE in Taverny Air Base, France
- The Civil-Military Cooperation (CIMIC) COE in Budel, the Netherlands
- The Combined Joint Operations from the Sea (CJOS) COE in the United States
- The Command & Control (C2) COE in Ede, the Netherlands
- The Cooperative Cyber Defence (CCD) COE in Tallinn, Estonia
- Defense Against Terrorism (DAT) COE in Ankara, Turkey
- The Joint Air Power Competence Centre (JAPCC) COE in Kalkar, Germany.
- The Joint Chemical, Biological, Radiation, & Nuclear Defence (JCBRN Defence) COE in Vyškov, Czech Republic

Examples of 'semi-excellence centres'

- Counter Improvised Explosive Devices (CIED) COE in Spain
- Operations in Confined and Shallow Waters (CSW) COE in Kiel, Germany
- Military engineering (MILENG) COE in Germany

Examples of Defence-related CoEs

- Centre of Excellence for (Military) Operations in Confined and Shallow Waters (Germany)
- Excellence for Stability Police Units (Italy)
- Air Operations Centre of Excellence (France)
- Submarine Centre of Excellence (UK)

An important part of the knowledge infrastructure is made up of the 'Centres of Excellence'. The following definition of Centre of Excellence is common, but not very illuminating, because it applies to a single university/research institute, a single company or a cluster like Silicon Valley or even a nation: a "place seeking highest standards: a place where the highest standards of achievement are aimed for in a particular sphere of activity". In this sense, single universities/research institutes can be called Centres of Excellence, but the term is also used in "Dresden is a Centre of Excellence for OLEDs". And on a larger scale it may be said that the UK is a Centre of Excellence for areo-engines, helicopters, aerospace parts /subsystems (avionics, ejector seats), defence electronics as well as aircraft carriers and nuclear submarines. There seems to exist a number of Centres of Excellence for a very broad variety of subjects and research areas. In the defence domain the primes or their own R&D departments can certainly be called Centres of Excellence. But existing CoEs will be a barrier to achieving a fair distribution of R&D in the EDTIB if such a fair distribution requires R&D work to be allocated to e.g. Eastern Europe (where technology is lagging behind, meaning that there will be some cost for supporting these new entrants).

An important aspect of the defence industry is that most primes have strong connections to knowledge, mostly in-house, but otherwise connected through the existing Centres of Excellence and the acadamia.

Factors of influence. Access to knowledge may increase with the increase in R&D funding by governments, a greater geographical distribution and the relaxation of the security of information restrictions. If industrial and governmental spending on R&D decreases, e.g. because of the current developments on the financial markets, the access to knowledge may also decrease. If no alternatives can be found (e.g. linkup with civilian research) this bears some specific risks for the industry.

In the defence industry, the government is the most important financial enabler of R&D, meaning that knowledge development depends very much on government spending on R&T and R&D. Access to knowledge is also much influenced by the level of in-house development of knowledge and the relations that are developed and maintained by the industry with the knowledge infrastructure. These relationships are influenced by cognitive and geographical proximity. When proximity becomes less, the development of knowledge usually follows suit. That is why large companies increasingly maintain a presence on university campuses. In short, the relationships within the Knowledge Triangle (Industry, Academia, RTOs) are intensifying. This is also most likely to happen in the EDTIB; CoEs developing on campuses around the presence of a national prime.

A closely related factor of influence regards the cost of Centres of Excellence and the financial sources. The cost could be high and if the CoE is financed by private firms, they most likely will support their choice of CoE and not the solutions imposed by the EC or the EDA. Furthermore, access to and/or availability of knowledge is influenced by the *development* of that knowledge (i.e. RTOs, R&D departments and universities doing research). If dual use can be further developed, the research on security or broader topics such as biotechnology or nanotechnology may become part of the knowledge-base for defence.

Impact on the EDTIB. Because the EDTIB is a highly R&D-intensive industry (up to 20% of spending), its development depends to a large extent on the development of defence R&D. The impact of defence R&D varies largely, because it still remains embedded in national R&D systems. If these systems are opened up under market pressure, this would highly benefit the EDTIB. Further access to research (e.g. better sharing, coordination, etc.) would have strong effects on its performance.

3.4.5 Integration of civil and defence industry

Definition. The traditional defence industry is increasingly integrating civilian components into their product portfolio and strengthening their relations with civilian industrial partners.

Description. When the Cold War ended, the defence industry was stimulated to find new markets for their high-quality products. Although directly after the Second World War defence research and development had become the most important driver for civilian innovations, this trend has been reversed during the last decades. Both trends are important drivers for the defence industry to integrate with civilian industries, enabling the use of their distinctive defence technologies to be also used for civilian purposes, and vice versa.

Looking at the core key technologies in defence, the enabling character of civilian technologies are often usable for civilian products. The developments in bulletproof vests are the result of the development of the aramid fibre, that also is very frequently used in civilian products like sails, cables and wings of aircraft. Also, many ICT technologies find a wide use in the defence domain, like administrative software (adapted to defence purposes). An example is the shift from a dedicated defence operating system to Microsoft systems. Often defence uses Commercial Off The Shelf defence solutions (COTS).

Looking at the four major European primes, BAE is the only firm that is purely defence-oriented. EADS, Thales and Finmeccanica are also much focused on the production of civilian technologies. In these three firms, the integration between defence and civilian has already taken place. Worldwide almost all larger firms have their connections to the civilian industry to the level that they address civilian markets. But also non-primes are often combinations between civilian and defence. A recent study of the Netherlands showed that about 80% of all companies had a dual character (TNO, 2007).

However, one must conclude that simply taking civilian technologies off the shelf is not enough. Adjustments to ensure operation in risky situations are very important; the risks would otherwise be too high. This also impacts the underlying innovation processes,

which therefore differ for defence innovation processes and civilian innovation processes. Usually, the defence innovation process is a longer-term process due to the complexity and high-quality requirements. The civilian innovation process, on the other hand, is highly susceptible to changing market conditions, needing short lead-times.

Factors of influence. The main factor of influence to further integrate defence and civilian industries is the reduction of defence budgets. This will stimulate defence-oriented firms to place more focus on civilian markets and to search for civilian cooperation. By doing this, 'economies of scale' are improved, as well as the R&D base. But also a further opening of generic industry policy instruments may stimulate defence-oriented organisations to enhance their civilian orientation. However, some areas of the defence domain will stay separated from the civilian industries, due to security requirements and the special character of their products and services, as well as existing networks.

Impact on EDTIB. The further integration of defence and civilian industries is expected to have a significant impact on the EDTIB, but since integration has already taken place to some extent, this will not be radical. Increased integration will broaden the R&D base and improve the economy of scale. Also, some interesting new technologies will be beneficial to both entities, enriching both industrial sectors. The dominance of national funding can be slightly reduced, leading to a more open market and enhanced competitiveness; cost consciousness will be enhanced. The overall speed and quality of innovation can also be improved, due to the diffent innovation processes from civilian sectors, as well as their new perspectives on innovation. However, due to the limitation of the niche markets, more radical innovations might be under pressure.

3.4.6 Nature of consolidation

Definition. This factor addresses the development of the size and focus of activities of the firms within the sector.

Description. The major European defence firms are already a long way down the road of concentration and globalisation, particularly in the aerospace sector. But in the land and naval sectors there is still some room for more consolidation. In Europe, following the end of the Cold War, increased concentration required cross-border mergers which traditionally were also prevented by national governments, especially where defence companies were state-owned enterprises.

Subsequent policy changes resulted in the formation in 2000 of a Europe-wide company, namely EADS (DASA, Germany; Aerospatiale Matra, France; CASA, Spain). BAE has made many large acquisitions in the US and Europe in the last decade, and has become the dominant UK defence company with a monopoly at the platform level in vessels, submarines, armoured vehicles and aircraft. Thales made a substantial increase of their UK footprint by acquiring Racal in 2000. Otherwise, Thales' business has primarily grown through acquiring medium-sized companies and by expanding business through joint ventures. Finmeccanica focuses on "organic growth driven by expanding its international footprint", i.e. not primarily growth by acquisition, albeit that Finmeccanica acquired AgustaWestland (UK). MBDA is seldom included in the description of European primes. It is, however, a company which unites most of Europe's missile development and production of missiles. It can be described as a consolidation of close to all of the future European missile R&D and production and a rival to Raytheon.

But it seems that the merger and acquisitions pace has decreased during 2008. The primes appear to have reached a critical size. It may also reflect the preambles of the financial crisis. According to the Aerospace and Defence Industries Association of Europe (ASD) "European defence contractors have reached the limits of what consolidation can achieve in Europe". However, European primes are still relatively small compared to their US counterparts. In a next phase a reverse process may occur, for example in a highly demanding and rapidly changing security environment where maximum spin-in from civilian technologies is needed. Large primes have become too large and are not agile enough to adapt to a fast changing and demanding environment. Lack of institutional harmonisation and reform of the European defence market have paved the way for new, profitable corporate models that can pick up on present globalised supplier structures and make them profitable in the defence sector. The larger market development is not driven by pan-European goals, but rather by globalised specialisation as presently in e.g. the automotive and commercial aircraft business (see also Chapter 2).

Impact on the EDTIB. In the short and medium terms, the primes will continue to consolidate their activities, reduce costs and concentrate on core businesses. In the longer term, the trend to larger firms and increased industry concentration could continue. Mergers and acquisitions amongst the major prime contractors will be of the horizontal, vertical and conglomerate type. Companies may acquire the same size as US firms. It is also possible that the rate of consolidation decreases and some mergers will even dissolve into into more specialised companies and more defence-oriented companies, to enhance efficiency. However, coordination and networks between the firms needs to be strong to keep the overall capabilities.

Consolidation and fragmentation of value chains have a huge impact on the competitiveness, capabilities and competencies of the EDTIB. Larger companies can carry the 'burden' of the required investments, while smaller companies are more innovative. A balance has to be struck. However, there is also a need for smaller, Midcap companies able to respond more easily to changes in demands and economic environment. Also Midcap firms will sometimes be more capable to create new innovations (the Dinosaur syndrome), although complex innovations need larger firms.

3.4.7 Extent of cooperation with related and supporting industries

Definition. The innovation and production networks are a core asset to defence firms, including their international networks. This factor focuses on the characteristics of the industry in this respect.

Description. Cooperation within the value chain or with related industries is an important factor influencing the costs and the technological characteristics of the product, including its international networks. A competitive supplier base is a source of innovation for industry and has the potential of 'risk-sharing' in major programmes. The relationships in the value chain are influenced by the negotiation power of the suppliers. The automobile industry is an example where the suppliers are the 'channel captains' because they control the key success factors (technology). In this context, the Japanese were the first to advocate the concept of co-makership (the Toyota way) and established a manufacturing philosophy that is based on a joint network of suppliers. A good current example of this industrial networking is the highly successful Dell cooperation, who even took the approach a step further. The 'we versus them' paradigm

was replaced with a paradigm of co-development and co-makership, close alignment of the value chain (JIT principles). Among others, its benefits are higher cost efficiency, reduction in lead-time, and improved quality.

Of course, this was also made possible because the manufacture of cars and computers is a volume business with large series, whereas the EDTIB develops much smaller series. However, the efficiency and effectiveness of the defence industry can be influenced by the organisation of research, development and production in networks, as the term 'system integrator' implies. In the EDTIB, cooperation basically takes the form of joint ventures in programmes. Sometimes it takes the form of shareholdership of a supplier or a buyer. An important aspect of the present EDTIB is the dominance of the primes, which are perhaps more than a system integrator, as much of the added value research is being done (research and manufacturing) by the primes themselves. Outsourcing and innovation networking is often limited to subcritical components (the R&D intensity of the primes is over 10%). A trend to be seen in the defence sector is that due to costs, the globalisation to low-cost countries seems to increase. Again, this is not the case for crucial components, but e.g. the hulls for naval vessels for the Damen shipyard are produced by Polish manufacturers. Also, the prime strategies often include a multidomestic aspect, not only to access the domestic markets, but also to create international networks.

Finally, it must be said that little is known on value chain relationships in the defence industry. Quantitative data are hard to find. This is also due to the enormous amount of suppliers. Both the EC and the EDA need more information on the EU defence industry's supply chains to develop sound policies. Such chains are complex; they differ between air, land and sea systems, and they contain some key capabilities which may be essential to ensuring security of supply. For instance, the number of 2nd tier players in the UK AFVs sector alone (Warrior) was 200.

Factors of influence. The value chain and innovation networks may in the future integrate under pressure of cost considerations and considerations of security of supply. Also, primes may integrate vertically backwards, as new entrants are most likely to emerge upstream in the value chain. If these entrants become a threat or too attractive, they will simply be acquired by the primes, as is happening with electronics suppliers. On the other hand, the value chain may also disintegrate under pressure of shareholders who want 'their' companies to concentrate on core competencies and sell off non-core activities. This could mean the exit of some key capabilities in the supply chains (e.g. SMEs). The level of demand and the stability/predictability of demand will play an important role in these processes, as well as the cross-border ownership (hard because of security of supply considerations). Decrease of national budgets would also stimulate these networks to create access to other markets, as well as access to new capabilities and competences.

Impact on the EDTIB. The EDTIB is dependent on a strong, innovative supplier base and linkups to research. If such a base would decrease, it would deteriorate the competitiveness and capabilities of the EDTIB. And if the pace of increasing complexity of goods will continue, a not so well-organised network of firms (and research organisations) would lead to an undesired inefficiency in the EDTIB. This would not only lead to decreasing competitiveness, but also the development of new future capabilities could be jeopardised. Although the primes do play an important role in the structuring of the networks, also the development of alternative networks is

needed to address these future demands that are not covered by these primes. In the end, opening up the networks will enhance the competitiveness of the EDTIB.

3.4.8 Barriers to entry and exit

Definition. Barriers to entry inhibit the entrance of new players on a market (e.g. Art. 296). Barriers to exit inhibit existing players of divesting from a market.

Description. Examples of entry barrier are the required economies of scale (which could be too large) and position on the learning curve (which to a certain extent determines the costs: see also the Appendix: The EU Defence Industrial Base). Also, the level of product differentiation could be a barrier to entry, especially when this differentiation meets current demand. On the other hand, an entry barrier could be too sophisticated a demand (which holds partly true for US defence demand), fragmented demand (EDEM is basically 27 national markets) and complex demand (demand consists of large, complex and financially risky programmes). The fourth barrier to entry could be switching costs. These are costs a customer has to make when it wants to change suppliers. The required production factors (capital, proprietary technology, skilled human resources, etc.) are also barriers to entry, especially if the investment in these production factors is fixed (i.e. R&D). The sixth entry barrier is the access to distribution channels. An entry barrier is market size and development. If a market is too small to create sufficient return on investment, this could be a significant barrier (basically, EDEM consists of 27 home markets, with differing demands). A final entry barrier is government regulation (for instance Art. 296 of the TEC). This reflects the desire for national defence industries which are retained for independence, security of supply and associated wider economic benefits (e.g. jobs, technology, spin-offs and exports).

Exit barriers consist of investments made which have not resulted in a sufficient rate of return yet. Exit barriers could also be investments in an installed base that cannot be divested and/or customers not allowing a divesture because of the high costs involved (i.e. governments not being able to bail out defence companies when faced with restructuring).

The importance of these barriers is also determined by the definition of the market. In the defence market, various definitions could be applied. Usually a distinction is made between national markets, the EU market and the international market. From the perspective of a non-prime, the market could also be defined as players further downstream in the value chain. In that perspective, upstream potential entrants of the defence-related value chain meet less barriers than potential entrants of market segments further downstream (i.e. 2nd and 1st tier suppliers and primes). Development of the EDTIB will require that the defence industry be defined. For example, are defence firms those where defence sales account for, say, 50% or more of total sales or is the cut-off 90% of sales (but some key defence firms such as shipping and airlines might have no defence sales currently, but these provide surge capability in conflict)?

In the European Defence Equipment Market, one of the biggest barriers is the limited access to national markets because of regulations (i.e. on security of supply, security of information, offsets, Art. 296). A second barrier is the limited size of the national markets. The US market, on the other hand, is a huge market. However, entry to this attractive market is near to impossible because of trade restrictions and regulations (i.e. Buy American Act). The significance of this is shown by the fact that European

companies have captured only 0.3% of the US procurement market while US companies won about one quarter of the European market (Source: The Cost of Non-Europe in the Area of Security and Defence). Even taking into account the possibility that the EDTIB cannot meet all US demand, still the difference is huge (Anticipating etc., 2008).

Factors of influence. EU regulation on opening up the markets creates a strong barrier for new entrants to the market (e.g. the EC Defence Package, EDA Code of Conduct, limiting the scope of Article 296); the ideal target for creating an EDEM is the elimination of Article 296.

Impact on the EDTIB: Continuing high entry barriers will severely impact the competitiveness of the EDTIB and EDEM. The absence of new entrants will result in the current level of competition and innovativeness, which is considered too low.

3.4.9 Strategies of the industry primes

Definition. The strategy of a firm includes its decisions about objectives to strive for, as well as the means by which the firm aims to achieve these objectives.

Developing scale and scope at BAE Systems

In recent years BAE showed three primary developments.

1. BAE (as BAe) used to have a range of non-defence businesses, especially Airbus (wings) and the Rover car company (when it was BAE). It sold all these civilian businesses to focus on defence activities.
2. Instead it gained a broader presence in all core military domains: sea, land, air and defence electronics.
3. They have continuously strengthened their US presence (in defence electronics and land sectors). The US DoD is a larger customer than the British MoD. BAE has among the European primes by far the most business in the US.

BAE has six 'home markets': Australia, Saudi Arabia, South Africa, Sweden, UK and US. A large part of BAE's US business has – due to US regulations – to be managed by US citizens (through a separate company BAE Systems Inc), with very limited control and insight into strategic considerations from the BAE UK headquarters. BAE has a continued strong presence in Saudi Arabia (Al Yamamah Agreements). The group has been awarded the assignment to create a Saudi defence industry, which as its base will have licensed offset production of UK defence products.

BAE has made many large acquisitions in the US and Europe in the last decade, and has become the dominating UK defence company with a monopoly capability on the platform level in vessels, submarines, armoured vehicles and aircraft. In the UK, BAE is a monopoly supplier for most major air, land and sea systems. This raises major procurement issues for UK MoD. It has to determine prices to provide efficiency incentives and avoid 'excessive' profits on non-competitive contracts.

Description. Industry primes function as 'channel captains' in the EDTIB. Their strategies therefore will have a serious impact on future industry developments. Therefore this section focuses on the strategies of the industry primes. The strategy of a firm includes different aspects. First of all, its *competitive strategy* is important. This includes whether a firm strives for cost leadership or differentiation as a basis for gaining a competitive advantage. The specific *innovation strategy* (technology leadership or follower) that is adhered to is also essential. Thirdly, within a highly dynamic environment, it is also becoming increasingly important to have an extensive

collaboration (including with suppliers for reasons of stable and secure sourcing and cost-sharing) and *M&A* policy. Finally, decision-making on where to locate and *how to expand geographically* is also included. The four primes on which this section is based are Thales, EADS, BAE and Finmeccanica.

In general, the European defence primes have been concentrating on their core competencies. They do not appear to favour diversification into new business or technology areas, unless there is an already defined strong demand. BAE Systems has e.g. sold off its non-defence aerostructure production (e.g. Airbus wing work, cars). On the other hand, within the defence realm, BAE Systems has created a broader presence in all core military domains: sea, land, air and defence electronics. This large defence firm is able to achieve economies of scale, learning and scope with further potential for technology transfer from, for instance, aerospace to land and sea systems (e.g. application of stealth technology to tanks, AFVs and warships). The other three primes, EADS, Thales and Finmeccanica do adhere to a dual-use strategy, by developing both military, security and civilian applications of their technologies. This dual-use business model represents an alternative to the business model focusing exclusively on military applications. Cost leadership does not seem to be the leading issue for the primes. The products developed by these firms are highly specialised, which enables them to compete on aspects of quality instead of price. Also, there is only a very limited number of competitors, while from the demand side often true competition is not required because of the requirements of the demand side (security of supply, security of information, etc.). They aim to create and maintain a competitive advantage based on technological excellence. Their innovation strategy is focused on achieving technology leadership rather than being a technology follower.

Thales

Thales has for decades had their 'multidomestic' strategy. This means that they want to act through a domestic affiliate or partner (often a joint venture partner) in order to get a rewarding access to the domestic defence infrastructure. Through its 2001 joint venture with Raytheon: Thales Raytheon Systems (TRS), the first strategic transatlantic joint venture was created. Most joint ventures are project joint ventures, i.e. they are only geared towards a time-limited specific defence contract. TRS has a strategic vision; that the companies shall cooperate and share long-term goals within a certain product area.

Thales made a substantial increase of its UK footprint by acquiring Racal in 2000. Otherwise, Thales' business has primarily grown through acquiring medium-sized companies and by expanding business through joint ventures (Thales is the largest defence contractor in Australia, Korea and the Netherlands, and the second-largest contractor to the UK Ministry of Defence).

In 2007, with the acquisition of Alcatel's space and security businesses, Thales Group has increased its stature as a global military and security contractor, expanding activities in space and transport systems sectors. With this operation, its portfolio of businesses is more balanced between civilian and military markets. At the same time, Thales became DCNS's industrial partner and shareholder with a 25% interest in the naval defence company (with the option to raise its 25% stake in DCNS to 35%).

In December 2008, the acquisition of Alcatel-Lucent's 20.9 % share in Thales by Dassault Aviation should impact the future of Thales, with possible further integration of Thales and Dassault Aviation activities and disinvestments.

Discussing now the collaboration and M&A strategies within the defence industry, it can be concluded that the overall M&A activity was relatively high (as was the case in other sectors) This includes vertical, horizontal as well as conglomerate mergers and acquisitions. During the 90s, consolidation in the defence sector took place primarily at the national level, as opposed to global M&A activity. National champions were formed in several EU countries. This national and intra-EU M&A activity has resulted in such companies as EADS and Thales. Subsequently, the primes also engaged in international M&A activity. This activity mainly occurred in countries in which the four primes already had established a significant presence. All firms aim for an increased presence in the US, while the Middle East is also perceived as a growing market. In the box, the BAE Systems case with regard to scope and M&A is presented.

Finmeccanica

Finmeccanica has three strategic pillars: Helicopters, Aeronautics and Defence Electronics & Security. The Italian defence aerospace conglomerate focuses on "organic growth driven by expanding international footprint", primarily in the United Kingdom and in the United States.

"Finmeccanica is the main Italian industrial group operating globally in the aerospace, defence and security sectors, and is one of the world's leading groups in the fields of helicopters and defence electronics. It is also the European leader for satellite and space services as well as having considerable know-how and production capacity in the energy and transport fields. A large part of R&D investment is channelled into dual-technology projects, leading to significant advantages in civilian applications of considerable strategic importance. To maintain its leadership in high-tech sectors, Finmeccanica focuses on the value of its human resources, and the laboratories of its subsidiaries are staffed by around 3,000 highly specialised researchers."

Finmeccanica has a significant footprint in the United Kingdom (mainly via the helicopter producer AgustaWestland and its Defence electronics division SELEX Sensors and Airborne Systems). Moreover, the Italian group is expanding in the United States. In may 2008, Finmeccanica had agreed to buy the US military contractor DRS Technologies in a $5.2 billion deal. For Pier Francesco Guarguaglini, CEO "The merger furthers Finmeccanica's tradition of investing in the US". Thus, Finmeccanica aims to capitalise on the well-established partnerships among its divisions (Alenia Aeronautica and Agusta Westland) and the US primes (L3-Com, Lockheed Martin, Boeing).

The extent of M&A activity has clearly decreased during 2008. The primes appear to have reached a critical size. It may also reflect the preambles and beginning of the financial crisis. According to the Aerospace and Defence Industries Association of Europe (ASD) "*European defence contractors have reached the limits of what consolidation can achieve in Europe*". This is based on the current business models, market sizes and organisational structure and management. However, European primes are still significantly smaller than their US counterparts, which can therefore reap more benefits from scale and scope.

Overall, between 1990 and 2005, the concentration ratios of the top 5 companies in the SIPRI Top 100 arms companies increased from 22% to 43%, the top 10 concentration ratio rose from 37% to 62%, for the top 15 the ratio rose from 48% to 69%, and for the top 20 it rose from 57% to 74% (based on arms sales for 1990-2005[24]). There is a view that the concentration ratio for the top 5 arms producers remains low compared with

[24] SIPRI, Concentration in the arms industry: data on mergers and acquisitions, SIPRI website, 2008.

other high-technology markets (c.f. civil airliners Airbus and Boeing, and pharmaceutical industry). In comparison, the US defence industry is also much more concentrated around a small number of large firms.

EADS

The defence activities of EADS are in the following divisions: MTA (91% Defence, now Airbus Military), Eurocopter (49% Defence), Astrium (35% Defence) Defence & Security (96% Defence). MBDA and Eurofighter GMBH are separate companies that through the EADS shares are regarded as "part of the activities of the Defence and Security Division". EADS is dominated by its non-defence business (75% of total sales in 2006).

"The EADS Defence & Security Division (DS) is the defence and security pillar within EADS, driving the Group's development of integrated system solutions that meet its customers' needs for Network Enhanced Capabilities (NEC). We build on a strong tradition of airborne weapons and missile systems and incorporate state-of-the-art Network Enhanced Capabilities: systems intelligence, integration and expertise. By recognising the need to be mission-critical and security oriented, we are preparing our customers to meet their new global challenges – whether land-, navy- or air-based."

EADS repeatedly expresses their strategic intention to become "a heavyweight in the US defence business". They appear to strive for a major US acquisition, but US authorities seem to be reluctant to approve of American defence technology becoming in the hands of a multipolitically influenced European company. However, in 2008, EADS acquired US PlantCML ($350 million), a leading provider of emergency response solutions, through EADS' US operating subsidiary, EADS North America. With PlantCML, EADS has shown its ambition to advance its professional mobile radio (PMR) solutions into the rapidly expanding US market.

A very large project in the US is the future acquisition of air-to-air tanker aircraft. EADS was awarded the KC-X replacement contract together with Lockheed Martin, but this deal was revoked in 2008 after a period of politically and US-protectionist coloured debate. The entire acquisition was cancelled later in 2008. These problems highlighted the difficulty in getting approval of all concerned US authorities and vested interests, especially Congress.

EADS Vision 2020: Secure future probitability, Balanced portfolio (military/civil businesses), Develop services directly and indirectly, Extend footprint out of Europe (US and Asia).

An explanation for this could be the efforts of national governments to prevent the growth of multinational firms by protecting their national defence industrial base (see the box included below for the policy of the French government). An example of this occurred in the US when the DoD blocked the planned merger of Lockheed Martin with Northrop Grumman in 1997. In Europe, following the end of the Cold War, cross-border mergers were traditionally also prevented by national governments, especially when defence companies were state-owned enterprises. Subsequent policy changes resulted in the formation in 2000 of a European-wide company, namely EADS (DASA, Germany; Aerospatiale Matra, France; CASA, Spain). In Europe considerable opportunities remain for further restructuring, especially in the land and sea sectors.

In the coming years, some degree of vertical integration will occur with primes acquiring some of their suppliers (e.g. electronics/avionics) or major suppliers acquiring a prime contractor, or primes undertaking forward vertical integration by acquiring military service companies. Increasingly, defence firms have acquired electronics firms reflecting the greater emphasis on electronic inputs in modern defence equipment. However, major vertical backward integration such as airframe companies acquiring

aero-engine firms is unlikely. Primes will more likely seek to develop new market opportunities based on their existing business: for example, by expanding into long-term repair and maintenance contracts for their equipment through offering total support packages (e.g. for maintaining and upgrading combat aircraft, repair and overhaul of aircraft engines).

With regard to *sourcing*, primes are increasingly moving less sophisticated production and mature production processes to low-cost alternatives in new MS or outside Europe. Such considerations are often guided by offset considerations, i.e. when buyers demand local defence production. This will create a segmented production hierarchy, which will resemble the production hierarchies in e.g. the civilian commercial aircraft, car and truck industries. These generic industrial tendencies to strive for economies of scope and scale will be counteracted by shorter military production series and the sensitivity of military technology. One could foresee that nMS defence contractors could emerge as much stronger competitors to the EU-based sources/suppliers. However, it seems, the nMS companies suffer from a fundamental imbalance between a strong legacy of largely Soviet-developed arms systems and a defence R&D structure that doesn't match this size at all from a financial point of view.

French defence industry restructuring policy

In France, the national defence industry policy includes obtaining and/or maintaining certain share percentages in companies which reflects that minority and majority shareholders achieve certain strategic advantages and rights when they exceed certain levels. They may e.g. have the right to appoint representatives of the board, and with higher percentages even the CEO. In all French defence industry restructuring, there is always some part of government orchestration and consent (e.g acquisition by Dassault Aviation of Alcatel-Lucent's shares in Thales), which is not a hidden agenda; it is clear government policy. The French government holds 27 % in Thales, 31 % of Safran, 75 % of DCNS, 100% of Nexter, and 15 % of EADS.

As a final aspect of strategy, the four primes strive for being truly multidomestic. BAE for instance has six 'home markets': Australia, Saudi Arabia, South Africa, Sweden, the UK and the US. To conclude, in the coming years it could be that a downsizing in US and European defence production occurs due to the financial crisis, decreased investor interest and a relative slump in the defence sector. In order to counteract the falling profits one may also foresee a shift of production to low(er)-cost nations in new MS or outside Europe, but as of now the four primes do not have a large presence in these nMS. In the Annex more specific strategies of the primes are shown.

Factors of influence. The strategies of the European primes are influenced by several factors. The most important are the defence procurement and R&D budgets of governments. Developments in these budgets also have a large impact on the M&A and collaboration strategies of the firms. As can be seen at present, the four primes all indicate to aim for an expansion of business activities in the US. The primary rationale for this is that US defence budgets are the highest by far. Large increases in the budgets of other countries will likely attract the attention of EU primes. Governments can also be an organisational factor of influence as can be seen by government-led and dominated collaboration of the type adopted for the EU aerospace industry.

Strategies in nMS

Companies do not start from scratch when developing and implementing their strategies. They have a legacy, there is an installed base of equipment/infrastructure restricting strategic choice. In quite some MS, notably in the new MS, national defence industrial capabilities are still primarily focused on large weapons platforms intended for use during the Cold War – ships, planes, tanks, and armoured vehicles, for example – and the operation and maintenance of these systems. In many nMS their niche capabilities stem from the specialisation within the former Warsaw Pact. Political capital in these nMS is still tied up in programmes inherited from the Cold War. R&D investments in radically new system concepts is very low vis-à-vis the U.S. The fact that several governments still own – at least in part – their defence industrial bases also leads to a national resistance to downsizing of existing assets and workforces. The economic costs of maintaining such outdated industry structures are so high and the operational deficits so clear, that a policy not moving to the production of expeditionary and interoperable systems for new missions, seems very hard to sustain. When government share in a defence industry drops in favour of private ownership, the market logic will rapidly force a transition.

The second factor of influence is formed by the increasing costs due to the increasing complexity of the products and programmes. Certainly, there are opportunities for improving the efficiency of the collaborative programmes. Typically, the focus on work-sharing rules results in substantial inefficiencies. Future collaborations may be based around a small number of partners (two partners) with other nations joining the programme as 'associates' with no prior commitment to receiving specific technology and production work packages (c.f. the partnering arrangements for the US JSF/F-35 aircraft).

A third factor of influence is globalisation. Developments in costs can stimulate firms to move parts of their business activity to low-cost countries such as China and the nMS. An increase in sourcing activities to these countries will then also be likely. Finally, whether or not true globalisation will occur, this has a decisive influence on aspects of firm location and the focus of M&A activities. At this moment, many countries have still closed off their defence market from foreign firms. If these markets start to open up, new business opportunities for firms will emerge, and hence their M&A activities will also focus more on these emerging markets. Along with the opening up of previously closed markets, the large firms will become even more multidomestic.

Impact on the EDTIB. A further restructuring of the defence industry might lead to the creation of new Europe-wide companies, an example being EADS. With budgets for defence falling in some EU countries, for instance Italy, the European primes are further decreasing their relative presence in the EU, while intensifying their activities in e.g. the US (all primes), the Middle East (Finmeccanica and BAE), China (EADS) and Australia (BAE).

3.4.10 Level of competition in the industry

Definition. This factor addresses the economic competition in the defence industry, impacting the actual performance of the firms.

Description. Competition is to a large extent determined by the number of competitors. In the defence industry, this depends on the level of perspective. On the national level, competition is rather limited (at least at the level of the primes). A monopoly is the typical market structure for the prime contractors in most national defence markets.

There is also an EU-wide monopoly for missiles (MBDA) and military airlifters (Airbus A400M) and a duopoly for helicopters (Eurocopter and Augusta Westland). However, if we consider the whole EU as a market, then the structure changes to oligopoly (e.a. Thales, EADS, BAE, Finmeccanica) while at the NATO and global level the market becomes more competitive, because here other global players enter the market.

Competition is also determined by the threat of substitute products and new entrants. A substitute product in the EDTIB is the UAV, where the UAV could become a substitute for manned combat aircraft. New entrants include firms entering the military outsourcing market. One may safely say that due to the complex nature of defence products and the high requirements on quality, new products are often produced by the existing firms. In some niche markets (less critical products) new entrants can be seen.

Competition can take the form of price and non-price factors. Defence firms usually compete on non-price factors such as speed, range and weapon load. As the buyer is almost always a national government, strong competition on price is limited. In the demand market the primes are mainly competing for programmes. Competition has been applied at the various stages of a programme's life cycle (competition at the initial design stage, prototype stage and production stage (Hartley, 2008).

Within the defence industry, a limited increase in competition can be expected. Although still with difficulties, the initiatives of the EU to open up at least the European market will in the future have some effect. Globally, the markets are opening up, facilitated by the primes' strive for a multidomestic character. However, for the SMEs and even Midcap organisations this will be more difficult due to the restrictions. Some interesting global markets are more easy to enter, like Southwest Asia.

Overall, it may be concluded that the character of the defence market on the national level is mostly limited, but on international (especially global) level becomes significant. Also, due to further expected globalisation of the market (both intra-EU and outside EU), it will become more competitive. Although the defence budgets will probably decrease, it is not to be expected that the dominance and national policy will change in the short term. An increase in competition will therefore be limited.

Factors of influence. The measures taken by the EU (i.e. Defence Package) and the EDA (i.e. Codes of Conduct) can partly decrease barriers to entry, allowing for new, innovative companies (level playing field). Also, competition will increase. However, the actual effect of these measures is not certain, because it is unsure if the measures will be made operational by the MS. Another important factor is the further integration of the civilian and defence domains, leading to possible opportunities of new entrants. Also of crucial importance is the development of national defence budgets. This has a direct effect on the competition in the defence industry, but also decreasing the 'attraction' for new players on the market. Looking at the new possible products, the changing nature of operations and other defence activities, combined with new innovations could be an important opening for newcomers to the market, increasing competition. However, a significant number of these new requirements will be met by the present firms in the industry. Competition can also decrease, because the EDTIB will further consolidate under pressure of high-cost, high-risk demand (defence programmes) and the high costs of R&D, leading to fewer firms that are able to play a role in the defence market.

Impact on the EDTIB. The level of competition has a direct influence on the EDTIB, because with an increased competition the number of companies may decrease. In the short term this will mean less employment, but in the medium term there will be more companies and more sustainable companies. Internationally, the competitiveness will increase, but a significant number of firms would be under pressure to meet the market demands. Decreased competition or competition at current levels will cause the EDTIB to remain in its current, less competitive state. On the other hand, an increase in competition will lead to less R&D spending, due to required cost reduction, but this could be compensated by an increased focus on linkups with research organisations.

3.4.11 Globalisation of the industry structure

Driver description. This driver refers to the level of cross-border cooperation and the development of companies. On the one hand, globalisation refers to sourcing from suppliers all over the world. On the other hand, globalisation also means aiming at customers all over the world (beyond the national and European markets). In general, the main influences are customer preferences becoming more general (less differentiated demand) and transparent markets.
In the case of EDTIB, globalisation is expected to affect different parts of the value chain in a different ways. Parts of the value chain (both in terms of organisations and specific goods) where there is more freedom in the market will experience more globalisation pressures than the parts of the value chain falling under regimes of security of supply, and security of information. Considerations are often guided by offset considerations, i.e. when buyers demand local defence production. Primes are increasingly moving less sophisticated production and mature production processes to low-cost alternatives in new MS or outside Europe.

Factors of influence. A further regional distribution may occur. This would create a segmented production hierarchy, which will resemble the production hierarchies in e.g. the civil commercial aircraft, car and truck industries. The financial logic of moving production to low-cost countries could also be negated by shorter military production series and the sensitivity of military technology.

A fall of profitability in the US and Europe due to the financial crisis will favour a shift of production to lower-cost nations in the new MSs or outside Europe, partly as an effect of offset. Trade barriers are an important factor against globalisation.

Impact on the EDTIB. An increase in the focus on core competences will enhance the competitiveness and efficiency of research and production, but will limit the broader coverage of the industry to address the challenges in defence.

3.5 Societal driving factors

3.5.1 Introduction to societal driving factors

Societal factors have a profound influence on the perception, objectives, demand, supply and degree of support for defence forces and military activities. Apart from the industries (supply side) and governments (demand side) operating within our society, there are also various general socio-economic challenges that may have *indirect* impact on the outcomes of the previously mentioned driving factors regarding the change of the EDTIB.

The costs for modern defence equipment, training and personnel are high and defence budgets have to compete with expenditures for e.g. healthcare, welfare, education, civilian R&D and the environment. Over the years the role of the public opinion has become increasingly stronger in many areas as well, ranging from consumer protection to peace activist groups. Especially the peace movement has established itself and even joined forces with different other groups like environmentalists, anti-racist groups, human rights activists, humanists and religious activists. The public opinion as well as ethical, social, political and legal aspects will play a profound driving role in determining the organisation, role and support of (future) defence operations, thus having an impact on the shape, actors and necessities of the EDTIB. The identification of possible driving factors from society with a potential impact on the EDTIB is based on the outcomes of a TNO study on the socio-economic challenges addressed by the Dutch coalition agreement.

Analysing the Dutch coalition agreement

In 2008, TNO was given the assignment to analyse the Dutch coalition agreement, in order to identify the most important issues for the individual Dutch Ministries. Core to this analysis was the development of a basic overview of potential socio-economic challenges. This generic overview was developed based on an assessment of 160 foresight studies, as well as an analysis of the EC priorities. The results were analysed by means of several expert workshops and questionnaires sent to the Dutch Ministries and advisory councils for evaluation of completion. The result was a list of over 30 core global societal challenges, presenting a wide variety of topics, from the issue of 'Poverty and hunger' to the 'Unpreparedness for crises and disasters'.

The following societal driving factors are seen as relevant for the defence domain[25]:

- **Aging population, declining birth rates and demographic changes**
  This driving factor includes the change of demographic characteristics influencing both the industry as well as the military apparatus.
- **The development of global migration**
  The relocation of citizens over the world, due to economic as well as security and political reasons, will change the demographic characteristics of the national population, and may lead to security issues.
- **Societal acceptance of defence operations**
  As (national) defence budgets and other policy implications are highly political, the societal acceptance of these operations is an important driving factor behind the actual defence activities.
- **The sustainability challenge**
  One of the major socio-economic challenges of today is to achieve a sustainable society. Further societal pressure on governments can also change the relative attention to the defence and security domain.
- **Pressure on healthcare**
  The healthcare system is under great pressure due to the increasing demands from society, as well as to demographic changes. This will lead to increasing government spending on healthcare, with potential repercussions for defence.
- **Competition over natural resources**
  In the near future, tensions will increase over the availability of e.g. water, energy and clean air. Defence and security operations may be diverted to address these challenges.

These societal driving factors may lead to potentially new demands imposed on the defence industry, including the required characteristics of the industrial and technology base.

[25] Socio-economic challenges that directly address defence challenges (e.g. Terrorism and armed conflicts) are excluded in this section, as they are already addressed in the 'EU/national policy driving factors' and 'Economic driving factors' sections.

3.5.2 Aging population, declining birth rates and demographic changes

Definition. This driving factor concerns the trends in demographics (e.g. aging, decrease in birth rates), changing the nature of the working population in the EU.

Description. By 2020, Europeans will comprise 9.4% of the world's population (UN population statistics) and the general tendency in Europe points towards an increasing life expectancy together with birth rates below replacement level. By 2020, 19% of the European population will be older than 65 years of age (UN population statistics). With older age, the occurrence of physical and mental degeneration is (still) getting increasingly probable. This, of course, has direct and indirect impacts on the personnel available to the defence forces. Due to decreasing birth rates, fewer young people will be available for military service. The aging of society also leads to a general older workforce within defence, including the industry. Civilian institutions like elderly care facilities and hospitals will compete with the military for increasingly scarce human resources of young people. It might get increasingly difficult to recruit enough human resources for defence, especially now that compulsory military service has been abolished, as is the case in most European countries.

In Europe, women are also still underrepresented in the military service, which is partly based on societal perception and the fact that women, unlike men, are exempted from the obligation to either perform military service or alternative civilian service in European countries where military service is compulsory. Changes in the nature of modern defence operations towards more technology and information-based activities may also contribute to changes in the perception about women serving in the army. In 2001 the European Court of Justice ruled that preventing women from acting in combat roles was an act against gender equality.

Possible evolutions. The effects of aging and population decline may lead to a dramatic evolutionary route. The core characteristics to be assessed are: 1) Number of potential employees available on the labour market (quantity); 2) Skills of personnel (quality). On the one hand, the evolution may lead to a situation that is still containable, due to migration and changing societal patterns that will reduce the effects on the defence-oriented labour market as well as compensation through technology. On the other hand, if the negative effects of aging are increasing, the lack of qualified young people will become more acute and immigration is seen as a security problem, meaning that the potential human resources for defence (in the industry as well as in military service) will decline.

Influencing factors. The shortage of personnel and nature of their skills may lead to extreme shortages in defence. This could, however, be compensated through migration and automation.

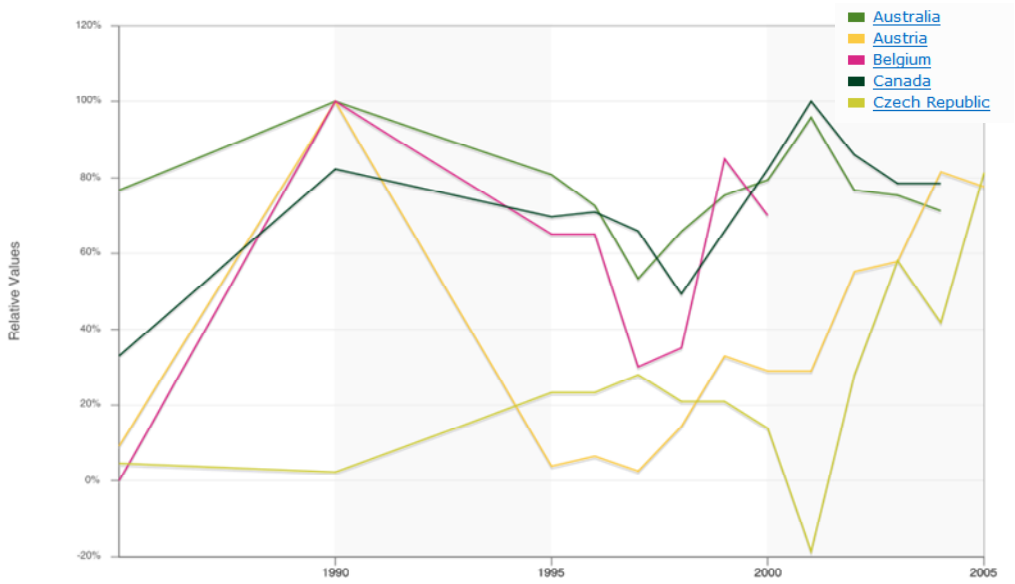
The trends in the aging aspects of the labour market are in principle predetermined. They are highly determined by birth rates and historically demographic developments (e.g. the baby boom). But also other factors influence the actual characteristics of this issue. An important element is migration towards the EU from other countries that has increased since the 1960s. Whereas in the industry immigration may compensate for national labour shortages, the effects for the armed forces are very limited, since in most countries foreign nationals are not allowed to serve in a country's national army. Since the defence industry is a very sensitive sector, persons from certain countries will

be considered to be a security threat and not be allowed to work there. Another important factor is the availability of technologies that will reduce labour intensity.

Impact on the EDTIB. If the human resources (quantity and quality) will evolve into a problematic situation, the military apparatus and the industry will be under pressure. The military will no longer be able to fulfil the social needs due to a shortage of qualified personnel. The number of potential employees on the labour market will be limited, and also the demographic trend will be towards older personnel which will be less qualified to participate in physically taxing operations. This means new ways will be needed to meet the demands. New technologies and other ways to organise operations must be found, including further international cooperation. Also, the quality of the EDTIB may deteriorate (capacities, competences, competitiveness) due to the shortage of qualified personnel. The requested skills will not be found, leading to a lock-in of skills/knowledge. On the other hand, the new demand for products and services may initiate the development of new products and services, including research, thus changing the technology base. Another possible effect is the stimulation of cooperation with international competitors. Personnel may become expensive, increasing prizes and reducing competitiveness.

3.5.3 *The development of global migration*

Definition. This factor concerns the relocation of groups of people, involving security, economic and other issues, and leading to cultural differences, security threats, but also opportunities (e.g. reduced pressure on the labour market).



Source: OECD Factbook 2007 - Economic, Environmental and Social Statistic

Description. Historically, global migration has always occurred in all societies. It was even one of the most important drivers of human evolution (migration from Africa to Europe). In recent history, in the 19th century, millions of people have moved in the area of Russia, China, Japan and India. Today, the reasons for migration often still are economic, cultural, political and environmental in nature. The relocation of large groups of people can, however, lead to greater security challenges, calling for more security and defence-related activities. Migration can, although it does not have to be, the result of civil conflicts or lead to civil conflicts. One way to minimise societal instability

therefore lies in the prevention of conflicts, a notion that has already become part of defence activities. However, global migration does not necessarily have to be the result of conflicts or lead to an increase in threat perception. It may also lead to more open and peaceful societies and increasing global cooperation, thus reducing the need for a strong defence.

According to the OECD (OECD, 2007), Poland is the only OECD country to experience a net negative migration on a systematic basis from 1995 until now. Some other countries show a significant increase in population of more than 0.5%, like Australia, Canada, Ireland, Luxemburg and Spain. Some former emigration countries tend to be prominent among the migration countries (e.g. Ireland, Spain, Portugal), which is expected to continue. Overall, most OECD countries show a larger contribution to population growth from net migration over the last years. It is expected that migration will be necessary to replace the labour force following the retirement of baby-boomers, leading to a rise in net migration (www.swivel.com).

Influencing factors. The main factor for migration is regulation and its enforcement. More indirect influences are the tensions on the labour market (economic growth), leading to shortage of e.g. healthcare personnel. This would enhance migration. Also the political environment towards immigrants is a crucial factor. This is highly dependent on acts of terrorism and media attention to these threats. Also, the more human issues (poverty, hunger and other human disasters) may influence public opinion on the issue of migration.

Impact on the EDTIB. Global migration as such is not the problem. Historically, it has often proved to be beneficial to the domestic economy (e.g. Mexican migration to the US). Problems occur in the way migrants are being perceived, e.g. as potential threats to the social and cultural order. Also, minority parts may prove to be a security threat, which will then help to determine the role of defence in regard to global migration.

Global migration can have an impact on the character of defence operations, as well as on the role of defence as such. If the main reason for migration lies in conflicts or if migration leads to increasing social instability, the role of defence may come to be regarded as an entity with the capability of averting involuntary migration (e.g. as a result of war or conflicts) and improving security (e.g. fight against international terrorism). If migration is only a part of the general tendency towards globalisation and multicultural societies, the need for expanding defence capabilities will get less support.

The effects can lead to an increase in the need for defence operations, including changes in the demand for technologies for fighting terrorism and improve security. This would change the industrial and technological base. But also the labour force in the industry may change when more migrants are present, leading to enhanced security measures. Also, cultural differences in the military apparatus could prove to be an issue that needs to be addressed.

3.5.4 Social acceptance of defence operations

Definition. This factor addresses the changes in the public awareness and acceptance of defence operations, leading to changes in budgets and political commitment.

Description. Especially defence issues depend very much on public support, and politicians have to take into consideration the public opinion. The degree of support for defence activities may be subject to a wide array of factors, some of which may not even be rationally assessable. For example, the growing fear of terrorism and the growing risk perception have not necessarily led to more public support for defence operations. The recent military activities in Iraq and Afghanistan received quite heavy criticism from the population as well as from politicians, especially in some European countries. On the other hand, the nature of defence operations is changing and activities now include humanitarian aid or emergency management. Also, a growing criticism of military service and military actions in general is closely related to specific life-styles that focus on pacifism and the environment. Defence-critical stances are especially popular with teenagers and young adults, and predominantly occur within the (Christian) religious, environmentalist, left-leaning and humanist communities.

Media influencing societal acceptance of defence operations

The 'age of ICT' also has its effect on the societal acceptance of defence. Due to the potential media coverage of defence operations, like the CNN coverage of the bombing of Bagdad, citizens become highly aware of the effects of military operations. This creates an in-depth insight into the actual day to day activities and consequences of these operations. The Abu Ghraib pictures of the American soldiers involved, its electronic distribution through the internet and the public response show the enormous changes that have occurred in the way the public is informed.

On the other hand, the easily available images of human horrors in Darfur, Zimbabwe and other monstrosities occurring in failing states create societal pressures on governments to initiate humanitarian operations. More and more, these operations include a security component increasing the need for defence operations.

Influencing factors. The social acceptance of defence operations could grow, due to an increased perception of insecurity or a general approval of success being achieved by defence. This would lead to a better climate to further strengthen the defence sector, and higher budgets being allocated to defence. If the current criticism of defence increases, politicians may feel pressured to tone down their commitment to defence operations, thus reducing defence budgets and shifting attention to humanitarian operations.

The social acceptance of defence operations very much depends on the way citizens weigh the importance of diverting resources to defence. This in turn depends on the tasks of defence and the perceived alternatives to defence operations. One has to bear in mind that social perceptions are not always logically based, but may still have profound influences on politics and the distribution of budgets. The acceptance of defence operations is likely to increase as the perception of safety and security decreases. If citizens are sceptical about defence operations, the budgets are likely to shrink and recruitment of human resources will become more difficult. However, it is clear that a new terrorist attack will strongly influence the societal acceptance of defence and security operations.

Impact on EDTIB. On one hand, the increasing attention to defence may lead to more acceptance of defence/security operations and increasing budgets. This will strengthen the industry, although more humanitarian elements will be integrated (due to a broader perspective of defence operations). But the alternative, where (European) societal acceptance is low, will affect the defence market and lead to more focus on globalisation of markets. Also, pressure on the societal acceptance of defence operations may lead to a shortage on labour in the industry, and this may be influenced by the economic climate. It is clear that a broader perspective on defence operations (also including security and humanitarian aid) will stimulate the linkup of the defence industry with civilian industries (e.g. medical, logistics, food, humanitarian aid, etc.).

This will increase the need for specific products and services, enhancing the involvement of SMEs.

3.5.5 The sustainability challenge

Definition. This factor addresses the increase in the public concern with sustainability, leading to more commitment of the greening of industries and leading to potential budgetary consequences for defence.

> Sustainable development
> "To meet the needs of the present without compromising the ability of future generations to meet their needs."
> (Brundtland Commission, 1987)

Description. It is clear that Al Gore has had a profound influence on the societal and political perspective of sustainability. Even the present credit crisis has not affected the public commitment to the sustainability issue. On the contrary, a number of leading figures see the business side of sustainability as an opportunity, as the Green Deal of Barak Obama clearly shows. Greening the economy and society is one of the major challenges of the last decade.

Although the importance of the ecological dimension of sustainability has constantly grown since the 1980s, sustainability has a broader meaning, as defined by the World Commission on Environment and Development (Brundtland, 1987). Companies pursuing their economic goals, which is increasing economic value, are increasingly expected to also increase social capital (varying from the well-being of their own personnel to the broader population) as well as ecological capital (water, forests, species, etc.). Such strategies are known a Corporate Social Responsibility (CSR; also including ecological issues). Especially Green Parties and international environmental organisations like Greenpeace, WWF or Friends of the Earth have had a profound influence in this regard. As far as the social side of sustainability is concerned, Amnesty International and MSF, for instance, have had a significant impact on the global agenda and also on the corporate agenda.

These actors are generally quite negative about defence operations and the defence industry and Green Parties, which are gaining growing support in many EU countries are mostly in favour of curtailing defence budgets. Fears about the consequences of climate change lead to priority settings in resource allocation towards environmental programmes.

The sustainability issue has different elements that influence the defence domain. The first element concerns the (decreasing) availability of natural resources (e.g. water, energy, biodiversity). Defence companies directly impact that with their own 'ecological footprint' and that of their customers (the armed forces). Reduction of the use of natural resources is already a business target of corporations and some armed forces. An even bigger impact is expected from the increasing scarcity of natural resources on the geopolitical situation. Expectations are that the next major crisis will be about one or more of the following three crucial resources: water, food and energy (e.g. the Ukrainian problems with the gas supply). A second element of sustainability is the polluting effect of defence and security operations. Radioactive residues, domestic pollution of army personnel camps, emissions of naval ships and other military platforms are just a few examples of potential environmental problems. But also the predominantly social perspective of sustainability is of importance. Human rights are under pressure in many countries, creating strong pressure on politics to act. Also, the

problems due to climate change and other environmental disasters could provide a more positive pressure towards the specific capabilities of the defence/security domain. But perhaps the most important indirect effect of the sustainability challenge is the fact that greening our society will require enormous investments from society, putting defence budgets under pressure. Increasingly also defence corporations are taking this issue seriously.

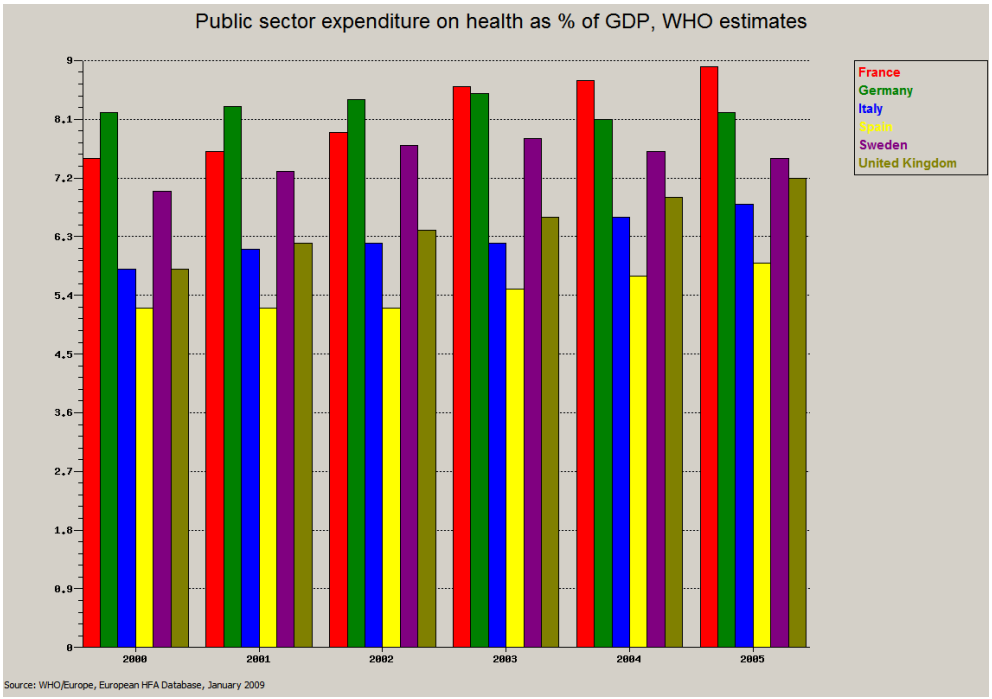
Influencing factors. The public may come to regard sustainability issues as so important that high defence budgets and defence activities will become increasingly criticised. Especially Green Parties and environmentalists are arguing along that line. This could have rather unfavourable consequences for the establishment of a strong EDTIB. But other issues, e.g. security or the fight on terrorism, may become more important than sustainability and defence budgets may not have to compete with sustainability issues. An important influencing factor is public opinion. How high will citizens rank sustainability issues against other societal and economic challenges? Regarding defence, this issue will be influenced by unpredictable events in society (e.g. humanitarian disasters, terrorism). But also information exchange may be vital if the question is to 'connect' to the public. From the sustainability challenge point of view, the ability to organise international initiatives is very important, since the issue cannot be solved by individual nations, needing international cooperation and agreements.

Impact on the EDTIB. Sustainability issues could impact the EDTIB when the demand changes to more energy-efficient products. Furthermore, defence activities increasingly include emergency operations and civilian support. The defence sector could also come to be seen as an entity that has the necessary equipment (e.g. special vehicles, sensor systems), know-how and training to be of assistance in case of environmental catastrophes like storms or floods. This would imply better public and budgetary support and lead to closer relations between civilian and defence industries.

3.5.6 The pressure on the healthcare system

Definition. One of the major trends in government spending is the increasing demand of the healthcare system, leading to pressures on the government budgets due to aging and better medical facilities.

Description. In 2008, governmental expenditure on healthcare in Europe was between 5-10% of the public GDP (WHO, 2009). Compared to the 2% of GDP the EU MS aim at for defence budgets, this is a large percentage of government spending. But this difference will even grow, due to the aging of society, as well as to improvements in medical care and technology, putting additional constraints on public budgets. The last decade, the overall public expenditure on healthcare has increased dramatically, with more than 20% in some EU countries. It is e.g. expected that the number of people with dementia will increase by about 50% in the coming decades, and since aging will continue, this increase is likely to accelerate in the coming years. The current pressures on the healthcare system are likely to increase to the extent that national governments will find themselves in trouble. These pressures may also lead to significant pressures on the defence budgets.



On the other hand, medical innovations, especially in the area of prosthetics and emergency medicine are being developed for and supported by the military. Especially in prosthetics there already exist close R&D cooperations between military and civilian institutions. The Military Amputee Research Program of the U.S. Army's Telemedicine and Advanced Technology Research Center (TATRC), for example, is funding prosthetics and other cutting-edge medical R&D (e.g. 'Trauma Pod'). Since the specific and dangerous nature of defence operations necessitate more advanced medical procedures, defence could also contribute to innovations in civilian medical care.

Influencing factors. The expected pressure on the healthcare system is expected to be increasing. Policy measures need to be developed, but experience shows that this will not be easy. Technological products may prove to be beneficial, but not all parts of the healthcare system are sensitive to technological solutions. Another important factor will be a continuing shortage of labour, which will be putting pressure on wages of medical personnel. Also, a possible system change could reduce costs, but this may have consequences that were not anticipated. A last possible measure may be increased migration to decrease the pressure on the healthcare system, by both increasing labour resources and the number of younger people.

Impact on EDTIB. The main potential impact for the EDTIB is a strong reduction of the budgets. As the annual *increase* in healthcare expenditures is in the same order of magnitude as the overall defence budgets, one may expect defence budgets to experience an additional pressure towards further reduction. Also, cost efficiency and less participation in operations may eventually lead to less research and innovation. On the other hand, medical R&D could become an important part of the EDTIB with benefits for defence and civilian use. A last potential impact on the EDTIB is formed by further pressure on the labour market, limiting the access to good personnel.

3.6 Technological driving factors

3.6.1 Introduction to technological driving factors

Technological development is crucial to the performance of the military. The introduction of new technologies like the crossbow already used in ancient Greece and Asia or the first firearms have had a crucial impact on victory or defeat. Rather recently, attackers and terrorists make increasing use of commercially available technologies such as cell phones, 'home-made' explosives and self-written computer viruses. But technology has different sides, looking at it from the defence perspective. New technologies are researched and developed, but also need to be transformed in usable products and services that can be used in military operations.

The ***research and development*** of new key scientific insights and technologies provide crucial components to the development of new products and services. It can be stated that developments in ICT have (had) a fundamental effect on the way military operations are conducted. Just after the Second World War, R&D in defence was about 50% of all R&D and provided the most important driving factor behind civilian innovations. Today, this has changed and civilian R&D proves to be an important driver for defence-oriented innovations. In 2007 the US budget on military Research, Development, Test and Evaluation was 76 billion US$ and is expected to rise to nearly 80 billion US$ in 2009 (US DoD, 2009). The European budget (including all MS) is only 1/6 of this[26]. To put this figure in perspective, this budget is in the same order of magnitude as the annual budget of the EU Seventh Framework Programme (only EC).

Most of the added value of defence research is crystallised in the defence products and services produced by the industry. This manufacturing is a historically evolved system, where important technological and organisational capacities are essential to an efficient and effective production. This ***Technological and Industrial Base*** (TIB), includes technological capital, human capital, but also organisational structures (firm and networks). Changing the nature of the products and services will also lead to changes in this TIB, and will mean a destruction of capital.

The third side to *Technological driving factors* are the ***changing demands*** of the military system. Changing future operations will also change the needs for products and services, and therefore a change of the TIB itself. If operations change to combined humanitarian/security operations, and no-war conflicts, the need for large state-of-the-art military platforms will be reduced. If a shift is made towards actual operations in local settings, logistics materiel is used very intensively, leading to more demand for maintenance. The Technological and Industrial Base needs to be adapted to deliver these 'new' products and services.

Looking at technology, the following driving factors can be identified that will likely change the EDTIB:

- **Supply: New key technologies as innovation drivers for new products and services**
  New enabling scientific insights and key technologies developed in (generic) research can be used for the development of new products and services.
- **Demand: Changing military demands leading to new products and services**
  Changes in military operations as well as other characteristics of the military

[26] http://www.europa-eu-un.org/articles/en/article_6733_en.htm.

apparatus (e.g. aging personnel, reduction of lethality, communication to the public) lead to new and adjusted requirements for defence products and services.

- **Dual use of defence and civilian technologies**
  The relation between civilian and military technology is growing. On the one hand civilian actors like the gaming industry for military training simulations are already important contributors to the military. On the other hand, military developments, especially in medicine (e.g. prosthetics, emergency medicine) are an important driver for civilian developments.
- **Increasing cost of defence equipment**
  An increase in the high-tech nature of the products and services used will lead to an increase in the cost of military equipment. E.g. the continuous increase of ICT being part of the products and services increase their costs.
- **New trends in innovation**
  New key enabling technologies and new demand requirements are integrated in new trends in innovation. New innovations in the field of e-learning, NEC and unmanned vehicles are just a few examples of interesting new areas of application. These are important change drivers to the EDTIB.

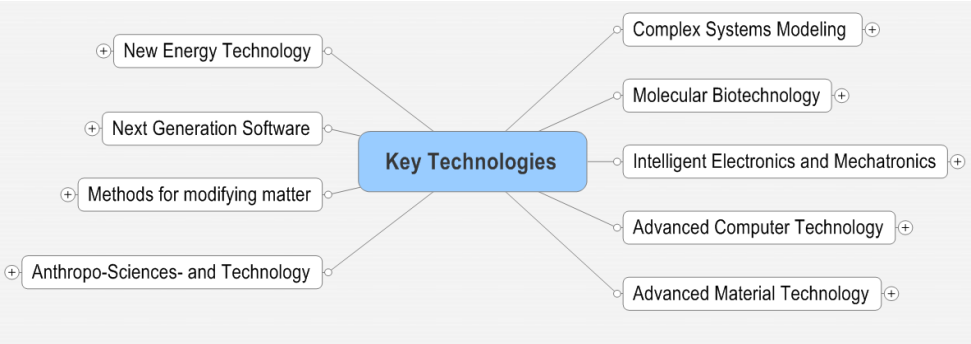
These driving factors will be further described in the following sections.

3.6.2 Supply: New key technologies, innovating defence products and services

Definition. This driving factor discusses the new enabling key technologies from academic research that may lead to new defence products and services.

Description. If one tries to keep track of the latest developments in science and technology, one can easily get the impression that technological progress is advancing at an increasingly faster pace. As human knowledge grows, so do the technological aids that help humanity to increase its knowledge. Today, the sequencing of a whole human genome only takes 4 months (the sequencing of James Watson's genome in 2008), whereas the Human Genome Project that started in 1990 needed over 10 years to accomplish the task. Computers have drastically shrunk in size as well as in cost, and the processing power of a common cell phone exceeds that of the early supercomputers of the 1940s that filled a factory hall.

New and emerging trends in science and technology will become materialised in innovative products that already have an enormous impact on our lives, which is likely to become even greater in the future as these developments mature. Based on earlier work, TNO has identified nine broad new *Key technologies* that initiate innovation in the industry (TNO, 2008).



These technologies drive innovation in the industry. Analysing these key technologies, 8 innovation principles may be identified that potentially change the products and services in industry (a more detailed description can be found in Annex C):

- An important trend is the ***miniaturisation*** of (mecha)-electronical devices, both by molecular technologies and new advanced materials with high performance and specialised functionalities. This trend enables both smaller products, but also the integration of functionalities that were normally too large, like the lab-on-a-chip and the micromobile devices.
- This trend is closely connected to the trend of ***increasing intelligence*** in products. Based on the still ongoing new technologies in hard- and software, information technology is becoming ubiquitous. In almost every product, a component is integrated that focuses on creating smart and intelligent interaction with its environment.
- The miniaturisation and increasing intelligence add up to a third trend: ***robotisation***. Based on the new technologies to manufacture mechatronic devices, the bulky robotic systems of yesterday can be reduced in size and made more intelligent.
- Advances in materials technologies will lead to ***smart and better materials***. The possibility to both create materials on the nanolevel and in-depth understanding of material properties will boost the development of stronger materials, lighter materials, biocompatible materials, materials with functional properties (e.g. disinfectant, self-cleaning, self-repairing).
- Advances in cogno-neurosciences and other medical technologies will lead to better ***insight into the way the human body*** works. The use of sophisticated software, in connection to further understanding of the human genome, allows a further understanding of human metabolisms and diseases. This enables new medicine, therapies and will even connect new foods to individual persons.
- This better management of information also enables further linking of information sources in social sciences, which creates a ***better understanding of society.*** In this way, complex dynamics in societies can improve governmental policy, but also understanding economic and social dynamics can lead to more competitive and user-oriented industrial strategies.
- The enhancement of information management also improves the ***understanding of ecosystems***. Improvement of the environmental friendliness of products and better preparedness for possible environmental problems hinges on a better understanding of the ecosystem.
- In all areas, ***virtual modelling and testing*** are becoming more sophisticated and more widely applied. Virtual modelling and testing can have great advantages for cost reduction (no real material is destroyed in the tests), accelerate developing time (e.g. in the pharmaceutical industry) and animal protection (e.g. by partly substituting for animal testing).

As science advances, so does the realisation that different disciplines are actually related to each other. For example, research in Artificial Intelligence is closely related to neuroscience, microchip technology is entering the domain of nanotechnology and even biology (self-assembling structures) and the borders between biology and technology are blurring. This development is leading to a ***convergence of science and technologies*** which ideally lead to an improved cooperation between different research areas in natural sciences, engineering, social sciences and humanities to find better solutions in a world that grows increasingly complex and interconnected.

3.6.3 Demand: Changing military demands leading to new products and service

Definition. New defence activities due to changing threats and other operations require new products and services and another technological and industrial base.

Description. "Industry needs a customer that knows his own mind: and Ministries of Defence need to identify to the industry what they want, as far ahead as possible" (EDA, 2007). During the Cold War, the military system focused on building and maintaining a military force that could defend Western Europe from an all-out attack by the Warsaw Pact. The force requirements were for force-on-force engagements: basically tanks against tanks, fighter aircraft against fighter aircraft and warships against warships. It is clear that providing the accompanying military capabilities led to a specific 'platform-centric' technological and industrial base. The main vectors of the Cold War, namely speed, stealth, precision, tactical intelligence, surveillance, and reconnaissance (ISR) are still important and should be further improved. Over the last decade, however, the changed and changing security environment has also given rise to new requirements that need to be reflected in the DTIB. The nature of threats as well as the potential opponent's weapons have changed. The 'global war on terror' (GWOT) has become a central topic for defence and security and new threats like cyber terrorism and asymmetric or unconventional warfare have emerged. Therefore, new strategies and capabilities have to be adopted, which include knowledge and anticipation, prevention of conflicts, surveillance and reconstruction. There is a clear shift in emphasis from weapon systems to means for Intelligence, Surveillance and Reconnaissance (ISR), as well as to analytical capabilities at the tactical, the operational and certainly the strategic level.

From manned to unmanned systems

In most countries the number of military personnel has considerably gone down over the last decade. This development can be compensated by engaging more technological assistance and reduced manning or even unmanned platforms and robots. Unmanned platforms for surveillance are already common in defence. They have clear advantages over manned vehicles and platforms, because they can be made very small, can enter regions and heights that are unsuitable for humans, may have a long endurance and human lives are not put at risk. As computer technology, sensors and Artificial Intelligence are getting increasingly better and to some extent cheaper, defence is becoming increasingly interested in using robots. The US DARPA even runs an annual challenge open to civilian participants to improve the capabilities of unmanned vehicles (DARPA Grand Challenge). Armed robot guards (although still without the capability to autonomously perform lethal actions) are already developed and deployed as border guards by South Korea, Israel, China and the US.

Unmanned systems are not necessarily more cost-effective than manned ones. In case of remote-controlled units (such as many of today's UAVs, Unmanned Aerial Vehicles), one or more controllers / operators are required. Furthermore, the technology needed to compensate for the lack of on-board 'human intelligence' may be quite expensive.

This is widely acknowledged, also in European vision documents and strategies, but nowhere as strongly as in the French White Paper of 2008, which even introduces 'knowledge and anticipation' as a new stand-alone strategic function at the heart of the new doctrine. The technical capabilities of intelligence agencies need to be enhanced in order to keep pace with information and communication technologies. Protection is also seen as one of the key operational capabilities for (future) investment, not only force protection, but increasingly also protection of civilians and civilian infrastructure.[27] Important categories here are: detection, analysis and response to CBRN threats, cyberdefence and missile detection and defence. In face of the greater threat of biological agents used as weapons and the increased danger of concealed attacks (e.g. through suicide bombings), new forms of protection (e.g. against biological agents or

[27] E.g. against ballistic missiles with nuclear, chemical or bacteriological war payloads.

bomb blast) and surveillance are needed. Reducing the risk to humans (defence personnel and civilians) is a target that is taken very seriously. Also, most threats and operations are likely to take place in challenging environments with less developed infrastructure and governance and more difficult terrain and climatic conditions.

- The new kinds of threats, which are broad in scope and complex in nature, require collective responses for intelligence gathering, localised knowledge, availability of local assets, low-intensity warfighting capabilities and other forms of cooperation and burden-sharing.
- For coalition operations, with many different nations intensively working together simultaneously and successively in complex endeavours, standardisation and interoperability in all its manifestations are a key issue in regard to effectiveness and efficiency. E.g. integrated logistics could provide enormous savings. However, apart from political will, this ideal requires a much higher level of standardisation and interoperability than achieved today. In the time to come, threats are more likely to require robust, interoperable and well-coordinated non-military as well as military capabilities, including robust diplomacy, economic and military assistance, and the type of stabilisation and reconstruction capabilities the US, NATO and others are struggling to develop and utilise effectively in Iraq and Afghanistan. So the issue of interoperability (in its broadest sense) not only applies to military organisations working together, but also a variety of agencies coordinating and cooperating.
- The wear and tear of actual operations and the expected rise in the number of expeditionary operations lead to drastically shortened maintenance and repair cycles and reduced in-service times. In the short run, there is a need for add-ons to existing equipment to better sustain local weather and terrain conditions, as well as system health monitoring. In the long run, for new equipment, the life cycle cost will become an extremely important design criterion, given the heavy-duty deployment profile.
- Each new operation leads to particular requirements in terms of personnel, materiel, organisation and processes/procedures/doctrine. This is further strengthened by dynamic environments and adaptive opponents. The development of the 'IED scare' in Iraq and in Afghanistan over the last couple of years is a troublesome example of the latter. In other words, there is an overarching requirement for flexibility and adaptivity to (re)adjust to the local and temporal environment. In the short run, this leads to the requirement for 'fast track' development and procurement. In the long run, this puts a strong emphasis on easy adaptable, modular equipment that allows for rapid technology insertion.

Factors of influence. Asymmetric threats will remain the most prominent security challenges – as opposed to 'symmetric' powerful state actors as potential adversaries, thus requiring new strategies, technologies and modes of operation. The availability of sufficient budgets for modernisation/transformation and the access to necessary know-how and technologies are critical factors. The degree of cooperation within Europe, but also with the US and maybe other competent partners like India will be influential for success.

In practice, the way these factors work out may vary drastically for different MS, dependent on e.g. the ambition level and the budget available for modernisation and transformation. This is certainly an area where 'a Europe of different speeds' is in

effect, leading to different clusters of MS that can fruitfully work together in actual operations.

The nature of operations is changing. Although the classic Cold War vectors and necessity for large platforms will remain, new trajectories have to be taken up in order to ensure security and successful defence in a changing world. Measures and technologies that improve prevention, surveillance, knowledge and anticipation are getting increasingly important and have to be integrated. This includes technological and non-technological ways to prevent cybercrimes, biological attacks and terrorism. The cooperation between defence forces with humanitarian aid and rescue operations is also very likely to become closer, which requires a greater adaptability and cooperation between defence and non-defence (civilian) systems. The European defence system certainly has to adapt to these new changes and challenges, but the question remains, how fast this can be achieved.

Fast adaptation to new changes and challenges could be achieved. The major European armed forces go through a transformation process associated with global power projection, expeditionary operations and a clear focus on continuous 'situational awareness', 'network centricity' and ways to improve surveillance and intelligence capabilities. Smaller MS will try to follow, to the extent that they are able to provide niche contributions in expeditionary operations. Wide area, air-/spaceborne ground surveillance capabilities are so expensive or technically challenging that few MS are able to develop and field them on their own, so these capabilities are developed and fielded in a European context. But it is also possible that the changes and shifts indicated above proceed very much slower or, for many MS, even will not take place.

Impact on the EDTIB. The trend towards more investment in ISR and network-centric solutions at the expense of investments in weapon systems and platform-centric solutions clearly already affects the EDTIB[28]. In the transformation of armed forces from platform to (more) network centricity, huge investments go into building flexible, fault-tolerant and secure networks with a high guaranteed quality of service. This shift in investment priorities is already visible. The influx of civilian-driven technology into the military technological base could be fast and more prominent and innovative SMEs could also become important as suppliers and experts for necessary know-how, especially in ICT, robotics and material science.

In a 'different speeds' scenario, there is a premium on technical, organisational and doctrinal solutions that are able to interface between partners at different stages of NEC development[29].

3.6.4 Trends in innovation for defence

Driver Description The main goal of military technological developments and visionary concepts lies in the aim of improving the effectiveness and efficiency of

[28] Two examples. Thales in 2008 launched an initiative to become a European UAV leader, stating that Europe needs a European strong UAV capability in order to not be dependent on the US UAV capabilities. EADS created a joint venture together with the French defence company Nexter (ex-Giat) to implement a transformation of the French army.

[29] The NATO NEC (NNEC) Strategic Framework defines four levels of 'NEC maturity': de-confliction, coordination, collaboration and coherence. The objective of the NNEC initiative is to support all NATO MS on the evolutionary path of increased NNEC maturity, while trying to safeguard interoperability across the maturity levels as much as possible.

operations, improving the survivability of personnel and equipment and – rather recently from a historical perspective – in the minimisation of collateral damage. Throughout the military, new technological innovations are being applied. They range from equipment for intelligence (e.g. scanning of information, surveillance and data analysis) over training (e.g. training simulations and e-learning), communication between personnel and equipment, protection of personnel and equipment, logistics (e.g. GPS assistance), soldier augmentation (e.g. augmented reality) and intelligent missiles (e.g. fire-and-forget missile guidance) to modern field medicine.

As the Cold War era was hugely influenced by nuclear technologies and large installations, the current advances in biotechnology, and in the foreseeable future in nanotechnology and Artificial Intelligence are likely to lead to totally different forms of warfare. The necessary need for sensor technologies, ICT and the ability to deal with invisible threats stem from new scientific and technological advances. New technologies, especially in the area of biotechnology and ICT, also lead to an increased blur between the military and civilian domain, which is also reflected in the growing discussion over dual-use technologies.

Among other things, much attention is paid to these new innovation trends in defence:

Improved communication. Communication and intelligence has been, is, and will be a key factor for military success. From flag signals to bulky field telephones in WWII, the demands for increasingly effective and efficient information gathering and sharing have constantly grown. Systems and concepts like NEC (Network Enabled Capability) which propagate a better use of information technology in the military and ISTAR (Intelligence, Surveillance, Target Acquisition, and Reconnaissance) that links different battlefield functions together, are becoming increasingly important. The right information should be there at the right time with as less as possible noise and information overload. The military of the future will be a networked entity with personnel, command posts and equipment being connected to each other and the internet.

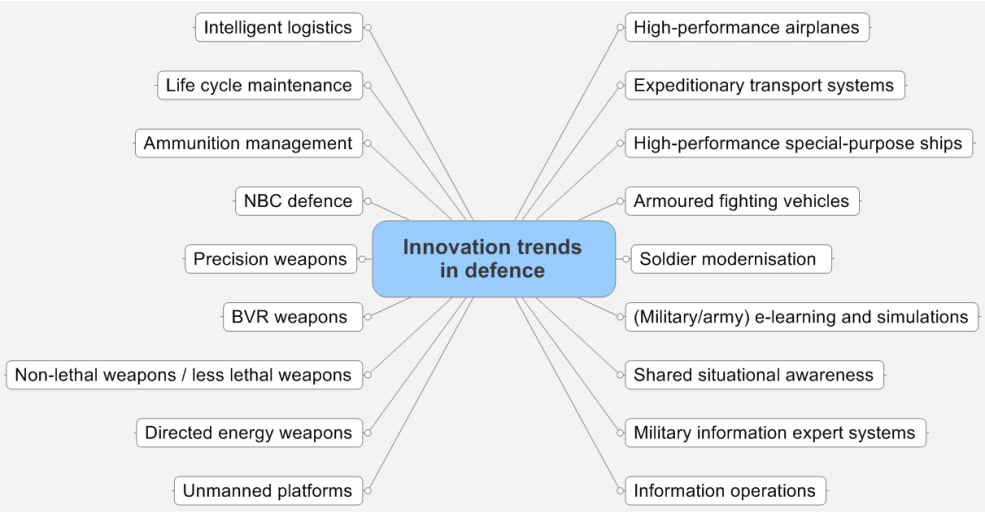
System-of-Systems approaches. Closely related to the objective of improving the communication within the military, is the wish to pool the resources and capabilities of single systems together into a 'system-of-systems' or 'metasystem' promising superior performance compared to the performance of each single system or the simple sum of subsystems. This allows for the interoperability and synergetic use of C4 or ISTAR and should bring together command, control, communications, computers, and intelligence. This necessitates an advanced systems engineering framework. Solutions have to be found to safely deal with the growing complexity and interdependence of different military technologies and units.

Ways to maximise effects and minimise (human) losses. Maximising military effects and minimising the damage to own personnel and equipment is also an important goal for defence forces. To achieve this, the military demands robust platforms and equipment which still display the necessary agility. Equipment should also become more intelligent, and be able to perform tasks more accurately (even more accurately than humans) and to act autonomously without endangering personnel.

Customised Off-the-Shelf Products and Compatibility. Commercially available products, especially software, are highly attractive for the military, because using

civilian products that have already been produced and tested may save costs and development time. While military-off-the-shelf (MOTS) or commercial-off-the-shelf (COTS) products do have their advantages as outlined above, they also pose challenges in meeting the special requirements for the military. In short: there is a need for MOTS/COTS that are highly suitable or easily and cost-efficiently adaptable and customisable to the military requirements.

An overview of the trends in innovations for the defence domain is given in the following figure.



For a detailed description of these trends in innovation, see Annex D.

Since the US is clearly leading in the development of advanced military technologies and capabilities, a look at the US vision should reveal some future-oriented capabilities and technologies. In assessing its science and technology strategy, the US Department of Defence has "identified a set of operational capabilities and their enabling technologies (strategic technology vectors) that are the successors to the Cold War's speed, stealth, precision, and tactical intelligence, surveillance and reconnaissance (ISR). These four Cold War 'vectors' remain important, but have evolved against the demands of today's missions. Speed remains critical, but it is not about just getting there fast, but about adapting, understanding, deciding, and acting. Counter-stealth has supplanted stealth as a critical need, since it is US adversaries who are able to operate hidden underground and hidden in plain sight among civilians. The capabilities needed for such counter-stealth operations are ubiquitous observation, recording, and archiving of difficult target data and being able to rapidly extract useful information hidden in massive clutter. Precision has expanded from 'hitting what you aim at' into tailoring effects to the circumstance, including minimizing counterproductive effects. Lastly, tactical ISR – seeing deep – can be viewed now as the much broader challenge of mapping the human terrain, including foes, ourselves, and others."[30] Together these four critical capabilities – human terrain preparation, ubiquitous observation and recording, contextual exploitation, and rapidly tailored effects (with speed implicit in all) – constitute a capability vital for success across all the missions and against adaptive adversaries. To paraphrase the above US vision, "being able to put a weapon anywhere

[30] Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, Defense Science Board 2006 Summer Study on 21st Century Strategic Technology Vectors, February 2007.

on the globe within a few decimetres", is not enough if we cannot "find those exact few decimetres". There is a clear shift in emphasis from weapon systems to means for intelligence, surveillance and reconnaissance, as well as to analytical capabilities at the tactical, the operational and the strategic level. It further states that "intelligence of all kinds, including from space and prospective studies, takes on major importance" and "a major boost will be given to space-based applications, with a doubling of the corresponding budget."

Factors of influence. Some important steps could come from the defence industries themselves. If they see the necessity to cooperate with research institutes, other firms or SMEs to obtain the necessary capabilities and the legal frameworks for this, more openness and innovativeness could evolve automatically. This could be specially the case if the blur between civilian and defence technology is already high, e.g. in regard to equipment for general security or data analysis. The procurement and innovation strategies of the defence ministries and the EU can provide necessary frameworks. Open procurement policies and less concerns about dual-use technologies (e.g. in respect to proliferation issues of advanced biotechnology) would lead towards the direction more dual use, a closer cooperation between civilian and defence R&D and more openness. Generally higher or more efficiently organised defence budgets allow for the procurement of more innovative, but also more expensive technologies. But also the external environment and security situation can be an important driver towards a positive development of the EDTIB. Changes in the logic of warfare, terrorism, asymmetric warfare and the threat of biological weapons necessitate innovative defence systems like smart sensors, unmanned platforms and a greater emphasis on technologies for surveillance and intelligence operations. A rather non-threatening external environment might not bring about enough incentives to invest in high-cost innovation efforts.

Of course, this 'technology-centred' US vision is not necessarily directly mirrored in the near future European capability investments. Even if it is accepted that, for instance, in order to stay relevant European armed forces should move towards more network-enabled capabilities (NEC), two important questions remain. First, *how*? How about the pace of change (transformation versus evolution), information management (push versus pull mechanisms, information overload), security issues in a networked, information-rich environment, the proper 'command & control' model in a self-organising environment, matching the demands of national joint networking with those of a combined *and* interagency environment[31], the most cost-effective distribution of functionality (including the basic military action loop: sense-decide-shoot) throughout the network, and so on? Second, is it *affordable*? In other words: can enough money be freed through e.g. reductions in operating costs to finance the costly transformation process towards full network-centricity? The major European armed forces might go through a transformation process associated with global power projection, expeditionary operations and a clear focus on continuous 'situational awareness' and 'network-centricity'. Smaller MS will try to follow, to the extent that they are able to provide niche contributions in expeditionary operations. Wide area, air-/spaceborne ground surveillance capabilities are so expensive or technically challenging that few MS are able to develop and field them on their own, so these capabilities are developed

[31] 'Interagency' referring to the cooperation of various instruments of state power (e.g. diplomacy, development or economic aid and defence), with various international organisations and with non-governmental organisations.

and fielded in a European context. The shifts indicated above could, however, turn out to be very much slower or, for many MS, even never take place.

Impact on the EDTIB. The different influence factors could either lead to a technologically highly innovative and fast-paced EDTIB that also includes innovative SMEs and actors from civilian R&D/S&T. This will be more likely if the external security environment necessitates such steps and if the defence budget is higher or more efficiently organised (e.g. through collaboration efforts). It is reasonable to assume that a greater perception of external threats also increases the justification for higher defence budgets and innovation efforts. If the incentives for innovation efforts are lacking, the technological part of the EDTIB would look less innovative with a slower pace of modernisation. In this case, dual use and the integration of civilian R&D sources would be much less pronounced.

3.6.5 Dual-use technologies and innovations

Driver description. Dual use is a term that is used to denote a technology that can be principally used for both, military and civilian purposes. However, dual use must be distinguished from using the same applications (e.g. defence using the same word-processing programmes as civilian institutions). One classic example is nuclear material that can be applied in civilian nuclear reactors as well as be used for military purposes. Recent dual-use discussions especially concern products of biotechnology or nanotechnology, where the same technology could be used to create, for example, applications for medical purposes or energy technology, but with certain modifications could also lead to the production of weapons.

Apart from political and social discussions about dual-use technology, many innovations and technologies (e.g. lasers, radar systems, biotechnology, AI, nanotechnology) have an intrinsic dual-use property that cannot be eliminated without banning the whole research. However, the scientific communities are quite aware of the dual-use potentials and are expressing their concerns about how their research might be used in different ways. In this sense dual-use technology can play an important role in the advancement of military technology, since many important scientific and technological developments are devised in civilian institutions (e.g. universities). The call for more surveillance and security vis-à-vis potential dual-use developments is growing, especially in the context of nano- or biotechnology and robotics. The degree to which military actors can make use of dual-use instruments therefore also depends on national and supranational legislation.

The application of dual-use developments can lead to savings in budgets and research time for defence and even improve the innovative capacity and technological progress for both, the military and the civilian developer. But there may also be challenges, since developments in the civilian context are often subject to strict regulations regarding safety and risk assessment, which could conflict with some interests of defence.

The domain of defence-specific technology, developed and applied in a secure, government-controlled environment has shrunk considerably over the past decades (especially in the US), and will continue to do so32. In the vast majority of technology

[32] "One feature of the security landscape has changed fundamentally. The DoD and its government and industry partners are no longer at the leading edge of most technologies. The globalization of multipurpose technology provides opportunities for U.S. adversaries to exploit that did not exist during

areas it is (already) the civilian world that sets the pace of innovation. A failure to make use of the potential offered by civilian R&D, technologies and innovations may even cause the defence sector to lag behind. Especially in the areas of nanotechnology and AI applications, research institutes, companies and even SMEs that are not explicitly defence-related play an increasingly important role as innovation drivers.

In combination with globalisation, this implies that actors across the world may get access to high-tech and the matching knowledge that can also be used for military purposes.

Factors of influence. An important factor influencing the development of the EDTIB is the success of translating civilian R&D and innovative products and services into viable applications within a military context. This not only depends on the question if civilian R&D is appropriate and useful in the defence context, but it also – or even to a greater degree - depends on legal regulations, public perception and the willingness of civilian actors to cooperate.

The possibilities for dual-use products are growing, but the debate is on how deep and how fast this development will (further) impact the defence market. The impact for the next decade might be very limited. Although more and more civilian technology becomes incorporated at the component level, the design and production of the most important and expensive weapon systems and platforms more or less follow the traditional development and in-service life cycle of the past decades. The cooperation with civilian institutions and firms is much challenged by legal barriers.

But it is also possible that the trend towards dual use accelerates. Basic platform designs (airframes, chassis and hulls) are more often than not based upon civilian designs and templates, as do most of the sensor, communication and command functions on the platform, and even increasingly more weapon functions (e.g. directed energy weapons based upon laser technology). The superior performance of Western forces will increasingly be achieved not at the component, subsystem or even system level, but through high-quality system and system-of-system operational integration of all DOTMLPFI elements[33] [34]. The defence seeks the cooperation with civilian institutions having general knowledge and innovation capacities in many key technology areas that can be adapted to defence purposes. This is where the West, through the combination of its economic strength, industrial base and high-quality military professional skills still has a competitive edge. The importance of this is illustrated by the fact that the UK in its Defence Industrial Strategy (UK MoD, 2005) starts the section on the various sectors with a chapter on Systems Engineering.

Impact on the EDTIB. A competitive, capable and capability-driven defence industry is characterised by the craftsmanship to combine the right dual-use technologies with the few remaining defence-specific technologies to produce efficient and effective military applications, certainly on a large scale.

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the Cold War. Time to market has become the competitive advantage." Citation from Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, Defense Science Board 2006 Summer Study on 21st Century Strategic Technology Vectors, February 2007.

[33] An important element is being able to achieve and maintain air and sea superiority or even dominance, which is a doctrinal prerequisite for NATO land operations.

[34] DOTMLPF stand for Doctrine, Organisation, Training, Materiel, Leadership Development, Personnel, Facilities and Interoperability.

3.6.6 Defence equipment costs

Driver description. In the past decades, defence equipment has meant rising costs. Data on equipment costs and cost increases for major systems are shown in the table below.

Table 3.1. Cost data: levels and trends (Pugh , 2007)

Equipment	Unit production cost (£mn, unless specified)	Annual rate of cost increase (%)	Ratio of development costs to unit production cost
Aircraft carrier	5.5 billion (acquisition cost)	3	NA[35]
Air defence vessel	640	2	NA
Nuclear submarine (SSN)	1.9 billion (acquisition cost)	1	NA
Conventional submarine	300 (acquisition cost)	3	NA
Main battle tank	4	1	250
Infantry fighting vehicle	4	4	250
Artillery	6	5	150
Combat aircraft	70	4	100 (or about 200 if new engine needed)
Bomber aircraft	2.5 billion	10	NA
Jet trainer aircraft	17	4	NA
Tanker/transport aircraft	40 (200 for strategic transport)	4	NA
Attack helicopter	24	5	120
Cruise missile	4.5	8	6500

Costly equipment includes aircraft carriers, nuclear-powered submarines, and bomber and combat aircraft. Cost increases ranging from 3% to 10% are typical for these kinds of equipments. Other systems become costly if production numbers are relatively small or heavily rely on new technologies and developments. But also the development of new technologies is expensive as a result of high R&D costs.

Factors of influence. The following factors may have important influences:

- More competition – for example, the introduction of a competitive procurement policy in the UK in the 1980s was estimated to have saved about 12% of the UK's equipment budget.
- Larger series – exports may help to achieve viable economic scales of output. Abandoning a policy of national operational sovereignty because it involves cost penalties (Kirkpatrick, 2008). This also opens up the road towards more procurement from low-cost countries[36].
- An increased use of high-end civilian standards and Commercial or Military Off the Shelf (COTS/MOTS) components and subsystems – as opposed to military-specific requirements (milspec).

Further consequences of rising materiel costs may be a greater emphasis on upgrading and modifying existing platforms, on electronics insertion and on military outsourcing (e.g. training, repair and maintenance, air tankers). There will be greater emphasis on Through Life Capability Management (TLCM). These market opportunities will lead to some new entries, but will also provide incentives for existing defence firms to acquire

[35] NA= not available.
[36] In its 2006 White Paper, Germany is advocating this path.

new businesses. In recent years, new entrants have included military service companies (e.g. the emergence of Halliburton in the SIPRI Top 100 arms producing companies). In fact, in 1996 there were only 10 military service companies in the SIPRI Top 100 list, but by 2006 there were 18.[37] The increasing importance of IT and electronics has allowed civilian electronics firms to enter defence markets (e.g. via supply chains to prime contractors)[38].

However, it is not a certainty that the current upward cost trend will remain – at least not across the board. Some argue that the paradigm shift towards network centricity may lead to (even significant) lower cost levels. Many examples from the civil market may be used as evidence for price erosion of high-tech. Others suggest caution. For example, some predict that by the time unmanned air vehicles are as capable as their manned equivalents, they will have become equally expensive and hence just as unaffordable (Pugh, 2007). In short, the debate on equipment cost escalation is undecided. But it can be assumed that defence will be an early adopter of new technologies being modified to be applicable in defence, making it generally more expensive than civilian mass-produced equipment.

Extrapolating the trend, defence equipment may continue to be characterised by rising costs. What most agree on, however, is that future generations of manned combat aircraft are unaffordable for any nation other than the USA.[39] As a result, a radical change is inevitable for Europe's national aerospace industries. More generally, defence budget pressures and rising equipment costs provide greater incentives to search for lower-cost solutions. These include overseas sources of supply and the use of civilian technologies and commercial-off-the-shelf products.

Impact on the EDTIB. A continuous trend of rising equipment costs creates a vicious circle of smaller series and higher per unit costs. Particularly for the high-end platforms (e.g. warships, fighter planes) this trend must be breached, e.g. through the factors mentioned above.

3.7 Overview of the change drivers

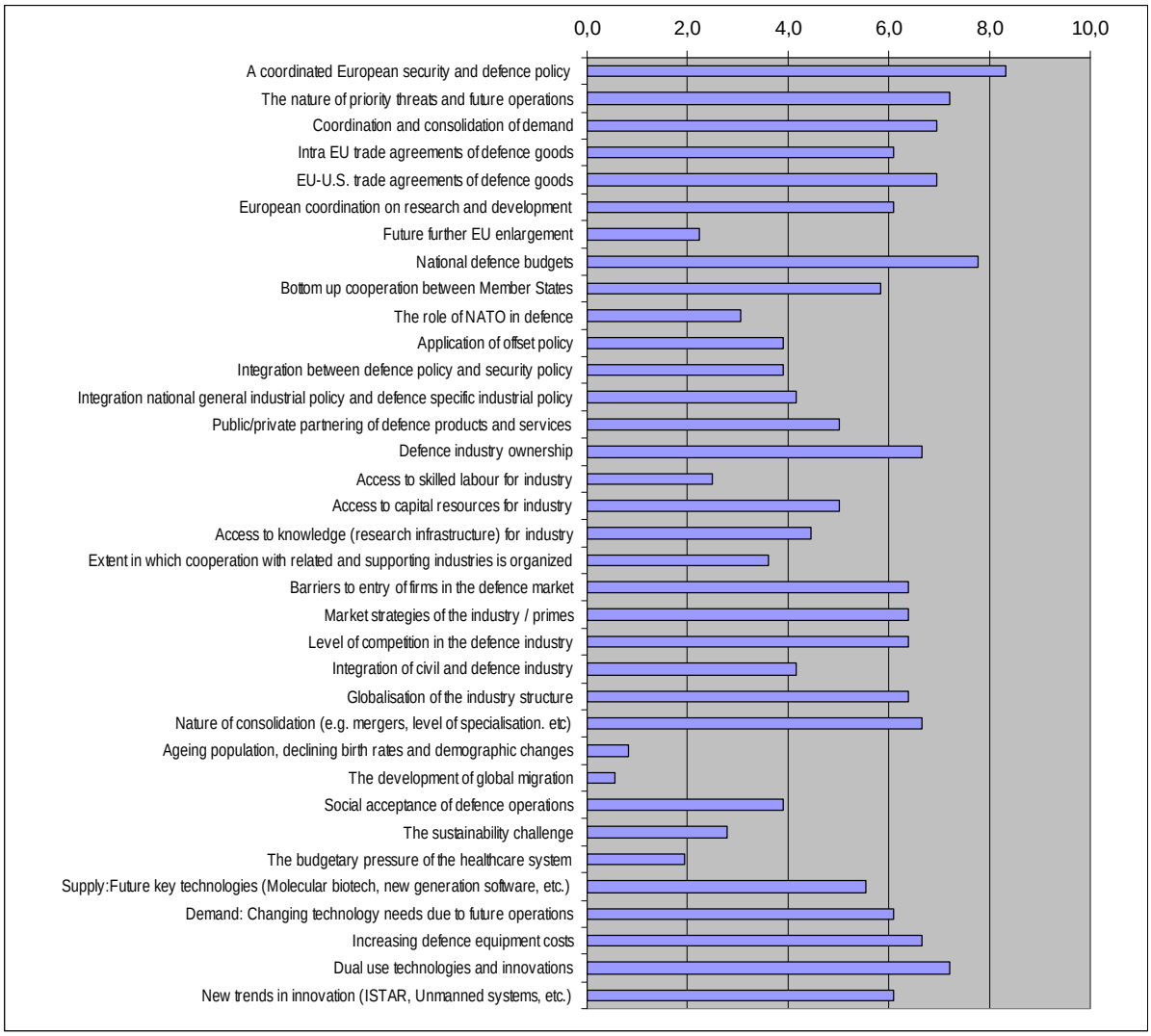
3.7.1 Prioritising the factors by potential impact on the EDTIB

The change drivers described in this chapter are not all of the same importance to the future of the EDTIB. A questionnaire has been sent to the project team members and a number of experts to assess which driving factors are the most important. The questionnaire has been sent to 20 experts, 14 of which responded.

Overview of the definition of the scaling indicators	
Very high	The factor will fundamentally change the industrial structure of the sectors of the EDTIB across the board
High	The factor will change a significant number of industrial networks of the individual sectors of the EDTIB (restructuring of the individual sectors)
Limited	The factor will change some individual industrial networks in the EDTIB
Weak	The factor will not lead to any structural changes in the EDTIB

The questionnaire contained an overview of all factors previously described. The participants were asked on a scale of 1) weak; 2) limited; 3) high 4) very high to indicate what potential effect the factors would have on the structure of the EDTIB (scale 0: weak-10: Very high).

[37] SIPRI, The private military services industry, SIPRI website, 2008.
[38] Cf. SAIC and CSC in U.S. top 10 (see Table 14).
[39] Ibid., p. 36.



The experts involved included policy-makers, defence consultants, industrial representatives and defence researchers and former army personnel. The results are the average outcomes.

Although the experts involved in this questionnaire form a selected group, this does provide an indication of the importance of specific factors described in this chapter.

It is clear that the experts think the 'Realisation of a Common European Policy on Defence and Security' would have the highest impact on the development of the EDTIB. On the 10 point scale, it scored 8.3 (SDEV 2.25). Also, the other Europe-oriented policy factors could have potentially far-reaching consequences for the development of the EDTIB.

But also the 'National budget' had a high score, which is to be expected. In general, however, national policy factors seem to have less potential impact on the further development of the EDTIB than most other factors.

The economic factors are expected to have a broad influence on the further development of the EDTIB. Although the market is dominated by government spending, other economic aspects are also considered to be of high importance to the functioning of the EDTIB, possibly changing its development.

Looking at the lower end of the outcomes, the social factors are rated very low. Possibly, the experts who participated in the questionnaire are biased because of their defence origin, but it seems likely that these factors will have little consequences for the EDTIB. It is on the whole surprising that the major societal challenges (sustainability, aging and healthcare) would not have any repercussions to the defence domain.

Another important conclusion is that the further development of technology is considered to be relatively important for the EDTIB. All factors in this area were considered to be highly influential when it came to the development of the EDTIB. One may conclude that future technologies may have strong implications for the EDTIB and anticipation should be part of its policy. Especially dual use was expected to have a significant influence. The experts stated that they felt the trend had not reached its full impact yet.

3.7.2 Potential influence by EU policymakers

An important aspect to the relevance of the factors addressed in this study is the actual influence EU policy-makers may have on the development.

Within our society, policy-makers have limited space for intervention. They need to address specific barriers, if a societal need is not taken care of by other stakeholders. They can resort to, roughly speaking, four different types or measures:

- Economic instruments, to change the economic incentive structure on the market.
- Legal and regulatory mechanisms, to change behaviour by imposing it on the stakeholders.
- Communication measures, to inform stakeholders and enhance communication between stakeholders.
- Setting up institutions, like research institutes, agencies and other entities that directly provide input to the market.

However, this portfolio of instruments is limited for this study, because many instruments are the domain of national policy-makers and therefore are not applicable. With this in mind, the potential influence by policy-makers on the factors may be discussed.

The first category of EU policy is by definition an area that falls within the domain of the EU policy-maker. Although participation of the national governments is required, this is still within the scope of influence of the EU policy-maker. The second category of national policy factors the EU policy can do less to influence. This is the domain of the national policy-maker, albeit that indirect influence may steer developments in the right direction. A first step is reaching agreements on the national budgets. Also, further development of integration on European industry/civil/defence policies can have a positive influence on these integrations on national level. Even though the role of NATO is primarily a national domain, EU participation may help the further development of the NATO. The EU can also facilitate bottom-up initiatives and stimulate discussions on industry ownership. In conclusion one may say that most influence is indirect, but can be crucial. The economic category is more difficult to

influence. Some regulatory instruments can be applied to e.g. increase access to financial capital. Also, more economic instruments may be used to initiate networking and integration of civilian and defence industries. However, many factors are just out of scope to EU policy-makers (nature of consolidation, competition, barriers to entry). The societal factors are rather societal challenges and often predetermined. The aging of our population is a demographic trend and the linked pressure on healthcare will also be out of the scope of influence of the EU policy-maker, this being the domain of national governments. But the sustainability challenge, migration and the societal acceptance of defence operations can be addressed by EU policy-makers. On the sustainability challenges EU policy is already developed and underway. Migration is a political issue, vehemently discussed within the European Union (regulation). The societal acceptance of defence operations can be addressed by communication instruments. The last category of factors is technology. Here, often more economic and even institutional measures can be applied. Linkups with the EU research programmes and other innovation-oriented instruments are in order, as well as communication mechanisms in cooperation with the national governments.

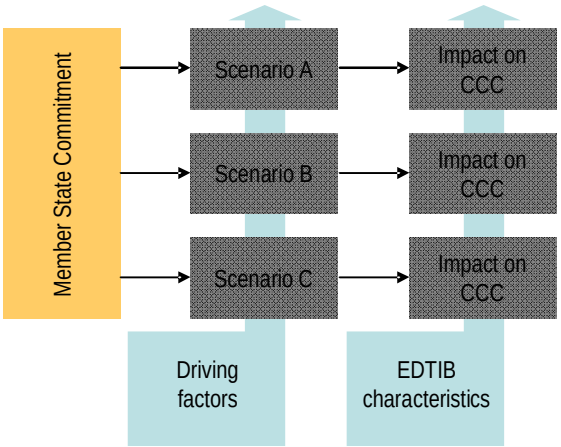
Concluding, it can be said that many of the factors are within the scope of influence of the EU policy-makers, although cooperation with national goverments is crucial. The following table shows the potential influence of the EU policy-maker.

EU policy driving factors	A coordinated European security and defence policy	Economic	Access to skilled labour for industry
	The nature of priority threats and future operations		Access to capital resources for industry
	Coordination and consolidation of demand		Access to knowledge (research infrastructure) for industry
	Intra EU trade agreements of defence goods		Extent in which cooperation with related/supporting industries is organized
	EU-U.S. trade agreements of defence goods		Barriers to entry of firms in the defence market
	European coordination on research and development		Market strategies of the industry / primes
	Future further EU enlargement		Level of competition in the defence industry
National policy driving factors	National defence budgets		Integration of civil and defence industry
	Bottom up cooperation between Member States		Globalisation of the industry structure
	The role of NATO in defence		Nature of consolidation (e.g. mergers, level of specialisation. etc)
	Application of offset policy	Societal	Ageing population, declining birth rates and demographic changes
	Integration between defence policy and security policy		The development of global migration
	Integration national general industrial policy & defence industrial policy		Social acceptance of defence operations
	Public/private partnering of defence products and services		The sustainability challenge
	Defence industry ownership		The budgetary pressure of the healthcare system
Green	High influence of EUpolicymakers	Technology	Supply:Future key technologies
Orange	Low influence by EU policymakers		Demand: Changing technology needs due to future operations
Red	Almost no influence by EU policymakers		Increasing defence equipment costs
			Dual use technologies and innovations
			New trends in innovation (ISTAR, Unmanned systems, etc.)

4 Towards three scenarios for the EDTIB

4.1 Introduction to the scenarios

The future of the EDTIB is uncertain and the driving factors for change described in the previous chapter show that different evolutionary routes may be realised. Also, the evolution of one driving factor will be linked to other driving factors. The scenario analysis approach can contribute to the development of a more systematic insight in possible futures for the EDTIB. This will help to anticipate the future and to evaluate the potential shape/direction of specific drivers. It will also enable a more focused analysis of their potential impact on the EDTIB and the identification of possible policy recommendations.



To create more insight in the future, three scenarios will be described. For a consistent approach to the scenarios, a core philosophy is selected, which fundamentally changes the regime of the scenario and allows a multiperspective analysis. In this chapter, first a description is given of the scenarios, addressing the different values of the driving factors from chapter 3. Following these descriptions, the actual potential impact on the different EDTIB sectors is addressed, using the three basic characteristics of the EDTIB (Capability, Competence, and Competitiveness). The chapter will conclude with an analysis of the scenarios, to identify the scenario that has the most advantages for the EDEM.

In this study, the philosophy behind the scenarios selected is *the commitment of the MS to have a coordinated defence policy on a European, or even global level (with the US).* The different shapes of this characteristic will produce specific 'values' for the driving factors described in the previous chapter. Although the actual setting of these 'values' cannot be seen as predictions (the future is not predictable), the discussion of these drivers in an overall scenario philosophy will help to reduce uncertainty.

The selection of the core-changing philosophy of the scenarios is based on the ToR, but often used in other scenario studies in the defence domain (e.g. RAND, 2004). Also, this core philosophy connects to the most dominant issue in the discussion on the future of the EDTIB and the European defence policy. The following three basic settings for the scenarios are:

1. **Scenario A: Muddling through.** The commitment of the MS towards coordinating the defence policy will remain at the current level.
2. **Scenario B: Market forces dominate.** The commitment of the MS towards coordination is the highest, even leading to an open market with the US.
3. **Scenario C: Europe of different speeds.** The commitment of the MS towards coordinating the defence policy grows, but materialises into different sets of harmonised policies within the MS.

It is clear that changing this core philosophy will have a fundamental impact on the value of the driving factors described in chapter 3. Also, it will have an impact on the actual characteristics of the EDTIB. Of course, the estimation of the value is relatively

arbitrary (this study is not a full modelling project). However, the descriptions of the driving factors in the scenarios are internally consistent and provide a framework for the analysis of the factors.

4.2 Scenario A: Muddling through

4.2.1 Basic description

Core to this scenario is the assumption that the commitment of the MS towards coordinating the defence policy did not increase since 2009 and the momentum that had developed in recent years is mostly gone. This means the EDEM is still dominated by ad hoc cooperation between companies, research organisations and governments, and limited to (a large number of) specific weapons programmes. There is little stability and relatively limited governmental investment in R&D to create a strong and competitive industry. As defence research and procurement are largely dominated by national policy, only suboptimal use is made of the industrial capacities. This all leads to a fragmented structure and inefficient use of resources from a European perspective. Capacities will be organised on a national scale and global competitiveness and use of resources remain limited.

4.2.2 EU policy

Looking back, in EU policy there were no major developments until 2020 regarding a more **coordinated European Security and Defence policy**, partly because of a general declining interest in military capabilities. The 2007 Defence Package with its directives on intra-EU trade and more 'open' EU procurement of defence and security products actually turned out to be difficult to implement. Although intra-EU trade of defence goods became easier and the use of Article 296 decreased, most MS were mainly interested in protecting their home industries. This trend was additionally underpinned by the financial crisis of 2008. The crisis was also largely to blame for the fact that the proposals to the MS, the EDA and to the Commission to strengthen the EDTIB, made during the French EU presidency in 2008, were not readily translated into new legislation or investments.

Some sporadic bottom-up cooperation will further evolve, however, like the continuation of the Nordic cooperation or even quite far-reaching cooperation between Central European (CE) MS. After all, for them defence modernisation is a priority. There is no European shared focus and coordination about defining the **nature of priority threats and future operations**, with the exception of the rather blurred aim of the 'global war on terror' (GWOT). The MS views on how to act in GWOT differ. CE MS are sceptical about Russia, which strengthens their joint CE-specific modernisation and cooperation efforts. Only the CE MS achieve much in **consolidation of demand**, because of their modernisation priority settings, but otherwise no major developments happened until 2020. At supply chain level **intra-European trade volumes** increase, due to policy measures like CoBP and the cross-border transfer directive, but the overall major systems trade volume decreases, because many Western European (WE) and CE MS are buying increasingly from the US. In regard to **EU-US trade** the US market shares rise particularly due to the CE MS strengthening their air defences. CE MS also increase their export shares as a result of the offset policy. Due to the overall uncoordinated actions between the MS, there is also no significant development in a joint **European coordination on research and development** to be expected. CE MS

develop their own cooperations, often with EDA programmes as platform, using offsets to source WE MS competencies. **EU enlargement** in general does not progress, notably due to the tendency towards ad hoc coordination and the importance of MS policy.

Driving factor	Value
A coordinated European security and defence policy	Low coordination
The nature of priority threats and future operations	No shared focus
Coordination and consolidation of demand	High in CE MS
Intra-EU trade of defence goods	Rather low
EU-US trade of defence goods	Decrease in EU import volume Increase in market share
European coordination in research and development	Low
Future further EU enlargement	Limited

4.2.3 National policy drivers

Scenario A is largely dominated by national policy and a general poor economic development. From 2010 to 2020 **National defence procurement policies** have even displayed a tendency towards growing protectionism. The CE MS, however, who have a distinct reason to strengthen their defence system, have established their own kind of 'CEDTIB'. Throughout Europe, **national defence budgets** have further declined with the exception of the CE, which also increased their investments. Due to the overall developments the most significant **bottom-up cooperation between MS** happened in the CE MS, but also the Nordic countries and the Netherlands and Belgium continued, even strengthening their efforts. This did not translate into EU-wide cooperations, however. **The role of NATO** remained important for both the CE and the WE transatlantic faction, and can be seen as the only real constant. **Offset policy** has been made more transparent and rational (EDA COC), but is still widely applied and was, in fact, an important factor behind building up the 'CEDTIB'. Since there have not been real coherent European focus and agreement on defining the nature of priority threats and future operations, the **integration between defence policy and security policy** did not succeed between 2010 and 2020. The **integration of the general industrial policy and the defence-specific industrial policy** also varies for each individual MS. High unemployment rates due to general weak economic performance, however, have made such integrations attractive to countries with predominantly *dirigiste* policies. In the time frame from 2010 to 2020 there have not been any noteworthy changes in s**ourcing and public-private partnering** and the **defence industry ownership**, because of the dominance of national-oriented policies.

Driving factor	Value
National defence procurement policies	Not open
National defence budgets	Low
Bottom-up cooperation between MS	Low, only high with CE MS
The role of NATO	Important
Offset policy	Offsets are used
Integration of defence policy and security policy	Low
Integration of general industrial policy and defence-specific industrial policy	Low
Sourcing and public-private partnering	Low
Defence industry ownership	State ownership in some MS

4.2.4 *Economic drivers*

Since unemployment rates have been high from 2010 to 2020, the **access to skilled labour** has not been a problem. The high unemployment rates have been the result of a generally weak economic performance, which also caused a drop in the industrial investments, especially in the defence sector. This has limited the **access to capital resources**, rendering the defence sector a generally rather uninteresting domain, resulting in limited interest in related R&D activities and, in turn, less **access to knowledge**. The CE MS form an exception due to their common interest in improving their defence capabilities as a precaution towards an assertive Russia. Their improved focus and political leadership have been a major factor in their improved performance in cooperations. As far as the **cooperation with related and supporting industries is** concerned, only a slight tendency towards more pan-European sourcing thanks to EDEM policy have been observed between 2010 and 2020. By contrast, the supply chain development of the CE MS is more vivid. Due to the more nationally-oriented policies and the overall fragmentation, **barriers to entry and exit** have remained high and the **strategies of the industry/primes** remained reactive to the governments, also because of lacking long-term guidance. For similar reasons the **competition in the industry** has also been low, and low levels of procurement have squeezed many of the national industries. With the exception of the CEDTIB, the national champion type of industry structure is not conducive to focus on core competencies. Since the traditional structures of the defence industry have remained basically intact from 2010 to 2020, the **integration of civilian and defence industry** has not materialised at the system level and has been limited to the supplier level. A **globalisation of the industrial structure** has not occurred, due to the national focus. Also, the **nature of consolidation** has remained national, with the exception of the CE MS and their CEDTIB development.

Driving factor	Value
Access to skilled labour for industry	Easy
Access to capital resources for industry	Hard
Access to knowledge for industry	Hard, exception CE MS
Cooperation with related and supporting industries	Pan-European sourcing
Barriers to entry and exit of firms in the defence market	High
Market strategies of the industry/primes	Reactive to governments
Level of competition in the defence industry	Low
Integration of civil and defence industry	Only at supplier level
Globalisation of the industrial structure	Low, national level
Nature of consolidation (e.g. mergers, level of specialisation, etc.)	National level

4.2.5 *Society drivers*

Aging population, declining birth rates and demographic changes were visible factors that took place externally and could not be influenced by policy actions within a decade. Because of the national policies and weak progress in EU integration, **the development of global migration** has not changed significantly in Europe between 2010 and 2020. This has raised the pressures connected with the aging and shrinking of European populations, since the compensation possibilities through immigration were limited. The s**ocial acceptance of defence operations** has remained low and even declined due to other priorities. These relate to the overall weak economy and concerns over pensions and welfare spending. **The sustainability challenge** receives some attention, but even this topic that had been so high on the agenda during the early 2000s becomes less important between 2010 and 2020, due to economic hardships and more

immediate issues. Especially **the pressure on the healthcare system** and other social security systems has grown during the 2010s because of the increasing number of retiring baby-boomers. This has resulted in a declining interest in investments in defence, which could not be compensated because of an overall lack in European coherence and interest in joint efforts.

Driving factor	Value
Aging population, declining birth rates and demographic changes	Pressing effect
The development of global migration	Low to medium
Social acceptance of defence operations	Low
The sustainability challenge	Low to medium attention
The pressure on the healthcare system	High

4.2.6 Technology drivers

The **developments in (future) key technologies** have been weak and remained below general capabilities during the 2010s, due to the overall unfavourable economic situation. Especially costly R&D projects, e.g. in molecular biotechnology, new generation software, robotics etc. have been curtailed. The capabilities for public as well as private funding have remained limited. Because there was no Europe-wide coherence when it came to defining the nature of the priority threats and future operations and a general short-term orientation, there have been little **changing technology needs due to future operations** on the demand side. The needs have been identified rather on an ad hoc basis instead of through robust strategic planning. Neither the supply side of key technologies nor the demand side has made significant contributions to innovation. Therefore, the **dual-use technologies and innovations** have been weak and limited, the traditional character of the defence industry also acting as a contributing factor. In some instances, **defence equipment costs** have increased due to lower demand. However, this had not led to an effective adaptation by the industry, except for the CEDTIB efforts of the CE MS. In Europe, real **new trends in innovation** have not materialised in the 2010s with the exception of some CEs that were really keen about their modernisation efforts. The US still is the dominating innovative power for defence technology.

Driving factor	Value
Supply: Future key technologies (molecular biotech, new generation software, etc.)	Weak
Demand: Changing technology needs due to future operations	Low
Defence equipment costs	High
Dual-use technologies and innovations	Weak
New trends in innovation (ISTAR, unmanned systems, etc.)	Weak

4.3 Scenario B: Market forces dominate

4.3.1 Basic description

Core to this scenario is an open and competitive global market, with special attention to EU-US relations. While defence equipment is increasingly bought off-the-shelf as in a regular market for sophisticated equipment, there are also needs for strong coordination at the EU level and beyond, to avoid the pitfalls of a free market. Therefore,

procurement is coordinated at the EU level, even including close cooperation with the US. The result is a vibrant competition, with a strong innovative character ('creative destruction'), although the attention paid to radical innovations is limited (due to their long-term complex trajectories). The defence industry is operating more and more like regular industries. Unprofitable areas are spun out and new mergers occur, even between European and US firms, and the cooperation with and inclusion of upcoming and innovative SMEs is high. Also, global competition will take its toll, since the present economic structure has some closed market characteristics and is not fully prepared for strong competition. Profit margins will be under pressure, as well as long term R&D spending. The structure of the defence industry is international, with strong collaborating networks to increase the efficiency of research and manufacture. As profits are a strong driver for industry, quality of goods, ethical industrial behaviour, and EU security of supply are under pressure.

4.3.2 EU policy

The implementation of a European **Common Security and Defence Policy** (CSDP) has been the basis of the EU policy from 2010 to 2020. This has led to a high degree of cooperation and open market policies. The attractiveness of the opportunities of an open market has inspired the MS to adopt the 2007 Defence Package with its directives on intra-EU trade and more 'open' EU procurement of defence and security goods, to its full extent. MS source their defence requirements to a large extent also from outside the home market (up from 13% from 2005 onwards[40]). Within the framework of the procurement directive, the use of Article 296 has significantly decreased and competition increased while costs dropped in a number of market segments. Also, the use of the EDA Codes of Conduct helped to bring about this situation. A number of the proposals to the NADs, the EDA and to the Commission to strengthen the EDTIB which were made during the French EU presidency of the EU Council in 2008, have been readily translated into new legislation and ultimately in investments. The financial crisis which started in 2008 proved to be less significant than expected. The **nature of priority threats and future operations** has been stated clearly and boasts the united support of the European MS and the US. Obama's new GWOT that started with Afghanistan provided an overarching guidance. The **consolidation of demand** even transcends the EU level and includes cooperations with the US, Canada and Australia. Also, a considerable number of defence equipment has been bought off-the-shelf. During the 2010s the defence industry has increasingly become more like a regular globalised industrial equipment market, which has also been reflected in a considerable increase **of intra-EU trade of defence goods** at system and supply chain levels. The same applied to the **EU-US trade of defence equipment** which also rose dramatically. US exports increased in most market segments, but the overall export to the EU decreased due to demand shifts to segments with less US strength (in particular not much aerospace procurement). In the 'globally' competitive defence equipment domain, public R&D expenditure remains a key method for increasing the competitiveness of the European defence industry. **European coordination in R&D** has been high and large supranational defence RDI programmes have been set up after the model of FP8 programmes. The EU plays a key role in spreading peace and democracy. The defence cooperations go hand in hand with further **EU enlargement** and integration. Most European former Soviet states as well as Turkey have joined during the 2010s. Close cooperations with Russia and Middle Eastern democracies are still being considered.

[40] Procurement directive.

Driving factor	Value
A coordinated European security and defence policy	High coordination
The nature of priority threats and future operations	Shared focus
Coordination and consolidation of demand	Global, beyond EU-level
Intra-EU trade of defence goods	High
EU-US trade of defence goods	High
European coordination on research and development	High
Future further EU enlargement	High
A coordinated European security and defence policy	High coordination

4.3.3 National policy drivers

As a result of the open market policy, **national defence procurement policies** have strongly shifted towards the best value for money. The **national defence budgets** have experienced increases throughout the 2010s, due to growing commitments and a fast economic recovery from the crisis of 2008/2009. The strong increase in operational commitments has left limited room for increased defence investments, thus strengthening the need for open market policies and cooperation. The formation of a 'coalition of the willing' has been the standard approach when governments did not find suitable off-the-shelf solutions. The **bottom-up cooperation between MS** has been strong and even extended beyond Europe, where especially Nordic countries and the Netherlands have started cooperations with Canada and Australia. **The role of NATO** has remained important within a network of cooperating organisations, whereas also new organisations have come into being, especially aiming to improve the cooperation between democracies based on the idea of a 'League of Democracies'. **Offset policy** has also changed and is only accepted for countries with less developed high-tech industry. The objective: to develop globally competitive niche industries in those countries. A comprehensive approach with military and non-military instruments has been emphasised during the 2010s, aiming to prevent future conflicts through human development. Therefore, the **integration between defence policy and security policy** has been very strong. Since the same 'socially responsible free trade model' has been used, **the integration of general industrial policy and defence-specific industrial policy** has been considerable. The reliance on **(out)sourcing and public-private partnering** solutions has grown very substantially, due to the nature of operations and general societal and economic trends. In addition to for-profit organisations NGOs have begun to play a vital role in the comprehensive approach. The **defence industry ownership** has greatly shifted towards privatisation. Nearly all previously state-owned industries have been privatised.

Driving factor	Value
National defence procurement policies	Open
National defence budgets	High
Bottom-up cooperation between MS	High
The role of NATO	Important
Offset policy	Very limited
Integration of defence policy and security policy	High
Integration of general industrial policy and defence-specific industrial policy	High
Sourcing and public-private partnering	High
Defence industry ownership	Private ownership

4.3.4 Economic drivers

From 2010 to 2020, the industrial structure has experienced a great shift towards globalisation and the exploitation of industrial (as opposed to political) synergies. This development has even gone beyond the EDTIB, towards a highly globalised setting. Strong growth has produced a tough competition on the labour market and made **access to skilled labour** challenging, whereas the open and global nature of the setting also made immigration easier to compensate for local shortages. **The access to and availability of (venture) capital** has been high and so has been the competition. The general climate for R&D is very favourable, the interest in S&T is high and the public opinion on defence is rather positive, since defence operations are now also seen as contributing to increased security and human development. During the 2010s the practices of the defence industry have become more similar to those of civilian industries, leading to e.g. a high degree of **cooperation with related and supporting industries.** The directive on intra-EU trade has facilitated this trend. The defence industry – or rather the large number of industries that provide major defence equipment among other things – have without exception applied the Supply Chain Management practices that were introduced in the 90s in commercial system industries (like vehicles). This has led to long-term relations with key suppliers that also played important roles in R&D. The general abandoning of offset was also helpful in bringing about this modernisation. The **barriers to entry and exit** did not differ significantly from that of other comparable commercial industries. The **strategies of the industry/primes** focused on taking the opportunity provided by opening up for competition and value chain integration. The defence industry has been more and more transformed into a more or less regular systems industry and the exploitation of industrial synergies with regular industries has been high. The same applies to the **level of competition in the industry**. As a logical result, the transformation process of the defence industry, the synergetic effects and the innovative nature of defence demand have led to a strong **integration of the civilian and defence industry**. The **globalisation of the industrial structure** may be regarded as the most remarkable development during the 2010s, **consolidation** having become more global than ever, even beyond the EDTIB.

Driving factor	Value
Access to skilled labour for industry	Challenging
Access to capital resources for industry	Easy
Access to knowledge for industry	Easy
Cooperation with related and supporting industries	High
Barriers to entry and exit of firms in the defence market	No difference with civilian setting
Market strategies of the industry/primes	Open competition
Level of competition in the defence industry	High
Integration of civilian and defence industry	High
Globalisation of the industry structure	High and global
Nature of consolidation (e.g. mergers, level of specialisation, etc.)	Global

4.3.5 Societal drivers

Aging population, declining birth rates and demographic changes were highly visible factors that occurred externally and could not be influenced by policy actions within a decade. The increased openness and globalisation, however, also opened the door for **the development of global migration**, thus compensating for local labour shortages. Since defence operations extended beyond the classic military activities and

successfully included humanitarian aid, conflict prevention, security assurance, reconstruction efforts and assistance in (natural) catastrophes, the **social acceptance of defence operations** has been quite high during the 2010s. This contributed positively to higher budgets for defence-related activities and R&D. The close cooperation and integration between the regular and the defence industries has led to an overall improvement for tackling the **sustainability challenge**, now that the high standards of civilian practices have been adopted. Since immigration took off the **pressure on the social security and healthcare systems** and the general unemployment rate has been low due fast economic recovery, the competition between budgets for social security and defence has not been very fierce during the 2010s. Some results of defence-related R&D have even positively contributed to healthcare, e.g. in regard to the development of emergency medicine, organ transplantation, prosthetics and improved ergonomics.

Driving factor	Value
Aging population, declining birth rates and demographic changes	No pressing effect
The development of global migration	High
Social acceptance of defence operations	High
The sustainability challenge	High attention
The pressure on the healthcare system	Medium to low

4.3.6 Technology drivers

During the 2010s the **developments in key technologies** are very strong and the pace of innovativeness is fast, due to effective innovation policies, a strong economic development and a general interest in research, science and technology. The changing nature of defence operations, which increasingly included civilian and humanitarian activities have also led to **changing technology needs,** which included many developments that could also be used for civilian purposes. The distinction between defence technology and civilian technology has become increasingly blurred between 2010 and 2020. This has also been reflected in the strong application of **dual-use science and technology**. The nature of defence operations has generated trust and support with citizens and political decision-makers, thus taking away many of the concerns associated with dual-use technologies. The **defence equipment costs** have decreased significantly due to open markets, increasing competition and the integration of off-the-shelf components. **New trends in innovation** (ISTAR, unmanned systems, etc.) have been realised and most defence systems have been significantly modernised. Global cooperation in R&D, interdisciplinary approaches and even open innovation have contributed much to a high degree of innovativeness. Especially SMEs and university spin-offs with specialisations in new technologies (e.g. next generation ICT, AI programming and nanotechnology) have played a significant contributing role in fostering innovations. In general, the US has specialised in high-end and expensive equipment, whereas Europeans have been highly competitive in non-high-end segments and technologies for humanitarian and rescue operations.

Driving factor	Value
Supply: Future key technologies (molecular biotech, next generation software, etc.)	Strong
Demand: Changing technology needs due to future operations	High
Defence equipment costs	Low
Dual-use technologies and innovations	Strong
New trends in innovation (ISTAR, unmanned systems, etc.)	Strong

4.4 Scenario C: Europe of different speeds

4.4.1 Basic description

The core to this scenario is that within the European Union, different groups of MS will cooperate on defence policy with different speeds of coordination. A Europe of different speeds is based on a number of key principles, e.g. that countries lagging behind should not hold back faster countries, much in the same way that non-contributing countries should not be allowed to slow down the whole enterprise. Coordination will take place at the level of pioneer groups. Participation in pioneer groups is determined by the national defence spending as a percentage of the GDP, the ambition of defence modernisation measured by investment per soldier and the ability to deploy troops (cf. Witney, 2008).

The European MS have chosen to deal with the fragmented and inefficient way of organising defence and security activities by allowing different (pioneer) groups to act at different speeds. Although an overall coordination by the EU in specific concrete policies is still operational, other, well-selected issues have little coordination. Ad hoc common strategies, constructive abstentions are fully exploited to enhance speed of action. This will lead to a better efficiency of procurement and research, stimulating the defence industry to create strong networks. Although cost reduction and 'creative destruction' is not core to the economic dynamics, healthy economic pressures are still in place.

4.4.2 EU policy

Since Europe has been developing at different speeds in the 2010s, a **coordinated European Security and Defence** is predominantly only achieved by the lead group of the most advanced MS, which, however, already comprise a significant part of the EU. The 2007 Defence Package with its directives on intra-EU trade and more 'open' EU procurement of defence and security goods, has likewise been implemented and operationalised at different speeds. A number of MS already apply the licensing scheme and source their defence requirements increasingly outside the home market (specifically products and services at the lower end of the technology spectrum). Within the framework of the procurement directive, the use of Article 296 has been significantly limited by a number of MS, and competition increased while costs decreased in a number of market segments. A number of the proposals to the NADs, the EDA and to the Commission to strengthen the EDTIB which were made during the French EU presidency of the EU Council in 2008, have been readily translated into new legislation and ultimately also in investments, but in different ways. Between 2010 and 2020 the US power and role as leader has waned, which provided a greater incentive especially for the richer EU MS to develop common strategies and a coherent view on the **nature of priority threats and future operations**. One aim has been the development of global reach capabilities to secure European interests, especially security against terrorist and environmental threats. The **consolidation of demand** has been achieved especially well in the lead group. Various countries and industries in Europe are building at specialisations and clusters, leading to an increase in **intra-EU trade of defence goods**. The 2010s are characterised by the European desire to become less dependent on the US. The EU has become sceptical about US willingness to provide security of supply/operational sovereignty in the future, since the US itself is also struggling with internal economic and security problems. This has resulted in a

drop in the **EU-US trade of defence goods**. The **European coordination in R&D** is close, with the large MS taking the lead of coordination and the EDA programmes serving as platform. **The EU enlargement** progresses rather slowly with Norway and Switzerland finally having reached the conclusion that only EU membership will secure their international trading interests in what looks like an emerging Hobbesian world of multipolar realism.

Driving factor	Value
A coordinated European security and defence policy	High by lead group only
The nature of priority threats and future operations	Shared focus by lead group
Coordination and consolidation of demand	EU level with specialisation and clusters
Intra-EU trade of defence goods	High
EU-US trade of defence goods	Low
European coordination in R&D	High in lead group
Future further EU enlargement	Limited

4.4.3 National policy drivers

As far as **national defence procurement policies** are concerned, the large MS have developed mutual specialisation patterns with 'juste retour' principles at the overall level, but not at system or system area levels. Although the general economic situation has been rather weak during the 2010s, especially the lead group MS saw the necessity to increase their **national defence budgets** to optimise Europe's independent capabilities in defence and security issues. Under the influence of the Defence Package, MS now source much more of their lower technology needs outside the home market. With regard to procurement of high-technology products and services, mainly non-producing countries apply the directive. **Bottom-up cooperation between MS** has occurred quite often, due to the initiatives of ambitious medium-sized and smaller MS like Sweden, Norway, Finland, the Netherlands and Belgium, starting cooperations to improve their position vis-à-vis the large players like the UK, France and Germany. **The role of NATO** has been declining during the 2010s, which is also due to the increasing feeling of independence towards the US. The **offset policy** has become more transparent and rational. Among the major defence industrial stakeholders indirect military offsets dominate. This practice has also supported the emerging structure of mutual specialisation. For countries without a developed DTIB indirect civil offsets are the norm, which helps to avoid creating unnecessary duplication. Within the context of the 'multipolar realism' and the general perception of global instability that dominated during the 2010s, the large powers in the EU have put great emphasis on domestic security, like border surveillance and the protection of civilians from terrorist threats. This has led to a stronger **integration of the defence policy and the security policy**, mostly for technical reasons. The defence industry has been regarded as an important component and a strategic asset for Europe, which requires such a specialised industry policy. Therefore, the **integration of the general industrial policy and the defence-specific industrial policy** has been limited. **Sourcing and public-private partnering** have been regarded as a practical issue causing a significant growth relative to the operations budget, which in turn declined. Changes also occurred in the **defence industry ownership** during the 2010s, where most of the previously state-owned industries have been privatised. The European primes have gone through a round of concentration in terms of production sites and corporate structure, leading to a reduced number production units in specific markets and a more networked character of primes.

Driving factor	Value
National defence procurement policies	Juste retour at overall level in large MS
National defence budgets	High in lead group
Bottom-up cooperation between MS	High around lead groups
The role of NATO	Less important
Offset policy	High indirect military offset among lead actors
Integration of defence policy and security policy	Medium
Integration of general industrial policy and defence-specific industrial policy	Limited
Sourcing and public-private partnering	Medium to high
Defence industry ownership	Private ownership

4.4.4 Economic drivers

Since the overall economic situation has been unfavourable between 2010 and 2020, the unemployment rate has been rather high. This has resulted in a fairly good **access to skilled labour**. Apart from this, the growing importance of defence in Europe has made the defence industry quite attractive for employees. Combined with quite clear priorities for the defence industry, capital has flowed into this sector in an otherwise rather bleak economic setting. The **access to capital resources** has been quite successful for defence. Also the access to knowledge has not been a problem during the 2010s, especially due to the positive cooperation between defence and security. This has also materialised in a closer **cooperation with related and supporting industries** within the value chain. The defence industry also adopted the Supply Chain Management practices already in use since the 90s or longer in commercial system industries (like vehicles). The **barriers to entry and exit** did not differ significantly from those in other comparable commercial industries. Due to the Europeanisation of defence the **strategies of the industry/primes** had been the development of a defence industry with a structure similar to the US counterpart. Regarding the **level of competition in the industry**, the target industrial structure has been 2 to 3 European providers of each system type, thus improving competition. Since Europe wanted to become less dependent on the US, the degree of **globalisation of the industrial structure** was limited to Europe and the **nature of consolidation** has been European across system areas.

Driving factor	Value
Access to skilled labour for industry	Easy
Access to capital resources for industry	Easy
Access to knowledge for industry	Easy
Cooperation with related and supporting industries	High within value chain
Barriers to entry and exit of firms in the defence market	No difference with civilian setting
Market strategies of the industry/primes	US model
Level of competition in the defence industry	Medium
Integration of civilian and defence industry	Medium
Globalisation of the industrial structure	European only
Nature of consolidation (e.g. mergers, level of specialisation, etc.)	European only, high specialisation

4.4.5 Societal drivers

Aging population, declining birth rates and demographic changes were visible factors that occurred externally and could not be influenced by policy actions within a decade. The related problems, like pressures on social security systems could not be compensated by migration, since **the development of global migration** decreased within Europe. The overall unemployment rate was rather high during the 2010s. The **social acceptance of defence operations** has been ambivalent between 2010 and 2020. On the one hand, comprehensive types of operations have failed, especially in the US, and thus been subjected to public criticism. On the other hand, the need for military build-up in the emerging post-Pax Americana vacuum had been accepted as a necessity by the public in some MS, including the major ones. The **sustainability challenge** receives less attention. Even though this topic had been high on the agenda during the early 2000s attention started to wane in the period up to 2020 due to economic hardships and more immediate issues. The retiring baby-boomers and the relatively high unemployment have put much **pressure on the social security and healthcare systems**. Social security and defence have been competing for budgets, whereas both were regarded as nearly equally important.

Driving factor	Value
Aging population, declining birth rates and demographic changes	Pressing effect
The development of global migration	Low
Social acceptance of defence operations	Ambivalent
The sustainability challenge	Low attention
The pressure on the healthcare system	High

4.4.6 Technology drivers

In the 2010s, the overall effort to **develop key technologies** has been neither strong nor weak, which is due to opposing factors. The need for a stronger European and the modernisation of defence did act a a driver for innovation, but a rather weak economy put many restraints on the ambitious goals. Some R&D-related pioneer groups and Centres of Excellence have established themselves. This has created a number of highly innovative regions and some less so, thus reflecting and even amplifying the Europe of different speeds. As far as the **changing technology needs due to future operations** are concerned, the traditional military types of systems were still in demand, albeit that also new technologies were needed, especially where defence and security were coming together, or where ways had to be developed to cope with new categories of threats like bioterrorism. These have also been the areas where **dual-use technologies and innovations** have found the widest application. Due to the establishment of a more effective industrial structure, **defence equipment costs** decreased in some areas. The greater demand for (and emphasis on) high-tech defence systems has caused prices to rise in specific equipment sectors. Some of the highly specialised clusters have achieved high success in realising **new trends in innovation**.

Driving factor	Value
Supply: Future key technologies (molecular biotech, next generation software, etc.)	Mixed, with some strong clusters
Demand: Changing technology needs due to future operations	Medium
Defence equipment costs	Medium
Dual-use technologies and innovations	Medium
New trends in innovation (ISTAR, unmanned systems, etc.)	Mixed, with some strong clusters

4.5 The EDTIB in scenario A

4.5.1 Introduction to the scenario

In this scenario, the defence sector develops a profile of low profitability and less dynamics. There is little stability and limited governmental investments in (defence-related) R&D to create a strong and competitive industry. Companies struggle to remain in business, unless they are able to commercialise their competencies in non-defence markets. The financial crisis of 2008-2010 puts the defence industry in a resource limbo, finding it difficult to regain a new momentum. The investment interest from private financers and venture capitalists is even more limited than today. The interest of management and R&D talent in the sector deteriorates. This leaves many companies at undercritical levels, largely left to operate in their national markets, unless they are able to export outside Europe or to establish partner arrangements outside Europe – for which the conditions are not favourable in this scenario. In short, the EDTIB becomes more of an offset-based, nationally-oriented supplier to US industries.

The technology exchange and interaction between the defence and civil sectors is limited. The reasons for this are 1) that the defence sector offers such limited profit margins that civilian companies see very limited business opportunities in the defence sector, and 2) with the increasing political and protectionist nature of the defence sector and of defence procurement, the administration of defence procurement and of defence R&D has become so complicated that this further adds to the negative image of the defence sector as a business environment.

Many defence companies remain in national contexts, in a semi-protected and subsidised state, which becomes even more prominent with the financial crisis. States accept the financial burden of maintaining national defence industries that have limited international connections. The internationally less visible first and lower tier companies either remain in a more or less motionless state as national defence arsenals, or they reposition themselves towards less defence-specific supplier positions. This way, there are also some companies from new MS that, with the advantage of lower factor costs and sufficient industrial sophistication, take positions in the supplier structure under the primes – a development that resembles the supplier structures in e.g. truck and car manufacturing today in Europe.

With fewer defence companies willing to truly engage in and focus on innovative defence R&D, the burden for defence innovation is even more on governments. The lack of drive for innovation in the industry itself creates opportunities for a small number of companies that occupy critical capabilities as specialised defence R&D providers.

4.5.2 Aerospace

The aerospace sector in general and the defence aerospace sector in particular are extremely R&D- and capital-intensive. To generate investment capital or, as the case may be, return on investment, a substantial market is required. A larger market allows for longer production runs and lower unit costs as well as increased profitability through increased exports. But in scenario A European firms cannot rely on a unified European market. Only few new major programmes will be launched in Europe. Most MS are hesitant to buy new fighters and no decision is taken to develop a next generation Eurofighter. Due to an absent domestic demand, the export seems to be a more lucrative

option, but without a substantial home market that generates sufficient investment capital and support for R&D, the European companies will fall behind their US peers in technology. They will have little or no leverage on the US market – which historically has been a very closed market, even at the supplier levels.

To summarise, European governments invest just enough to keep programmes going and very little is left to launch new programmes. US companies increasingly dominate the industry from the point of view of competition. Nevertheless, in this scenario a relatively marginal European defence aerospace sector lives on, because a number of MS prefer European products, even if these have an inferior price-quality profile.

4.5.3 Land

Basically, the relatively fragmented land sector will become even more fragmented when the new MS (re)develop their own national DTIBs. Because of the low level of urgent actual operations, the operational pressure to drive powerful innovation is lacking. A relatively slow pace of innovation stimulates many MS to retain many technological capabilities within the national industry. With a low level of munitions consumption across Europe (due to the downsizing of the forces, less live tests and exercises, only limited consumption in actual operations, less 'dumb' and more 'smart' munitions), even in this scenario a major restructuring of the munitions industry is inevitable, certainly in the new MS. In specific categories of land vehicles, with the exception of combat vehicles, commercial off-the-shelf products are becoming increasingly popular. Due to budgetary constraints, land equipment generally remains conventional with little technological upgrades and innovations. New technologies, e.g. in materials or propulsion, are hardly considered.

4.5.4 Defence electronics

ICT will become increasingly important and does not depend on large equipment. This sector relies heavily on ICT and software solutions, where progress is dominated by the civilian sector. Many civilian industries can offer solutions that are also suitable for defence. The market is open, global and highly competitive. Adherence to open standards is increasingly required for cost-effective and maintainable applications. This is also a domain where the merging of 'defence' and 'security' has the most impact. Transnational ICT and software providers and service suppliers, through national offices or partners that provide the local knowledge and entries, will enter the market more often. ICT will be the winner and most innovative sector in this scenario.

4.5.5 Naval

Naval technology also belongs to the expensive elements of defence equipment. Continued pressure to maintain national industrial bases and employment will render consolidation within Europe painfully slow. Governments continue to hold on to their stakes in defence companies, carefully reducing their stakes in such companies but making sure to keep influence on the key decisions deemed to be of national interest. Examples are the French firms Thales and DCNS, the Italian firm Fincantieri (90% public share) and Spanish firm Navantia (100% state owned).

4.5.6 Conclusions for scenario A

Table 4.1. The shape of the EDTIB in scenario A: Muddling Through

Indicator	Scenario A: Muddling Through
Size	Employment. Quite a few inefficiently operating national champions remain in business through open or hidden national subsidies. Overall employment in the defence industries in Europe slowly declines. See table 4.2 Geographical distribution. A more or less fixed regional distribution
Capabilities	Security of supply. Security of supply remains a justification for retaining government-dominated national champions. However, because of weak industry performance provision of state-of-the-art capabilities and System of Systems solutions becomes more difficult Through-life support. Mostly secured through long-term service contracts with national champions Agility. Responsiveness to changing geopolitical and operational requirements is low
Competence	Innovation. Weak industry performance limits innovation potential[41] RTD model. RTD cooperation remains fragmented. EDA initiatives slowly grow in size and substance, but remain marginal. Associating with other innovation sources mostly through national lines – although innovative approaches and ideas promulgate through e.g. EU initiatives for common pre-competitive research and sharing of 'best practices', fragmentation and duplication of RTD remains a strong inhibitor for powerful innovation
Competitiveness	Cost-efficiency. Global market pressure leads to high cost-efficiency for 'export solutions' from the big primes, but in many MS large inefficiencies remain in the production for the domestic market Export potential. Europe's global market position deteriorates, exports dwindle. As a direct consequence of the formal and political interfaces between the MS, intra-EU trade stalls or declines Economic impact. In the absence of a strong drive for innovation, the defence industry plays a marginal role the in overall economic impetus

Size. Table 4.2 below shows the possible consequences of scenario A for the size of the EDTIB**.** The table is based on the following assumptions:

- Labour productivity increases at 1% per annum and real defence budgets fall by 1% per year, influencing employment by the same percentages. The changes are compound rates.
- A negative development in the trade balance (less European exports to outside Europe and/or more European imports from outside Europe) accounts for 1% decrease in sales, and thereby employment.
- The relative size and share of total employment for each sector remain unchanged between 2007 and 2018.
- The employment estimates for 2018 are illustrative only and suggest broad orders of magnitude, if only because it is assumed that the same developments apply uniformly across Europe. This is an unrealistic but necessary assumption to be able to say anything at all. The estimates are rounded off at thousands.

Even under the conservative assumptions of this scenario, the total employment reductions are substantial between 2007 and 2018, equivalent to reductions of just under 30%.

Table 4.2. EDTIB employment estimate in scenario A: Muddling Through

[41] With interoperability of European and US armed forces becoming even more of an issue, with joint operations and burden-sharing less likely – and even less *possible* – when challenges to the vital interests of Europe and the US do occur.

Sector[42]	Employment 2007[43]		Employment 2018	
	Direct	Total	Direct	Total
EU Defence Industries	376,700	718,150	269,000	514,000
Military aerospace	199,500	380,300	143,000	272,000
Land sector	106,200	202,500	76,000	145,000
Naval sector	71,000	135,350	51,000	97,000

4.6 The EDTIB in scenario B

4.6.1 Introduction to the scenario

General EDTIB structure. Core to this scenario is an open and competitive market, with large defence spending, much support for innovations and R&D with special attention to EU-US relations. The defence industry is becoming increasingly similar to the 'regular industry'. Unprofitable areas are being spun out and new mergers and cooperations occur. In this scenario there has been substantial EDEM harmonisation. The global defence market is much more open, but on a European scale the industrial concentration has increased. Defence firms have mostly been privatised and the structural difference between defence and civilian industries has decreased substantially. Innovative SMEs have also joined as important contributors. The progress in key technology development is very high, giving Europe competitive advantages. Next to the prime level, there has also been considerable consolidation in the first and second tiers of the EDTIB. The new first and second tier firms are sophisticated design and R&D powerhouses, where innovation is organised and coordinated, but where shorter-term testing and long-term serial production are outsourced. The global financial crisis has been overcome sooner than expected, but it has also pushed and stressed this market structure reform. However, since the defence industry is operating more and more like the 'regular' industry, it simultaneously becomes more vulnerable to political and economic changes and security of supply may not necessarily be guaranteed. The interest in manufacturing defence equipment may also change.

The rapprochement of the US and Europe translates into increased industrial cooperation, including mergers. As a distinct alternative to (very complex) mergers between entire global groups at the prime level, particularly transatlantic mergers, this scenario likely sees a series of mergers among entities or subsidiaries of the different groups and conglomerates. Thales Raytheon Systems could be a role model, i.e. operations are spun out to joint ventures.

Another major aspect in the competitive dynamics of the EDTIB in this scenario is that the defence industries in the BRIC countries[44] have furthered their global positions. European defence companies therefore face more competition when trying to secure global defence exports. For India, this is partly due to the build-up of a local DTIB as a result of offset from earlier defence sales from Europe. This has resulted in new and competitive partner companies in India that are able to compete globally. Procurement from the BRIC countries does not force Third World countries to be submissive to a global Western – primarily US – defence technology umbrella. BRIC-produced defence

[42] Because of a lack of data, the Electronics / ISTAR / C3 sector is not broken down.
[43] EU defence industries numbers are based on ASD data adjusting aerospace for military employment only; see chapter 2. Direct employment based on ASD data. Total employment includes estimated indirect employment as defined in chapter 2.
[44] Brasil, Russia, India and China.

materiel is also less expensive. The degree of sophistication of the technology is satisfactory, whereas US technology is often overly advanced for the requirements of these nations.

We consider two combinations of European defence players resulting in European megaprimes. BAE Systems and EADS could join forces to become the ultimate European prime manufacturer for platforms, capable of managing and financing complex systems integration programmes. BAE Systems and EADS already have some joint ventures and alliances. Integration could happen successively by activity, starting in the land and naval sector, according to each partner's strategic advantages and interests. A merger with BAE Systems would help EADS overcome one of its toughest hurdles, which is to gain political acceptability as a defence supplier in the US through the extensive foothold of BAE Systems in the US.[45] Assuming that this combination materialises, Thales would retain the software, defence electronics, surveillance, and reconnaissance activities, remaining independent and integrating smaller European subsystems and defence electronics manufacturers to become the European software and subsystems giant. Finmeccanica assets would be brought into these two larger entities according to the same platform versus subsystems logic.

An alternative megaprime scenario would see the acquisition of Thales by EADS. This would represent value chain integration by joining a platform-maker with a defence electronics company, similar to the way BAE Systems acquired Marconi. Thales and EADS cooperate in several areas already. Thales would help EADS expand its defence business as well as its acceptability in the US market through Thales' US activities, particularly after the acquisition of Racal. Moreover, a shareholders pact blocking other companies from buying into Thales expired in summer 2003.

4.6.2 Aerospace

In this scenario we see an EDTIB that profits from a growing home market to gain better access to global markets. This is very favourable to the R&D-intensive aerospace sector generally characterised by expensive equipment. Although Europe cannot compete with US high-end fighters, Europe will be globally competitive with lower-capability fighters. This will also be the key focus of the European aerospace sector.

Even so, further consolidation is necessary and indeed happening in this scenario, resulting in much larger European aerospace companies. E.g. the smaller German and Italian jet engine companies are either disappearing or taken over by Rolls-Royce or SAFRAN – with the latter two further strengthening their collaboration, e.g. with joint R&D programmes. An alternative or subsequent option would be that the engine companies acquire non-engine businesses or even merge with the airframe companies.

New European programmes, e.g. for small and medium-sized UAVs and satellites, including small and relatively cheap tactical satellites, move swiftly ahead to help boost the technological capabilities of the remaining companies. These products also compete successfully in export markets. To successfully enter the US market with such products, the European megaprimes would have to acquire smaller US players. For very large programmes, such as the F-35, partnerships with the US megaprimes would be appropriate – either temporary or permanent.

[45] Part of the US-based activities of BAE Systems could also allign with US firms in various types of joint ventures, even under a EADS-BAE Systems merger scenario.

4.6.3 Land

Because current operations occur mostly on land, national procurement policies have adjusted their weights in favour of army materiel to the detriment of naval and air force materiel. Furthermore, this is a traditional European area of strength vis-à-vis the US.[46] If, as part of the logic of this scenario, the US 'buys' a more active Europe in return for opening up its defence equipment market, this would be the sector where the gains for the EDTIB are most likely.

The performance and competition-driven consolidation process in Europe would also effect to the land subsector, although the wider variety of land platforms would warrant a broader range of viable companies across Europe. The consolidation within the UK over the past decade serves as a template.[47] The strong German land sector (with firms such as Rheinmetall and Krauss-Maffei Wegman) is likely to play an important role in this process. Also, transatlantic consolidation among system and subsystem suppliers face fewer obstacles and occur more frequently. Asymmetric challenges from non-state actors stimulate fast development and acquisition processes to provide new solutions for e.g. force protection in running operations. Particularly in the land environment, there is an increasing requirement for and reliance on private military companies rendering logistics services, maintenance and repair, transport and other non-core tasks. The PMC sector, already quite big in the US, will also boost in Europe. However, since a lot of the workforce for the PMC is recruited locally in the theatres of operation, the impact on employment in Europe is limited.

4.6.4 Defence electronics

Defence electronics will be the backbone of many innovations and technology upgrades. The megaprimes, taking responsibility for System of Systems solutions, also deliver the major C3I solutions. There likely will be a transatlantic integration of supply chains[48]. Specialised SMEs deliver customised solutions for security technology, data analysis, surveillance, training, networking and equipment-integrated systems.

4.6.5 Naval

Many of the remarks for the aerospace market also apply to the naval sector. Because the naval sector has a much more fragmented starting point, the consolidation process clearly lags behind that of the aerospace industry. National consolidation, e.g. similar to what has taken place in the German, French and British shipbuilding industry, is preceding the restructuring process in Europe.

4.6.6 Conclusions for scenario B

Table 4.3. The shape of the EDTIB in scenario B: Market Forces Dominate

[46] As a piece of anecdotal evidence, note that the US Stryker armoured personnel carrier is a version of the Swiss Pirhana APC.
[47] Over the past 10 years, the UK land sector has been reduced from some 5 prime platform suppliers to one prime, namely, BAE Land Systems (see Chapter 2).
[48] In this scenario interoperability between European and US armed forces is important both politically and operationally. Since C3I is at the heart of the interoperability issue, this is an area where transatlantic tie-ups are likely to be prominent.

Indicator	Scenario B: Market Forces Dominate
Size	Employment. Competition and rationalisation forces downscaling of personnel, but this is to a large extent softened by increased demand and global competitiveness of remaining big primes and (clusters of) first tier system providers (See table 4.4). There will be a substantial growth of Private Military Companies, providing all kind of non-core military support and services in the preparation and execution of operations. However, since a lot of the work force for the PMC is recruited locally in the theatres of operation, the impact on employment in Europe is limited. Geographical distribution. Remaining industry in terms of ownership is concentrated in the LOI 6. However, a substantial fraction of the production capacity is moved to the lower-cost new MS
Capabilities	Security of supply. In general the defence industry has become more like the 'regular' industry with large and global companies producing defence as well as civilian products. They are able to deliver and sustain key military capabilities and provide complex System of Systems solutions, but security of supply is not necessarily guaranteed Through-life support. Through-life support of platforms and systems is mostly secured through long-term service contracts with (a subsidiary of) the original supplier Agility. Political, geopolitical and economic changes can have a large and fast impact as it is the case with 'regular' markets and industries
Competency	Innovation. Innovation closely associated with vested interests of strong primes. Civilian spin-in relatively slow. Strong tendency to build innovation upon existing programmes and proven solutions RTD model. Strong primes dominate RTD structure with a movement towards a limited number of large Centres of Excellence closely associated with the big primes – also physically close, i.e. in the larger MS Associating with other innovation sources mostly through established lines – limited influx of new approaches and ideas from outside the defence domain and non-Western sources
Competitiveness	Cost-efficiency. High level of cost-efficiency based on market pressure Export potential. Trade with US flourishes and inter EU trade increases Economic impact. Limited impact on economic activities outside the defence domain. Potential new entrants on the defence market effectively blocked and no particular incentive for strong defence firms to spin-out innovations to other markets SMEs play a limited role in the supply chain of the primes and few dominant clusters of first tier system providers

Size. Table 4.4 below shows the possible consequences of scenario B for the EDTIB. The table is based on the following assumptions:

- Labour productivity increases at 4% per annum and real defence budgets rise by 2% per year.
- The overall trade balance accounts for 1% increase in sales, which particularly benefits the land sector.
- The sector shares change for aerospace 53% (2007) to 45% (2018), for land from 28% to 40% and for naval from 18% to 15%, reflecting relative requirements for and competitiveness of each sector.
- There is more use of external contractors by primes, giving a ratio of direct to indirect of 1:1. 'Direct' are firms supplying directly to national defence ministries; 'indirect' represents supply chains.
- Again, the employment estimates for 2018 are illustrative only and suggest broad orders of magnitude. The estimates are rounded off at thousands.

Under this scenario, the total EU defence industry employment only decreases by 6%, but with substantial differences between the sectors.

Table 4.4. EDTIB employment estimate in scenario B: Market Forces Dominate

Sector	Employment 2007		Employment 2018	
	Direct	Total	Direct	Total
EU Defence Industries	376,700	718,150	337,000	675,000
Military aerospace	199,500	380,300	152,000	304,000
Land sector	106,200	202,500	135,000	270,000
Naval sector	71,000	135,350	51,000	101,000

4.7 The EDTIB in scenario C

4.7.1 Introduction to the scenario

General EDTIB structure. The core to this scenario is that within the European Union, different groups of MS will cooperate on defence policy and that innovation leaders will materialise. The activities of the European defence industry at large are also mainly focused on Europe. In terms of the EDTIB structure, this is also the scenario that shows the most radical changes. The primes become smaller, because the corporate model of large primes has become unattractive and even unnecessary. The industrial landscape is characterised by innovation leaders who will focus on concentrating their efforts on their core competencies and divest other non-core areas and production assets. Complementary competences are acquired through (ad hoc) cooperation, often with SMEs. The business model of the large primes has also become too inflexible. Furthermore, the influx of technology from non-defence sectors (technology is less defence-specific and the general technology forefront can supply many of the solutions required by the defence community) is very high. This will reduce the size of the primes.

In the evolution of this scenario European producers of platforms remain the Lead System Integrators. However, although Europe is the main market, a significant part of the actual production has been moved to either new lower-cost MS, or outside Europe in controlled subsidiaries or long-term partner companies (security of supply remains an issue). This is reminiscent of the present (real world) development of the supply chain structure under Airbus and Boeing. This duopoly has decided to concentrate on the integrative capabilities and is moving more and more production outside Europe and the US. This development is driven by cost. Also, most Airbus and Boeing orders come from nations outside Europe and the US. Likewise, in this scenario, an Anglo-French duopoly in high-level platform production coordination has emerged. Their defence production has also increasingly moved towards the buying nations outside Europe. However, there is one crucial difference with the Airbus/Boeing example. In the latter case the highly specialised and hierarchical industrial supplier structures are shaped by each of the two aerospace companies and basically resemble a chain, whereas in this scenario the pace of innovation and the influx of civil technology, products and services turns the supply structure of the Anglo-French Lead System Integrators into a network with no clear top-down leadership.

Next to the new style primes, there are three new types of defence-oriented companies:

- *Innovative defence R&D SMEs*. Parts of the present defence R&D infrastructure in Europe have a potential for commercialisation. In certain niches of R&D-intensive capabilities (e.g. underwater and microwave technology) defence research establishments such as Qinetiq, Frauenhofer, ONERA, TNO and FOI are

encouraged to create spin-offs. Some of these will fail, but on the whole a new biodiversity arises of defence-oriented labs that are profitable and attractive for the defence technology buyers. Thanks to legislative openings due to present EDEM deregulation, these SMEs can operate in a far more border-crossing fashion.

- *Virtual technology midcaps.* L3 Communications is a US company that has grown considerably over the past ten years, and has been highly profitable. By acquiring divestments from primes and by acquiring promising SMEs and medium-sized (by US standards, so large for Europe) high-tech companies in network-centric and C3I technology areas, L3 has created a synergetic, critical mass of defence technologies that are non-platform-oriented. In this scenario, also in Europe, several such powerhouses emerge. They have acquired attractive parts of the disintegrating European primes. These companies would typically be in the 500-2,000 employee size.
- *Specialist production artists.* In the production of platforms, there has (just as in the present car, truck and commercial aircraft manufacture) been a creation of highly specialised industrial networks of designated supplier structures. Risk and innovation responsibility is shared between the larger companies (both Lead System Integrators and the above virtual technology midcaps) and these smaller specialist production artists. Only this infrastructure of small companies is agile, flexible and adaptive enough to cater for smaller platforms, faster upgrading, and less predictable technology development. Several of these specialist production artists are spin-offs or remnants from present companies that have decided to conform and adapt to supplier positions (just like Latecoère, Fokker and Saab in commercial aircraft). As suppliers, they are more profitable than as national deliverers of platforms that are always fighting for survival.

4.7.2 Aerospace

EADS may decide to reduce its exposure in the defence market because of the lack of structural profitability, and to focus on its civilian jets. Saab, which is a conglomerate of defence activities (including UAV and space), may retract to other defence sectors. Dassault Aviation may concentrate on its UAV and UCAV business (e.g. Neuron) and civilian jet business, in close cooperation with the Groupe SAFRAN (and maybe with Saab AB, after a possible merger of activities). With no technology push towards a next generation manned fighter aircraft programme, European governments may then be faced with the option to either accept full future dependency on the US, or to accelerate the transition towards unmanned[49] solutions. Both Saab AB and Dassault Aviation are already active in the UAV market (as well as the space market). In this UAV market virtual technology midcaps and special production artists play an important role, with a substantial cross-fertilisation between defence, security and civilian technologies and applications. Some of these firms sell services rather than systems, operating the UAVs in-house.

In the space sector, innovative R&D SMEs and special production artists both create (technology push) and respond to (demand pull) a new market for tactical micro- and mini satellites for specific communication, navigation and reconnaissance uses.

[49] Or rather combined manned-unmanned solutions. However, with no new generation of manned fighters planned for the period of 2040 and beyond.

4.7.3 Land

The array of programmes and producers of land systems in Europe, in the status quo leading to fragmentation, poor performance and problems with innovation, in this scenario becomes an advantage. A European pioneer group enforces the use of, mostly civil, open standards and commissions precompetitive architecture studies that result in modular designs for land platforms (compare the US 'Future Combat Systems' programme). Strong German land sector firms such as Rheinmetall and Krauss-Maffei Wegman remain as Lead System Integrators. Many of the other current producers of land systems also survive and thrive by moving into a niche contribution to a wide family of land platforms. They are accompanied by new entrants to the market, being able to transform a product or service developed for the civilian market into a niche product in the defence market. In the diffuse security situation of this scenario, there is room for a wide array of add-ons to only a few basic land platform designs. E.g. in the armoured vehicles and land robots market the special production artists emerge to provide mission-specific add-ons – developed for and acquired by defence organisations in fast track processes outside the normal materiel processes.

This modularity also facilitates a trans-European market and upward compatibility for the MS that cannot or will not move at the same pace as the pioneer group. It also creates niches for innovative SMEs, including new entrants, as well as regional distribution of these firms. Scenario C sees a similar role for PMCs as scenario B.

4.7.4 Defence electronics

This sector has a larger share of the overall defence spending than it does at present. In this sector, the two basic characteristics of this scenario come to full bloom: vibrant innovation, to a large extent based on spin-in of civil technology, and a full range of variations on a few central themes, opening up the floor to midcaps across Europe becoming the heart of the EDTIB in this scenario. Initiated by a pioneer group, many C3 standards and interface specifications are set and openly available, allowing for interoperability at various levels of sophistication. Certainly in this sector, the vast majority of the market parties are dual-use companies. Also, a number of dedicated system integrators (including, but not exclusively, the downsized primes) enter the scene, specialising in complex project management and delivering long-term service.

4.7.5 Naval

As large programmes continue to be plagued by cost overruns and delays, such players as DCN and Fincantieri seek the relative stability of becoming system suppliers instead of platform integrators. Civilian shipyards move into the ensuing vacuum, partly by acquiring military shipyards, and use commercial hull designs as the basis for naval system integration. For large, ocean-going vessels in small series, integrators are still required to integrate the military-specific sensor, weapon and command suites, combining own products as a backbone, and best-in-class components and add-ons from a host of suppliers. Apart from a strong Franco-British leg, such Lead System Integrators still exist in Germany and Italy.

For smaller vessels, including unmanned surface and underwater vehicles, smaller companies refurbish civil designs to incorporate specific military requirements.

4.7.6 Conclusions for scenario C

Table 4.4. The shape of the EDTIB in scenario C: Europe of Different Speeds

Indicator	Scenario C: Europe of Different Speeds
Size	Employment. The traditional defence firms slim down or, especially in the new MS, move out of business. As a partial compensation, new small and midcap firms enter the defence market with niche products and services, thriving on the overlap between the civilian and defence market. Although increasingly difficult to determine because of the blurring of the defence and civil industrial base, overall employment contracts. See Table 3.10 Geographical distribution. Only the UK and FR have Lead System Integrators in all sectors; DE and IT only in the naval sector. However, a substantial fraction of the production capacity is moved to the lower-cost new MS. Innovative small and midcap niche players emerge all across Europe
Capabilities	Security of supply. Security of supply relying on long-term customer-supplier relationships is less guaranteed because of the nature of the portfolio of suppliers (mostly SMEs, embedded in civilian economy). However, the open market often provides timely alternative solutions for suppliers moving out of business. System of Systems integration capability is more adaptive, but possibly somewhat less secure because clear prime leadership is lacking Through-life support. Increased standardisation and modularisation makes multiparty through-life support of platforms and systems more feasible Agility. For the same reason responsiveness to changing geopolitical and operational requirements is high
Competence	Innovation. The EDTIB profits from a continuous influx of innovative products and services from the civilian market (directly or after adoption to the particular defence domain) RTD model. Mostly dual-use RTD, civilian-led with military spin-off, with niche contributions from all over Europe associated with the dynamic portfolio of SME suppliers. Important role of EDA in promoting standardisation and interoperability across the 'different speeds' The 'open innovation' culture that characterises this EDTIB stimulates the (re)use of new approaches and ideas from all sources
Competitiveness	Cost-efficiency. Good level of cost-efficiency based on market pressures and constant innovation at the systems level and down the supply chain. Because of lack of economies of scale, efficiency gains at the System of Systems level lag behind Export potential. Global export of high turnover System of Systems/large platform decreases, export of innovative products and services from SMEs increases. Primes oriented towards home markets, but vibrant intra-EU trade of innovative products and services from SMEs Economic impact. Defence-related production has a relatively high impact on overall economic activities. The high premium on innovation in the defence domain stimulates dual-use firms SMEs form a central element of the EDTIB

Size. Table 4.5 shows possible consequences of scenario C on the EDTIB. It is based on the following assumptions:

- Labour productivity increases at 5% per annum and real defence budgets rise by 1% per year.
- There is more use of outside contractors by primes, giving a ratio of direct to indirect of 1:1.3.
- Again, the employment estimates for 2018 are illustrative only and suggest broad orders of magnitude. The estimates are rounded off at thousands.

This scenario is assumed to be positioned somewhere halfway between scenarios A and B, leading to a total employment reduction of 23% over the period 2007-2018.

Table 4.5.: EDTIB employment estimate in scenario C: Europe of Different Speeds

Sector	Employment 2007		Employment 2018	
	Direct	Total	Direct	Total
EU Defence Industries	376,700	718,150	240,000	553,000
Military aerospace	199,500	380,300	127,000	293,000
Land sector	106,200	202,500	68,000	156,000
Naval sector	71,000	135,350	45,000	104,000

4.8 Selection of the scenario

In this section we will compare the different scenarios to the ideal EDTIB as described in Chapter 1 in order to make a selection on which scenario would be best fitting the ideal situation.

In order to do this, a comparison can be made between the different values the driving factors take in the different scenarios. In the following table this comparison is made.

	Muddling trough	Market forces dominate	Europe of different speeds
Driving factor	Value	Value	Value
A coordinated European security and defence policy	Low co-ordination	High co-ordination	High by lead group only
The nature of priority threats and future operations	No shared focus	shared focus	shared focus by lead group
Coordination and consolidation of demand	High in CE MS	Global, beyond EU-level	EU-level with specialisation and clusters
Intra EU trade of defence goods	Rather low	High	High
EU-U.S. trade of defence goods	Decrease EU import, increase market share	High	Low
European coordination on research and development	Low	High	High in lead group
Future further EU enlargement	Limited	High	Limited
National defence procurement policies	Not open	Open	Juste retour at overall level in big MS
National defence budgets	Low	High	High in lead group
Bottom up cooperation between MS	Low, only high with CE MS	High	High around lead groups
The role of NATO	Important	Important	Less important
Offset policy	Offsets are used	Very limited	High indirect military offset among lead actors
Integration between defence policy and security policy	Low	High	Medium
Integration general industrial policy/defence industrial policy	Low	High	Limited
Sourcing and public/private partnering	Low	High	Medium to high
Defence industry ownership	State ownership remains in some MS	Private ownership	Private ownership
Access to skilled labour for industry	Easy	Challenging	Easy
Access to capital resources for industry	Hard	Easy	Easy
Access to knowledge for industry	Hard, exception CE MS	Easy	Easy
Cooperation with related and supporting industries	Pan-European sourcing	High	High within value chain
Barriers to entry and exit of firms in the defence market	High	No difference to civilian setting	No difference to civilian setting
Market strategies of the industry / primes	Reactive to governments	Open competition	US model
Level of competition in the defence industry	Low	High	Medium
Integration of civil and defence industry	Only at supplier level	High	Medium
Globalisation of the industry structure	Low, national level	High and global	European only
Nature of consolidation	National level	Global	European only, high specialisation
Ageing population, demographic changes	Pressing effect	No pressing effect	Pressing effect
The development of global migration	Low to medium	High	Low
Social acceptance of defence operations	Low	High	Ambivalent
The sustainability challenge	Low to medium attention	High attention	Low attention
The pressure on the healthcare system	High	Medium to low	High
Supply: Future key technologies	Weak	Strong	Mixed, with some strong clusters
Demand: Changing technology needs due to future operations	Low	High	Medium
Defence equipment costs	High	Low	Medium
Dual use technologies and innovations	Weak	Strong	Medium
New trends in innovation (ISTAR, Unmanned systems, etc.)	Weak	Strong	Mixed, with some strong clusters

Looking at this overview, it is clear that scenario B: Market forces dominate is the best scenario, as all factors take a positive value in comparison with the other two scenarios. The first scenario of Muddling though is clearly the worst scenario, as many economic and political indicators are negative. The third scenario of Europe at different speeds is moderately positive.

Based on this assessment, scenario B: Market forces dominate should be chosen.

However, the factor overview does not include the characteristics of the ideal EDTIB. Repeating from chapter 1, the following characteristics should be met:

- ***Capabilities***
  The EDTIB is capable to deliver and sustain key military capabilities, in the short term and over the long-term, on order to sustain the necessary levels of European and national operational sovereignty.
- ***Competence***
  The EDTIB should be able to develop new technologies and innovation, in close cooperation with other research and development organisation (e.g. academia).
- ***Competitiveness***
  In business terms, the EDTIB must be competitive (cost efficient) in a global sense, being able to export internationally and attracting cooperation with European SMEs and non-European partners.

A second assessment of the characteristics of the three scenarios is in order, looking at those three categories. This overview is provided in the next table (adding the indicator of firm size).

	Indicator	Scenario A	Scenario B	Scenario C
Size	Employment	Decrease	Increase	Stable
	Geographical distribution.	Regional	LOI6	UK and FR have lead
Capabilities	Security of supply.	Difficult	Not necessarily guaranteed	Guaranteed
	Through life support.	secured through long term service contracts	secured through long term service contracts	Multi party
	Agility.	Low	Very prone to political and economic factors	High
Competence	Innovation.	Low	High	High in clusters
	RTD model.	National	Strong Primes	Dual-use
Competitiveness	Cost efficiency.	Low	High	Good
	Export potential.	Low	High	Primes focus home market
	Economic impact.	Low	Limited	High

Here the conclusion is different. Although at many indicators Scenario B: Market forces dominate are overall very positive, a main indicator: “Security of supply” is not guaranteed. E.g. a potential change in administration in the US could have high implications to the security of supply in Europe, as the overall open market concept can change. Looking at the present situation of the credit crisis, it is not so hard to believe that a different administration would choose a more protectionistic approach. And as in the Market forces dominate scenario the European defence industry will not be able to cover all capabilities needed, but will rely on other suppliers in the US, security of supply is at risk.

The conclusion therefore must be that Scenario C: Europe of different speeds is the most desired scenario.

5 Policy analysis and recommendation

5.1 Introduction

This chapter presents the gaps between the current situation and the preferred scenario C: "Europe of different speeds". First, the gaps are identified and analysed; second, suggestions for policy are given.

The analysis is focused on the assessment of the three basic characteristics of the EDTIB: Capabilities, competences and competitiveness. The analysis makes use of Chapter 2: The current characteristics of the European defence industry, and Chapter 4: The description of the EDTIB in scenario "Europe of different speeds. The descriptions of the driving factors of Chapter 3 are also used as input for the further elaboration of the identified gaps.

As a starting point for the analysis, the current situation as described in Chapter two was examined. The observations across sectors were synthesized and summarised. From this, shortcomings were distilled. Subsequently, the most relevant driving factors were connected with the shortcomings of the current situation. Finally, based on the identification of gaps (additional) appropriate policy recommendations were formulated, taking into account policy initiatives that are already in place.

These recommendations are targeted at various levels, making a distinction between: 1) The European Commission; 2) The EDA; 3) The Member State level; 4) The Industry level.

The policy recommendations are not developed in a void. First of all, there are already numerous policy initiatives in place or scheduled to address (some of) the gaps. Second, the EDTIB has become an increasingly hot topic for policy makers and policy analysts. As a result, policy analyses already available were used to further develop policy recommendations. Thus, while the majority of recommendations are not invented just in this report, their applicability and priority have been determined through the previous analysis presented in this report. The recommendations are formulated in such a way that it is clear what gap is targeted, what has been done already, and what stakeholders are involved in the implementation of the recommendation and how.

5.2 Gap analysis

5.2.1 Gap analysis of capabilities

The first characteristic of the EDTIB relates to the **capabilities** that the industry base should be able to deliver. These capabilities can be defined as *the way the EDTIB is capable to deliver and sustain key military capabilities, in the short term and over the long-term, in order to sustain the necessary levels of European and national operational sovereignty*. The following table lists the capability shortcomings that were identified in the gap analysis between the 'current situation' and "Scenario C: Europe of different speeds". For most of these current shortcomings, a description or future development has been presented in Scenario C. Some of these shortcomings have been resolved or improved in Scenario C. That situation has been decribed in the third column.

Current Situation	Scenario C
• No common policy to counter EU-wide threats • Military capabilities nationally based and maintained, allowing for security of supply; Most military capabilities delivered albeit at high costs; however, some not covered (ICBMs, AMD, strategic bombers, some specialised electronic systems) • Excess production capacity (at EU level) to meet military capabilities, despite some national restructuring • Weak integration of civil and military capabilities • Costs pressures lead to difficulty in sustaining future capabilities	• European agreement on military capabilities (at different speeds) • Strong intra-European cooperation to fulfil capabilities and security of supply and almost full coverage of needed military capabilities • Decrease of excess capacity to deliver key future military capabilities • See below under competitiveness

The overall assessment of the gaps on "Capability" leads to the conclusion that the following gaps are priority:

- **Lacking vision on common European military capabilities**
  There is little European agreement on the commonly needed capabilities (thematical), especially from the perspective of a Europe of different speeds.
- **Lacking European organisational structure for fulfilling capabilities**
  A strong intra-European cooperation needs to be organized to fulfil the needed capabilities and ensure security of supply (organisation);
- **Policy to address problems on excess technological and industrial (production) capacities**
  If an efficient and effective EDTIB is established, restructuring will have resulted in clear excess of technological and industrial (production) capacity that needs to be addressed by policy.

These capability gaps and their associated policy recommendations will be discussed in sections 5.3, 5.4, and 5.5. Some other gaps will be discussed under the following section on "Competitiveness".

5.2.2 Gap analysis of competences

The second gap analysis focuses on **competences** of the industry to operate in the market. This characteristic can be described as: *The EDTIB should be able to develop new technologies and innovation, in close cooperation with other research and development organisation (e.g. academia).* Similar to the previous section, the following table lists the shortcomings that are identified in the gap analysis between the 'current situation' and "Scenario C: Europe of different speeds".

Current Situation	Scenario C

• Delivery of cutting-edge technology in most sectors albeit at high costs • Marginal cross-sectoral learning / spin offs • Focus of industry more on development and less on research	• Delivery of cutting-edge technology
• Limited contacts between academia and industry (especially outside of aerospace).	• Selectively open research/industry networks
• Absolute levels of defence R&D funding low compared to US; Defence R&D funding (as part of Defence budgets) under pressure; Efficiency of R&D is low; much overlap in research; • Limited R&D collaboration and cooperation across EU • Shortage on qualified (R&D) personnel	• Defence R&D levels not necessarily raised, but efficiency of expenditures across Europe and across civil/military domains has been increased; Cooperation between research and industry; Cooperation between defence and civil research

The overall assessment of the gaps on "competences" leads to the conclusion that the following gaps are priority:

- **Limited deliverance of cutting-edge technologies**
  In general, the current EDTIB is suboptimal in the development of cutting edge technologies, mainly because of costs, research budgets and focus on development.
- **Selectively open research/industry networks**
  The meso organisational networks of the industry are suboptimal and improvements in firm/firm and firm/research networks are needed.
- **Suboptimal connection between defence and civil R&D**
  The linkage between civil and defence industry is suboptimal and therefore the defence industry can not use the civil technologies in an optimal way.

These competence gaps and their associated policy recommendations will be discussed in sections 5.6, 5.7, and 5.8.

5.2.3 Gap analysis of competitiveness

The third gap analysis focuses on competitiveness of the industry. This characteristic can be described as: *the EDTIB must be competitive (cost efficient) in a global sense, being able to export internationally and attracting cooperation with European SMEs and non-European partners.* As in the previous section, the following table lists the shortcomings identified in the gap analysis between the 'current situation' and "Scenario C: Europe of different speeds".

Current Situation	Scenario C
• Very limited cost efficiency (see above) • Limited competitiveness on costs • Economies of scales are low, size of firms (too) small and dependent on national markets • Limited dual use and integration of civil/defence • Strong internal EU competition, esp. in naval sector • State ownership still existing; limited incentives for change and increasing production efficiency; national protectionism • Relatively closed industrial networks, providing barriers to entry	• Improved cost efficiency (see above) • Significant intra European markets, intra-European economy of scale; Reduced barriers to entry in intra-European markets.

The overall assessment of the gaps on "competitiveness" leads to the conclusion that the following gaps are priority:

- **Need to improve cost efficiency**
  There is a need to improve the overall cost efficiency of the EDTIB in order to be competitive in a intra-EU and global market.
- **Lack of economy-of-scales**
  Shifting from national markets to intra-EU and global markets, a significant step is to be made in economies-of-scale.

The gap on improving the cost efficiency will be tackled in the discussion of the second capability gap (see 5.4, dealing with the delivery of military capabilities not just through national markets and at high costs and delays) and also at the first competence gap (see 5.6 that is targeted at identifying measures to resolve delivery of cutting-edge technology in most sectors at high costs).

5.3 Gap Capability: Lacking vision on common European military capabilities

5.3.1 Description of the gap

This gap concerns the lack of an EU-wide driving force in the form of ESDP in the current situation compared with the multinational capacity of formulating European military capabilities and acting upon these as presented in Scenario C. In the current situation, an EU common perspective on threats to security is not fully developed, despite the existence of the European Security Strategy. A **European Security and Defence Policy** might be in place, but has still limited reach notwithstanding the many efforts made in this area. This lack of progress strains the capacity to formulate EU-wide military capabilities. Despite the Lisbon treaty, no true move forward has been made in this domain.

Without a common or at least **coordinated defence and security policy**, the development of EDEM and EDTIB will only be limited. ESDP is seen as essential for 'harmonization' of military capabilities or **consolidation of demand**, the main guiding principle for industries active in the defence market. As such, it is a driving force for delivering and sustaining key military capabilities at the European level.

A common vision on European military capability needs will also create a common supported vision of a European industrial policy. Most important enabler for this development will be the establishment of the political will to create this market. While EU national governments have recognised and accepted that nationalism and self-sufficiency are no longer an option for defence industries, defining and identifying the key defence industrial capabilities needed at the European level for 'operational sovereignty' still remain a difficult task, especially where a capability is regarded as 'key' at the European level but not at the national level or vice versa.

Scenario C has not presented a truly EU-wide breakthrough on this front either. Rather, EU countries have formed coalitions on different topics though **bottom up cooperation between member states**, where EU-directed progress has not been sufficient or is not desired. This also implies that member states have committed resources to common objectives and have thus overcome national thinking. For instance, a mutual understanding between France and the UK may have triggered other countries, in particular Germany and Italy, to take a more European rather than a national stance. Also, the stronger **role of NATO** can strengthen the focus on operationalising required military capabilities, as a result of its practical experiences. The differences in speeds are partially the result of different ambitions and different expectations regarding the

involvement in types of **military operations**. Thus, while there is not a commonly shared picture emerging about the types of missions in which European or multinational forces should be involved, this **bottom-up coming together** is driven by decreasing **national defence budgets** (because of various budgetary pressures elsewhere), a multi-polar **global security environment** (leading to involvement in varying types of missions), and a common incentive by countries with substantial defence industries (with possible do or die consequences) (especially relevant to the LoI 6 countries). It is in such a dynamic and versatile environment with continuously increasing mutual dependencies, in which security of supply arrangements are more feasibly maintained than in a broader community.

5.3.2 Ongoing initiatives

At this time, there are a number of ambitions stated and activities ongoing that aim to accomplish a more European wide vision on common future military capabilities.

First of all, there is EDA's Long-Term Vision (LTV) report, which "is designed to serve as a compass for defence planners as they develop the military capabilities the European Security and Defence Policy will require over the next twenty years in an increasingly challenging environment." The capabilities are formulated as key issues and capability areas without going in to much detail about specific capabilities. As the report states itself "(t)he picture offered here will need further development, and regular reassessment – but may be judged a useful starting-point (EDA, 2006)" In addition, the participating Member States (pMS) stipulated that the LTV document was explicitly an initial, non committing document without full agreement on all particulars.

Following from this report are the activities developed by EDA to come to a Capability Development Plan (CDP). This plan was agreed by the pMS in July 2008 and will be used to guide future national defence investment decisions and to seek opportunities to collaborate so as to address their short-to-longer-term military requirements coherently. It is more specific than the LTV, but is still not a supranational military equipment or capability plan which could replace national defence plans and programmes. It should support, not replace national decision-making.[50]

More recently, in a Council declaration of 8 December 2008 on the enhancement of the capabilities of the European Security and Defence Policy, specific targets for different types of operations were developed. [51]

At the national level, some countries (especially France and the UK) have clearly identified what they perceive as their key military capabilities for the coming years.

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[50] http://www.eda.europa.eu/genericitem.aspx?area=2&id=385

[51] Council of the European Union, 16840/08: Europe should actually be capable, in the years ahead, in the framework of the level of ambition established, inter alia of deploying 60 000 men in 60 days for a major operation, within the range of operations envisaged within the headline goal for 2010 and within the civilian headline goal for 2010, of planning and conducting simultaneously: two major stabilisation and reconstruction operations, with a suitable civilian component, supported by a maximum of 10 000 men for at least two years; two rapid response operations of limited duration using inter alia the EU's battle groups; an emergency operation for the evacuation of European nationals (in less than ten days), bearing in mind the primary role of each Member State as regards its nationals and making use of the consular lead State concept; a maritime or air surveillance/interdiction mission; a civilian-military humanitarian assistance operation lasting up to 90 days; around a dozen ESDP civilian missions (inter alia police, rule of law, civil administration, civil protection, security sector reform and observation missions) of varying formats, inter alia in a rapid reaction situation, including a major mission (possibly up to 3 000 experts), which could last several years.

5.3.3 Still Missing

In the past years, there have been a number of thorough efforts to clearly analyse and formulate (future) military capabilities. Some of these have been overhauled, primarily because the expressed ambition became out of reach. This is partly due to the lack of political and high level commitment. Concrete plans of actions are required to fill the gaps between the well analysed requirements and the available capabilities. Despite the identified requirements, the military thinking and current equipments are still rather traditional. As a result, crucial deficiencies still exist (Withney, 2008). This all becomes even more complicated in Scenario C. As a Europe of different speeds has never been the starting point for discussions, the present visions for future capabilities must be further elaborated.

5.3.4 Possible measures

Facilitating the formation of partial markets and favourable collaboration

In order to prevent a plethora of ad-hoc collaborations to come into existence with opposing or conflicting objectives, the European Commission should develop a common vision of how to establish partial markets that will guide their further implementation. In addition, the European Commission should aim to streamline relationships with existing structures (such as LoI 6, OCCAR) so that no unnecessary duplication will occur. Finally, the EC could coordinate in what inclusion criteria are most appropriate and acceptable in order to create favourable collaboration.

Looking at the different levels action can take place:

- The European Commission in close collaboration with EDA should provide the strategic direction on and the tactical means for the development of the partial markets:
  - the **European Commission,** from a European perspective, will have to develop a vision (what areas should be prioritized, what players are relevant) and the collaborative mechanisms that allow for coalitions of the willing (in the spirit of the permanent structured cooperation as laid out in the Lisbon Treaty). Furthermore, it can support EDA in the further development of these activities
  - The **EDA** and pMS have already identified prioritized areas where pMS will co-operate through CDP. The EDA is creating and using the mechanism to identify common requirements and initiate co-operation. IDTs and PTs, are already working on the first tranche of commonly agreed priorities. In this context, EDA is a facilitator of cooperation in all areas where pMS express their willingness to work together. EDA should further elaborate the prioritized areas where clusters of MS can join forces and initiate these cooperations (e.g. by workshops, conferences of background studies) and support the formation of these clusters. These are crucial in the creation of common or converging objectives and the identification of potential for the formation of coalitions in these areas. The EDA will also need to facilitate further development of these programs where the MS can join efforts.
- **National member states** have to become more politically committed to following up on these actions. As clusters of MS will be joining forces, they need to open up their markets and establish relationships on specific areas.
- The **defence industries** need to be actively involved in the development of the vision on the European military capabilities, as they are in the best position to test the formulation of capabilities requirements on their feasibility and timeliness.

Setting up institutional arrangements that can allow (or speed up) upward interoperability by countries not part of pioneer groups

A Europe of Different Speeds should avoid the perception that countries are left behind. Smaller member states could fear that favourable collaboration leads to a "core Europe" built around the "big four" – Germany, France, Italy and the UK, with little room for the interests of other countries. In addition to creating the appropriate inclusion criteria, the **Commission** should also create a tracking system for countries to follow their progress relative to the leading group and assist in these cases where progress is lacking but commitment to join is present.

Looking at the different levels action can take place:

- the **European Commission** needs to establish the commitment of the member states to participate in setting up this tracking system. Pitfall of many systems is that providing information is hard to sustain, leading to a suboptimal situation.
- **EDA** can be the actual organizer and "owner" of the system. They also need to coordinate activities to collect data and disseminate to users. This also needs other dissemination activities than just the technical system. One of the ongoing follow-on activities of the Capability Development Plan is the development of a mechanism for" Landscaping" ongoing and future capability development in different areas. This mechanism will also provide a system for pMS to "track" individually their progress in comparison to the overall EU wide progress.
- **National member states** have to provide information on a regular basis. This needs institutionalization of a function within the member states.
- The **defence industries** may also be in a position to provide certain information to keep the system up to date.

Identifying common objectives regarding the commitment of resources

To facilitate the formation of collaborative coalitions, the **European Commission**, together with **EDA**, should identify in what fields common or converging objectives are to occur and the potential for the formation of coalitions in these areas. EDA is now already establishing joint investment programmes. This type of activity should be extended to take a more permanent and strategic character.

Looking at the different levels action can take place:

- The **European Commission** has a limited role, but can be part of the discussions to ensure linkage to the EU policy developments in this area.
- **EDA** is the lead player in this recommendation. Organisation of a periodic foresight and identification of potential priority issues needs to be organized by the EU in close cooperation with the member states. Central is the development of a vision on future common objectives and potential joint programs to discuss with member states and industry. The CDP is the first step in this process, having lead to the presentation of the first 12 priorities. Also, the further development of the programs needs to be facilitated by EDA.
- **National member states** need to commit to the process in order to take the outcomes and participate in the joint programming.
- The **defence industries** can provide (generalised) information about their current and potential future product and service portfolio, to enhance the practical perspective of joint programming. Also, participation to the process is crucial to ensure linkage to the EDTIB.

5.4 Gap Capability: Lacking European organisational structure to fulfil capabilities

5.4.1 Description of the gap

This gap is related to the fact that (key) military capabilities defined are currently nationally based, procured and delivered, while Scenario C presents a situation that is characterised by strong intra-European cooperation and moderate European consolidation. Core difference between this gap and the previous gap on "lacking vision on capabilities", is that this gap focuses on the organisational structure on fulfilling the capacities rather than the substantive focus of the gap described in section 5.3..

The political will to define European capabilities and act upon these is a *conditio sine qua non*. However, it is not sufficient to develop an EDTIB. This will require actual cooperation at a more tactical level. Common capabilities and equipment can help to meet the operational requirements of Europe's Armed Forces (European and national operational sovereignty) or at least work together on joint missions. Thus, it supports the creation of an EDTIB which is 'more integrated, less duplicative and more interdependent with increasing specialisation at all levels in the supply chain'. Currently, many countries still look at their home markets first and the US second to fulfil most of their procurement needs. In the current situation, EU countries have been able of delivering and maintaining a wide series of military capabilities. In general, this has been accomplished at a national level and at very high costs. Some of the major current national defence industry strategies have realized that sustaining these capabilities is very hard and have already started to identify certain capabilities that should be maintained outside of the national boundaries (e.g., France, the UK).

In Scenario C, the delivery of military capabilities will be more multinationally organised, especially for those not considered key capabilities. Corresponding with the formulation of common military capabilities (at different speeds), Scenario C presents a situation in which there is agreement on the identification of EU-wide (or tier-wide) capabilities and where the competencies to fulfil these are situated. In addition, there is agreement on where national capabilities cannot be fulfilled at a multinational level. Clearly, the coverage of capabilities is highly dependent on the type of operations that these countries are wiling to get involved in. While the needs and priorities may have been agreed upon across a select group of member states, this does not necessarily mean that the delivery of key military capabilities is also organised and implemented at a more European level. However, it is likely to direct and coordinate defence investment decisions and to facilitate collaboration. Participating countries have recognised that possible consequences of industrial restructuring will be the creation of transnational defence companies, possible abandonment of national industrial capacity and thus the acceptance of mutual dependence. This leads to consequences with respect to security of supply and the fair and efficient distribution and maintenance of strategically important assets, activities and skills.

5.4.2 Ongoing initiatives

As part of its defence package, the European Commission introduced a directive on **defence procurement** in December 2007[52]. A major objective is to facilitate and encourage cross-national procurement activities. The Commission has proposed a new Directive, tailor-made for defence and security. The Directive requires publication of certain contracts and has provisions on sub-contracting which will also be beneficial to

[52] The directive was recently approved in European Parliament

SMEs. This will improve the openness of defence and security markets between Member States. The new Directive will contain a number of innovations tailored to the specificities of such procurement cases. They may also require from candidates specific clauses for security of information (in order to ensure the confidentiality of sensitive information) and for security of supply (in order to ensure on-time delivery).

There are various European multilateral initiatives in the field of security of supply. Most importantly perhaps are arrangements made between the LoI 6 countries (France, Germany, Italy, Spain, Sweden, UK). In their framework agreement[53] on security of supply, these countries have defined[54] and made arrangements on **Security of Supply**.

In the various sectors, a number of **collaborative programmes** have been developed, involving the sharing of total R&D costs and the pooling of production orders between the partner nations. Some of these have even led to the formation of European companies (e.g., Airbus, MBDA, Eurocopter). Collaboration is one of the distinctive features of European defence industrial policy; but it has been mostly confined to the aerospace sector.

5.4.3 Still missing

Although the defence procurement is not yet actively implemented in the member states, it can be an important instrument to further cross-national collaboration. At the same time, Member States will still have the possibility to use Article 296 to exempt defence and security procurement contracts which are so sensitive that even the new rules do not satisfy their security needs. In most cases, however, member states should be able to use the new Directive without any risk for their security.

Opportunities remain for improving the efficiency of **European collaboration** on military projects. Typically, work-sharing arrangements and the bureaucracy associated with these projects leads to overruns and delays. Also, there remain opportunities for creating European companies rather than relying on ad hoc loose federations of project-specific arrangements for managing such programmes. Airbus in the civil aircraft market shows that international collaboration can be successful.

Major bottlenecks in current collaborative programmes are the number of countries that are involved in them on equal share, the differences in the defence industries that they represent, and the work sharing arrangements that are often based on juste retour and as such are driven by cost efficiency.[55]

5.4.4 Possible measures

Improve the efficiency of collaborative programmes

There are numerous lessons learned about the efficiency of collaborative programmes. These are, for example, the fact that there should be fewer leading partners (ideally two prime partners) in collaborative programmes; the allocation of work should be done on the basis of competitive advantage and not on the basis of *juste retour*.

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[53] Framework Agreement between the French Republic, the Federal Republic of Germany, the Italian Republic, the Kingdom of Spain, the Kingdom of Sweden, and the United Kingdom of Great Britain and Northern Ireland concerning Measures to Facilitate the Restructuring and Operation of the European Defence Industry, July 2000.

[54] "A Nation's ability to guarantee a supply of Defence Articles and Services sufficient to discharge its military commitments in accordance with its foreign and security policy requirements."

[55] See for instance, EU ISS, 2007.

Looking at the four levels of action, the following activities can be identified:

- The **European Commission** can support and strengthen the further development and implementation of the ESDP and make it more operational to include the development of collaboration programs. However, crucial to closing the gap is also to enable a Europe of different speeds, in which not a full agreement among all member states is needed, but in which a route is developed that allows for the organisation of the military capabilities organized on, for example, a cluster level. Commitment from the member states to such clusters should be organized by the Commission (see also section 5.3.4).
- **EDA** is instrumental to the further development of this measure. Although the European Commission will be needed to establish commitment from the member states, the EDA should organize both selection of specific subtopics and the trajectory for operation. Here, previous lessons learned should be incorporated. EDA recognises work in this area is necessary and has already taken steps to address it, taking into account French Presidency proposal.
- In dialogue with **industry and participating member states**, the EDA should identify and evaluate the de facto centres of excellence within the defence industry in Europe. The various national defence industrial strategies (including the analysis that has been provided in the previous chapter) can be a helpful instrument to guide this process.

Create a common regime of appropriate guarantees

'Appropriate sovereignty and operational autonomy' requires that the EU becomes less dependent on non-EU sources of supply for key technologies. Again, such an objective is not costless and requires appropriate funding of defence technologies to provide more independence.

Looking at the four levels of action, the following activities can be identified:

- The **European Commission** could play a role in determining burden-sharing mechanisms, based on the experiences it has with these mechanisms in other policy areas (e.g. energy security).
- **EDA** should develop a common concept of security of supply which takes into consideration the existing multilateral initiatives mentioned above.

Establish a closer connection between defence planners in MS and industry

To have capability requirements from defence organisations meet with their delivery of the industry, better connections need to be established between the two sides. Industry will be able to indicate the feasibility of delivery of certain requirements, their profitability (including potential export performance), and the time span within which certain technologies can be developed and delivered. Vice versa, planners can indicate if and when certain requirements will have to be in place.

Looking at the four levels of action, the following activities can be identified:

- The **European Commission** has a minor role and could collect and disseminate good practices in this field and possibly stimulate industry to be open to this connection.
- **EDA** which already comprehends many of the national defence planners can expand on the currently existing forum within which experiences with sector specific and cross-national issues are instrumental to the further development of this measure. National practices as to industry involvement varies, and

multinational organisations will have to use an approach all member states find acceptable. This can be difficult and sensitive to implement.
- Obviously, **national governments** should take the lead in this and be the first to reinforce the connections.

5.5 Gap Capability: Excess capacity to deliver key future military capabilities

5.5.1 Description of the gap

This gap focuses on reducing the existing excess production capacity in industry toward a situation in which the overcapacity has been much decreased. This situation is a particular requirement for sustaining key military capabilities and the necessary levels of European operational sovereignty.

At this point time in time, there is excess EU capacity for the production of most military capabilities in the member states. It is clear that the number of firms and the number of armament programs under development across Europe are much higher compared to the United States. For instance, there are 12 major warship building companies in Europe, while there are only 2-4 in the US. These EU-based companies generally have smaller operating margins. In short, there is too much capacity operating at a fairly small scale. This massive duplication and excess capacity is maintained by nations that are predominantly focused on and committed to their own national markets, not in the least because of partial ownership in the industries operating at these markets.

In Scenario C, reduced **defence budgets** and **defence equipment costs**, in combination with increased **technology development costs** will have put increasing pressure on this excess capacity. There will be lower levels of employment in typical defence companies, especially in the land and naval sectors. Overall employment might only contract mildly because of the **increased integration of civil-military sectors**, allowing for human capital to crossover to civil markets. At the same time, cross-national, intra-European market access and dependencies will require arrangements for the guarantee of security of supply.

A major obstacle for the removal of excess capacity is **national protection** and **ownership of industries**. If no measures are taken to facilitate this reduction of excess capacity, member states will be reluctant to participate in the establishment of a new more efficient EDTIB.

5.5.2 Ongoing initiatives

In the past, industry has taken initiatives to restructure and consolidate the sectors. Given that a considerable number of these firms were government owned, this was subject to Government regulation and approval. Where mergers involve foreign firms, these approvals are not as hastily provided. The UK has opened its defence market to allow foreign firms to acquire UK defence companies. Privatisation will help to improve efficiency, and may sometimes be a necessary first step for further consolidation.

5.5.3 Still missing

In essence, all energy that has been directed under the aegis of developing EDTIB has in principle been focused on exactly removing excess capacity and duplication of effort. Conclusions about what is lacking in the current situation has already been part of prior analysis.

There is a need for a more **coherent demand side**. A greater combined demand of defence capabilities will lead to bigger markets for industrial parties to deliver these. This will be an important driver for industries to restructure themselves. Although the merits to this reasoning seem obvious, the actual establishment of structural (i.e., not ad hoc) collaborative programmes are still not taking place. Also, a clear **division of roles** between government as a regulator, contractor and owner is needed. The various roles that governments have combined have resulted in conflicting political, economic and social consideration with respect to national industries. Clearer delineation of these roles could lead to more rational choices. The ability of industries to **move easily across borders** is limited. European defence companies have been managing consolidation through rationalization and integration programs and restructuring of their portfolios and relationships. This is a complex task, slowed by bi-national work-share rules that are not always compatible with efficiency. The structure around the four big players is so complex that it hinders further consolidation.

5.5.4 Possible measures

Stimulate and facilitate national and international consolidation of defence industry, especially in the naval sector and, to a lesser extent, land sector

Despite the consolidation efforts that have been made in the aerospace sector and that have been leading to the emergence of four big players in the defence industry, there is still considerable room for further consolidation. Again, governments have two roles in this: letting go of their ownership (see below) and stimulating more forcefully the industrial consolidation bottom-up. A major bottleneck in this remains the fact that governments still have trouble not favouring their own national industries. It is important that governments consider the longer-term benefits to their economy above the shorter term survival of these firms. A first step to encourage this is restructuring within countries. As a result, the second step, across borders, might become easier to make. An important intermediate step can be the establishment of innovation networks and joint ventures.

In his paper, Witney has suggested a more forceful manner to deal with industrial consolidation. He suggests to copy the US example in the 1990s in which industry leaders were to choose between consolidation or liquidation. In line with this, Witney calls for a European “Last Supper”: Convene summit meetings with industrial leaders to hammer out a plan for defence consolidation (Witney 2008, p. 38):

- The **European Commission and EDA** can help in facilitating the second step by bringing together the political and industrial leaders of the countries most involved. However, the European Commission needs also to be prepared to facilitate the consolidation with supporting programs, for example, the opportunity to establish innovation networks on areas were consolidation is needed and opportunities are present.
- **National governments** (in collaboration) should take a leading role in this development. Here, a carrot and stick approach is in order. Governments can require far going cooperation during procurement on specific areas, but also need to facilitate joining forces by supported funding.
- The **Industry** itself also has to take its responsibility. They need to actively set up initiatives to create joint ventures and respond to the programs and initiatives presented.

Selling off public shares to the private market
A sincere effort by industrial leaders to remove excess capacity from the European defence equipment market may only succeed if public ownership of defence-related firms is gradually stopped. Private ownership will give industry the possibility of further consolidation, access to capital markets and formation of cross-border operating companies.

With the flow of capital across nations, issues of foreign ownership and investment need to be considered. As with previous measures, security of supply and information matters are important side conditions that have to be taken into account.

The European Commission, in collaboration with national governments, should put in place an information system that keeps track of ownership and investment structures in possibly sensitive industries.

5.6 Gap competence: Delivery of cutting-edge technology

5.6.1 Gap description

This competence gap relates to a certain extent to the previous capabilities gap. While in the current situation the delivery of cutting-edge technology is accomplished, it is done so at unsustainable cost levels. Scenario C presents a situation in which much more acceptable and feasible cost efficiency levels are reached, through better cooperation and focus.

In the current situation, the defence industries are capable of delivering cutting-edge technologies. For instance, within the aerospace sector, industries are involved in new engine technology development; for land equipment new munitions technology and lightweight armour protection are provided; the naval sector is capable of delivering nuclear powered submarines and aircraft carriers. However, the development of these technologies takes place at relatively high costs. Under the current conditions, developing and sustaining these key technologies will be under pressure.

In scenario C, the delivery of cutting-edge technology has not been halted. Given the increased growth on **technology development costs** and the slightly **reduced defence budgets**, the costs issue will still need to be resolved. This will have to take place through a different organisation of research and development (R&D) or research and technology (R&T):

- The more efficient use of technology budgets (for instance through multilateral collaboration and cross-sectoral learning)
- The more aligned agreement on **developing certain key technologies**, such as related to miniaturisation and materials, the use of intelligence and command and control/NEC.

In addition, given the rapid technology development in the civil domain, companies seek diversification from purely defence-oriented R&D to investments in **dual-use technologies** to create larger investment and subsequent market opportunities.

5.6.2 Ongoing initiatives

In November 2007, EDA's Ministerial Steering Board approved four collective benchmarks for investment:

- All pMS should spent **20%** of total defence spending on *Equipment procurement* (including R&D/R&T)
- European *collaborative equipment* procurement: **35%** of total equipment spending
- pMS should spent **2%** of total defence spending on Defence R&T
- European *collaborative* Defence *R&T*: **20%** of total Defence R&T spending.

These benchmarks have been set as collective targets: they apply to the total sum spent by all participating Member States together. Whether participating member states use them as national targets is left to the member states themselves. Furthermore, the timing of the realization of the benchmarks is open ended.

A number of activities have supported the facilitation of reaching these objectives. Within EDA, the joint investment programmes in defence R&T have been established, based on a framework for a joint Strategy on Defence Research & Technology. This framework describes why and how they intend to invest collectively on technologies that are crucial for future military capabilities and industrial capacities in Europe.

Also within EDA, EDA's Capability Development Plan aims to guide future national defence investment decisions and to seek opportunities to collaborate so as to address their short-to-longer-term military requirements coherently. Within the CDP, an initial tranche of 12 selected actions were defined, which may help concentrate activities on delivering the relevant technologies.

Finally, multilateral collaboration programmes have been established in various sectors in an ad hoc manner.

5.6.3 Still missing

Having mentioned the most relevant collaborative efforts, it must be said that measures to stop fragmentation and duplication of R&D budgets have still been limited. In addition, there is no clear view of how much defence R&D spending is really available across EU member states, as these activities are European oriented.

While certain industries are capable of incorporating lessons from one sector to another (e.g., BAE), many research organisations and industries are still focused mono-disciplinary. As a trend in **convergence of technologies** can be seen, this will still lead to a structure where attention to future cutting-edge technologies is limited.

Although the EDA R&T strategy and EU's 7th Framework programme on Security are starting points for concentrated efforts for the large scale use of common technology budgets, the actual monies available remain very dispersed over countries, programmes, and themes.

5.6.4 Possible Measures

Increase defence R&D spending levels in an absolute sense

To maintain a competent base for the delivery of technologies, the overall investment in defence R&D needs to be increased. In comparison with the United States, Europe is investing only a fraction of its defence budget on R&D. Although the US level does not need to be the aim, increasing R&D is an effective way of improving the EDTIB given that defence R&D affects each of the three Cs:

- Capability: New technologies are crucial to address the (future) challenges and sustaining the required key military capabilities.

- Competence: The need for on-time deliverance of cutting-edge technologies for the development of, for example, disruptive technologies relies on a sound research infrastructure.
- Competitiveness: R&D has a significant impact on an industry's future viability and competitiveness, as it forms the fundament in renewal of production in light of changing demands. It also has a strong effect on, for instance, cost reduction.

Looking at the four levels of action, the following activities can be identified:

- As described earlier, agreement on common goals and targets on defence spending across **European MS** has been reached, including targets related to R&D and procurement spending. This process is similar to setting the targets for overall investment in R&D (three per cent of GDP) to realise the objectives stated in the Lisbon agenda. However, currently most of the benchmarks established are not within reach.
- Also, new additional funding for defence research and development can be made available though the **EDA** programs, although compared with the research budgets of the MS, the available funds will still be very limited.
- The **European Commission** will have no opportunities to directly increase the overall budget for defence R&D. It should thus focus on stimulating dual-use application of security-related and space R&D which is financed through the Commission's framework programme.
- Looking at contributions from the **industrial** side, it can be said that the Primes are already large investors in research. As a matter of fact, the R&D ratio to revenues of European firms is often higher than of American counterparts. This is a direct result of the much higher US government R&D budgets in the defence domain..

Change mechanisms for R&D budget allocation

Increased spending is not sufficient by itself. The more efficient use of existing R&D spent is another important objective. Changing mechanisms for R&D budget allocation can help accomplish this. One new mechanism could be to establish an EU Defence Advanced Research Projects Agency (DARPA) similar to what is existing in the US. EU DARPA could stimulate innovation, generate break-through solutions for which individual nations cannot find the necessary budges, and could share the risks in R&D in high-risk but potentially high-value system solutions.

- The **European Commission** or **EDA** could be the managers of this mechanism, but they would need substantial more budgets that current defence R&T initiatives.
- **National governments** need to be willing to re-invest some of their national R&D budgets at this European level.

Evaluate relevance of R&D output for other programmes

Finally, in addition to intensity and efficiency, the effectiveness of R&D investments should be improved. In alignment with one of the recommendations made by the French presidency to all EU National Armaments Directors, to EDA and to the European Commission, the systematic evaluation of the relevance of R&T programmes for programmes under preparation (for instance programmes in other sectors) should be developed. In addition to supporting the (re) direction of R&D investments, this will also help to stimulate cross-sectoral (within the defence industry) learning to increase profitability from R&D investments.

- Given the **European Commission's** experience and expertise in the evaluation of large scale research programmes, this task would naturally be housed there, but the **EDA** can play an important role.

- For **National governments**, the same activities apply. Also here, better evaluation of national organized defence research is important to increase efficiency. An international benchmarking instrument would facilitate.
- For **industry**, a benchmarking instrument to assess compliance and opportunities with other programs would also facilitate the increase of research efficiency.

5.7 Gap competence: Selectively open research/industry networks

5.7.1 Description of the gap

This gap stresses the differences between the current situation which depends on the use of fairly narrow knowledge and production bases in developing key technologies and the situation in Scenario C that is capable of using a much broader network of research and industry competence in order to innovate and accelerate the fielding of new technologies.

In the current situation, links between the various actors in the R&D value chain are not as well developed in the military domain as they are in other domains. Often, security of information is an important driver that limits the collaboration between, for instance, basic research at universities and defence R&D outfits and the technology development in industry. The aerospace sector maintains good contacts with universities (partly due to its civil components); for the other sectors, these linkages are currently much less obvious. Partly driven by this, the main European firms spent much more of their total turnover in R&D than US firms (which investments are supplemented by the US government), obviously negatively affecting their operational performance.

In Scenario C, these research networks have become much more open and the **links between research and industry** more powerful. This is driven by the need for **integrating innovations** from the civil domain into the military domain and for valorizing the results from basic research. There is a much more fluid and non-hierarchical, networked supply chain. In addition, cooperation takes place cross-nationally.

5.7.2 Ongoing initiatives

EDA has set up an Electronic Bulletin Board (EBB) on defence contracts opportunities. This EBB opens up the possible government and industry contract possibilities to a much wider field of suppliers than before. Concomitantly, the Code of Best Practices in the Supply Chain is established to promote the principles of the Code of Conduct on Defence Procurement in the supply chain thereby encouraging increased competition and fair opportunities for all suppliers, including for small and medium-sized enterprises (SMEs). The CoBPSC should encourage value to flow up the supply chain to the benefit of the pMS by adopting good practice down the supply chain.

EDA is also developing with pMS experts the Guidelines for facilitating SMEs access to the defence market. The Guidelines are foreseen as a coherent document, comprising a number of recommendations in various areas. They will, amongst others, include the proposals for policies supporting SMEs involvement in R&D/R&T contracts. EDA is analysing existing policies in this area to evaluate their effectiveness.

When establishing the mechanism of Joint Investment Programmes (JIPs), the emphasis on industrial cooperation, particularly involving SMEs, in EDA R&T programmes was

put through the requirement to include SMEs, academia or non-governmental laboratory in the cross-border consortia.

At the national level, defence oriented research institutes are slowly broadening their scope to include security research (e.g., civil emergency) topics as well (see for instance the large defence related institutes in Europe, such as DSTL and Qinetiq in the UK, TNO in the Netherlands, FOI in Sweden, IAG in Poland and other examples described in the case studies). Also some national governments are exploring the possibilities to include defence research in the more generic industrial research, where the ICT related research topics are often point of discussion (e.g. the bi-departmental Dutch "Defence Industry Strategy" of the ministries of Economic Affairs and Defence).

5.7.3 Still missing

As much as governments look at their national industries to deliver capabilities, they tend to only consider a narrow research base for the delivery of innovations and key technologies. Due to **security of supply** and **security of information** reasons, more open networks are not often supported by governmental programs. However, these open networks could provide a more stimulating arena for innovation.

Although quite some (research) Centres of Excellence (CoE) are present, these outfits often have a very national focus. The NATO CoE are an exception to the rule. Moreover, the large RTOs only have limited initiatives related to the establishment of new innovation networks.

A third missing element is the lack of attention to establishing industry/academic networks, in which non-defence and more basic research can be incorporated. This is of importance also to valorise the outcomes of more academic research, in order to close the innovation paradox.

A final lack is the shortage of policy initiatives that focus on the increased participation of SMEs in defence research and innovation. In many national settings, as well as on the European level, SMEs are given attention, but attention to the defence oriented SMEs is missing up to now. Establishing SME-networks can create a positive contribution to increase the innovation capacity of the defence industry.

5.7.4 Possible measures

Set up innovation programs for the participation of SME's

To better involve SMEs in the defence networks and make use of their innovative strengths, these firms need to be facilitated. Usually, the barriers to entry are limiting introduction to the defence industry. However, these new entrants can establish new perspectives to the defence domain and should be facilitated. Within the European instruments, there are strong opportunities for SMEs to be internationally active (e.g. CIP), but a pre-program is needed to initiate the use of these funding mechanisms by the defence sector.

At the different levels, these activities can be initiated:

- The **European Commission** should do more to increase the awareness of its SME-policy instruments among more defence-oriented SMEs as well as improving the availability of these instruments to the more naturally closed off defence markets. Often, defence-oriented SMEs have had little access to these funds due to the traditional non-defence-oriented focus of these instruments while at the same time non-defence-oriented SMEs see little possibility to use the instruments.

- The **EDA** can initiate a pre-programming initiative to facilitate defence SMEs to make use of these more general funding schemes. This initiative can be based on more common SME initiatives that use a phased initiation of SME networks.
- On a **national level**, SME innovation programs need to open the possibility for both defence oriented research and development, as well as international cooperation.
- On **the industry** level, industry associations can play a crucial role in the initiation of initiatives for the development of new networks.

Establish industry/academic networks, defence and non-defence
Similar to what has been done through EDA's EBB on procurement matters, networks for innovation funding should become available to a much wider network of organisations. However, there where EBB just presents the opportunities to 'outsiders' to enter the defence contracts environment, more incentives may be required to open up research and innovation networks to non-traditional defence outfits. Thus, two activities may be required. First, the establishment of an innovation funding mechanism for defence-related or dual use technologies. This includes the setting of specific participation requirements, stimulating the involvement of SME, large military organisations and civil organisations. Second more information on EU defence supply chains is required, including information from and to SMEs (what SMEs are involved in the supply chains, which could be involved?)

Looking at the different levels action can take place:

- The **European Commission** has given the dual use implications a leading role in developing and managing innovation funding programmes
  EDA is the lead player in this recommendation. Organisation of a periodic foresight and identification of potential priority issues needs to be organized by the EU in close cooperation with the MS. Also the further development of the programs needs to be facilitated by the EDA. For instance, EDA was tasked by the October 2008 NAD SB to develop an armaments cooperation driven IT platform to enable industry to propose solutions to pMS priorities set out in the CDP.
- **National member states** needs to give commitment to the process and stimulate the involvement of SMEs in these programmes, making them aware of funding possibilities.
- The **industries** need to be willing to participate in these programmes. This will require flexibility in the programming and funding arrangements to fit to different outfits.

5.8 Gap competence: Suboptimal integration between defence R&D and civil R&D

5.8.1 Description of the gap

This gap concerns the issue that the present integration between civil and defence related research is limited, while scenario C shows a strong integration of both (for example, due to pressure on R&D budgets).

In the current situation already, **national defence R&D expenditures** are declining across EU member states, both in absolute terms as well as relatively to the overall **national defence budgets** (OECD). At the same time, the pressures of costly and rising R&D and defence equipment costs keep building. This makes the more efficient exploitation of R&D input of crucial importance. An important aspect of the current

EDTIB is also that the Technological Base is still partly founded on the technology and innovation developments that took place during the (post) cold war period.

On the other hand, the general research expenditures in Europe are stable or even rising, as research, development and innovation is considered a key to further economic development and dealing with important societal challenges (e.g. sustainability).

Scenario C presents a number of developments that respond to these pressures. First of all, based on a better cooperation within the EU, an **increasing influx of civil technology** can be seen to keep up with capability requirements. An important second driving factor is the developments in the **nature of consolidation**, which stimulate large defence firms to spin off non-profitable and non-core activities to remain competitive. This makes the market more fragmented on one hand, but has lead to a broadening of the markets scope of the firms on their core technologies. And the integration in and collaboration with organisations in the civil economy has increased profits from the absorption of innovation from other sources. A third driving factor is the fact that the **costs of equipment** will increase, which is naturally accompanied by a higher research intensity.

Concluding, there is a need for defence-related companies and their R&D activities to seek integration with their civil counterparts. The purely defence-oriented R&D spend will decrease (or will at least be incapable of matching up with increasing R&D costs), the need for R&D investment remains important for a strong EDTIB that delivers key military capabilities, and the technology requirements become more complex. Given the rapid technology development in the civil domain, companies seek diversification from purely defence-oriented R&D to investments in **dual-use technologies** to create larger investment and subsequent market opportunities. All of this drives the need to increased civil-military collaboration, especially in the field of R&D, which needs to be addressed.

5.8.2 Ongoing activities

Several multinational funding programmes for security and defence have become available in recent years. Community policies like the 7th EU Framework Programme positively affect the defence relevant EDTIB in terms of generic high-tech being part of defence supply chains and now also in terms of security systems technologies which are often very similar to their defence counterparts. Some examples are the Security Theme within the Framework Programme, and EDA's R&T Joint Investment Programmes. These programmes aim to create economies of scale from rather scarce R&D funds. The establishment of a Security Theme within FP7 has already resulted in combined expertise in the more civil dominated sectors with many defence-related industries participating in it.

EDA is taking important steps with regard to the pooling of the money of pMS in research and technology. Last year was the first time that a joint investment project in research and technology had been launched with M€55 to be spent over a three year period, with pMS putting money into a pot without knowing where the money would flow to. While this amount can be considered trivial, it is the underlying process that should provide the impetus for increased funding over the coming decade. In that sense, the Preparatory Action for Security Research (PASR) started with a budget of M€45 over three years. The current security theme within the 7th Framework Programme has an overall budget of M€1400 over a period of six years.

5.8.3 Still missing

While some of the initiatives mentioned above target the increased need for civil and military R&D collaboration and integration, the current situation still needs improvement. That need for improvement is underscored by the following shortcomings:

- Collaborative and overall effort of R&D is still too small: only, 14.5% of all R&D spending in Europe is done collaboratively, meaning that the bulk is still initiated nationally. In addition, the overall EU defence R&D spending is 20% of that of the United States, seriously undermining the competence and competitiveness in the DTIBs.
- Defence-specific R&D quality conditions hamper sufficient integration with broader security and/or civil oriented research requirements. In general, quality requirements of the outcome of defence research considerably extend development paths compared to security and/or civil oriented research in which market introduction of new services and products takes place much faster. This puts serious conditions to the design of research programmes that should benefit from similar innovations.
- National integration of civil and defence R&D is not sufficiently progressing. While the mutual interests and capability deployments in the defence and security sectors are increasingly converging, the development of common research agendas and programmes is still haphazard.
- Institutional financial arrangements: the national defence R&D landscape is often characterized by long-term funding and programme arrangements that are not prone to flexibility or openness to other sectors (Exit and Entry barriers). Obviously, this limits the ability to learn and profit from developments from these other sectors, as required in settings, such as presented in Scenario C.

5.8.4 Possible measures

Synchronise European and national R&D funding programmes

To effectively and efficiently use various ongoing R&D efforts that are of importance to military capability requirements, European and national R&D funding programmes both in the field of defence and security should be better synchronised.

The synchronisation would be accomplished by coordinating, monitoring and informing participants about objectives, innovation priorities, approaches, participants of programs, as well as their results. Possible approaches can be:

- periodic conferences/workshops (taskforce and network);
- a shared website with all programs (technology oriented, in stead of innovation oriented), stakeholders (with expertise) and results;
- active matchmaking to stakeholders; shared newsletter.

These measures should lead to a more efficient and effective use of financial budgets as well as better use of the results of programs. Duplication of research and development will be reduced, as well as the use of existing knowledge and experience. Also, there will be an increase in network development (e.g. centres of excellence), because of more systematic networking activities. The use of non-security/defence programs for the security/defence domain will be enhanced, creating more opportunities for dual use.

Action could be taking place at several levels:

- The **European Commission** should, in collaboration with national coordinators of the EU member states, set up this mechanism. EDA is currently conducting similar

activities, but these are very much focused on defence R&D only. The Commission should take the lead in this activity in which the synergy of defence R&D with the security theme of the 7th Framework Programme and various security related R&D programmes of member states can be identified.

- **EDA's** role in synchronising the European and national level is particularly on defence-related R&D. This focus should only be broadened to the extent to which national MoD research programme already show incorporation of security related themes. EDA is already engaged in driving this forward. Guiding national member states to identify their research activities and exploring opportunities for synchronization should remain EDA's prime responsibility in this domain.
- **National member states** should systematically identify and coordinate their defence-related R&D programmes in order to allow for continuous comparison of national R&D programmes.
- The experiences of **industry** involved in R&D across Europe should be tapped. As the aligning of civil and defence related R&D is not common, lessons learned should be disseminated. In addition, the identification of centres of expertise can help develop strongholds for R&D centres.

Actively initiate spin-out of defence technologies to civil innovations

To change a used strategy of firms is hard to change, especially looking at SME's. Only some firms will be able to change their innovation behaviour. Looking at the gap to be addressed, a better integration of civil and defence innovation is to be stimulated. Experience shows that firms need to be facilitated in the actual process of creating new opportunities by changing their existing networks and markets. Many national and EU programs aim at the realization of these new spin out processes, like the EU-CIP. But also a special program has been running for some years to facilitate the spin-out of space technologies to the non-space market (ESA initiative). To create these active imitation of defence firms to spin-out their technologies to non defence markets, the following activities could be developed:

- On the **European Commission** level, a special program can be initiated to support defence organisations in transforming their technologies to non-defence markets. This could be part of the CIP and part of the 7th Framework Program.
- **EDA** should play an important active facilitation role in advising the European Commission in these programs. However, the success of the program is also highly dependable on the activation of the EDTIB towards this program. Workshops and conferences organized by the EDA should inform and facilitate the firms. Also, a connection to the EDA EBB website can inform potential users and thus developing an internet market place.
- The **member states** can play an active role in directing their agencies to facilitate national firms.
- Also **Industry associations** need to play a role by communicating the opportunities to their members. This can include both direct communication and the organisation of workshops.

Disseminate successful experiences of combined civil and defence-related R&D
Important to the actual decision of firms to initiate dual use activities is the experience from other firms in this area. This measure is aimed at developing a communication strategy to inform firms in the industry about possible success stories on joined civil/defence research initiatives. They can learn from these examples reducing the barriers to engage in these activities.

Looking at the different levels, the following activities and roles can be identified:

- For the **European Commission**, no active role is foreseen.
- The **EDA** would play a pivotal role in this measure. Both the collection and dissemination of this information would be their responsibility. Also more background information about the actual problems in these processes should be analyzed in order to better inform the firms.
- The **member states** will have little role in this measure, other than being a linking pin to the national firms. The innovation agencies can join forces to facilitate the EDA in providing the required information.
- The **Industry** needs to be willing to cooperate in providing actual information. Here as well, the Industry associations must play an active role in getting information from the relevant firms (or even identifying them).

5.9 Gap competitiveness: Barriers to entry in intra-European markets

5.9.1 Description of the gap

In the current situation, the size of many defence-related firms is too small. They are involved in a variety of products, but generally targeted at their national market only. In addition, too many firms are active in a relatively small market. As indicated, the firms can deliver capabilities and some are at the cutting-edge of technology development, which is reflected in good export performance outside of the EU, for instance in the aerospace sector. Performance in the land equipment sector is less favourable. However, this all takes place at very limited cost-efficiency and high public costs.

In Scenario C, some **consolidation of the industry** will have occurred. This consolidation may have occurred in a variety of ways, but primarily by ways of national and some intra-European mergers. There will be smaller primes, due to a stronger focus on core competencies; there will be fewer numbers of small, defence-only, national-oriented firms, and in exchange a considerable increase in dual use midcap companies and SMEs. Also, the establishment of high-tech spin offs from defence-related research institutes and large technology institutes is encouraged. Economies of scale are better because of more **coordinated defence procurement policies**. All of this (restructuring, economies of scale) will have improved the **cost-efficiency** of the European defence industry. At the same time, the quality of performance has remained, boosting the overall **levels of competitiveness** of the sectors within Europe. Changes in the land equipment and naval sectors will have to be more significant than the other sectors and can be partly accomplished by cross-sectoral mergers.

5.9.2 Ongoing initiatives

The European Commission has provided Member States with guidelines on when defence contracts can be exempt from EU rules requiring competitive bidding. The Commission sees these guidelines, which are set out in an 'Interpretative Communication', as a necessary first step towards greater competitiveness, openness and efficiency in EU defence markets.

Article 296 of the EC Treaty gives Member States the possibility to derogate from Internal Market rules on public procurement when this is necessary for the protection of their 'essential security interests'. The Interpretative Communication aims to prevent possible misinterpretation and misuse of the Article 296 exemption in the field of defence procurement. In particular, it explains the principles of the exemption, and clarifies the conditions for its use in the light of European Court of Justice case law.
The Communication is a non-legislative measure and does not modify the existing legal framework.

The EC has developed several initiatives in the past decade to further progress in this area. The package of initiatives presented by the European Commission in early December 2007 is an important step in the right direction. Together with EDA's code of conduct on defence procurement, the CoBP for the supply chain and the Commission's interpretative communication about article 296, these new directives create openness and transparency in defence procurement. Critics have claimed that it is unclear whether the directive will create a level playing field across Europe or whether it could be ignored by some governments while others place their industry at competitive advantage by implementing it. The proposal for the directive on intra-community arms trade is general in nature and leaves much room to the member states to interpret the policy. Exact conditions for being able to use general or global licences, or the products to which they may apply, are not defined on a Europe-wide basis.

As indicated above, EDA's Code of Best Practices in the Supply Chain is established to promote the principles of the Code of Conduct on Defence Procurement in the supply chain thereby encouraging increased competition and fair opportunities for all suppliers, including for small and medium-sized enterprises (SMEs). The CoBPSC should encourage value to flow up the supply chain to the benefit of the sMS by adopting good practice down the supply chain.

5.9.3 Still missing

While various activities have targeted the bottlenecks in the defence market, there are still a number of market distortions remaining that distinguish it from open and competitive markets. The most crucial of these are

- Protection from competition through article 296 (see also 5.4.3)
- Public ownership / Subsidised state-owned enterprises (see also 5.5.2 – 5.5.4) and as a result no access to a genuine capital market
- Barriers to entry and exit foreign markets, especially for SMEs

5.9.4 Possible measures

Set up a roadmap for the gradual phasing out of Art 296 restrictions

A widely applicable interpretation of Article 296 will hinder all economic parties (albeit SMEs even more severely). For organisations to be able to move in between civil and defence related services, transparency of regulation will need to be accomplished. The European Commission should take the prime responsibility of clarifying this. An alternative to the strict interpretation of article 296 would be the total abolishment of it altogether. However, the acceptance among national member states as well as defence firms might be questionable, based on the argument that the defence market, even in the Scenario Europe of Different Speeds, remains a specific creature.

In the mean time, action could be taking place at several levels:

- the **European Commission** should concentrate on a transparent, uniform and strict implementation of the rules and mechanisms as suggested in the Defence package across Europe and enforce a strict interpretation of Art. 296 lists.
- **EDA** should prepare national governments and defence industries to accept the benefits from abolishment of article 296 or to limit the adverse effects of Article 296 (on fair and transparent competition) particularly through the Code of Conduct on Defence Procurement.

Need for more information on EU defence supply chains and support participation of SMEs (see also 5.7.4)

Innovation programs and framework programs are good vehicles to stimulate collaboration and to provide additional financial injections for development. An innovation fund could be established to support the supply chain and SMEs in the defence sector. Such a fund would give SMEs financial assistance both to pay for seeding innovation and achieve successful technological transfers. It should assist technology transfer from defence to security sector and vice versa. Similar to the support that the European Commission provides to SMEs in the broader field of innovation (e.g., the Lead Market Initiative, risk-sharing finance facility (RSFF)) to find these sources for capital, it could do the same for the defence sector.

- The **European Commission** should commission studies that examine the composition and working of the defence supply chain in order to better involve the firms in the defence procurement process and to understand the mechanism of this economic structure.
- **EDA** should more closely examine the performance of the EBB and Code of Best Practice in the Supply Chain

Create a flourishing intra-EU trade of innovative products and services from SMEs

European companies that intend to enter into transnational linkages are faced with significant regulatory obstacles. These obstacles are often linked to concerns and sensitivities about national security and the preservation of a domestic defence industrial capability. Providing more opportunities for cooperation across national boundaries will allow defence customers to use the most innovative and high quality services and products from across Europe.

Action could be taking place at several levels:

- In line with the Intra-community trade directive, the **European Commission** should in addition to the enforcement of the directive, provide simplification of transfer of information while at the same times providing for guarantees of security of information
- **EDA** should collect experiences that are based on the implementation of the new directive and resulting information exchange systems. Both national defence organisations as well as industrial parties should provide their experience with this new environment.
- **National governments** should develop harmonised procedures for export/transfer management systems to facilitate the implementation of global licenses.

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