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Working paper

BEPIDS[1]

Defining the BE-DTIB through Multiple Case Study Analysis.

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Defining the Belgian Defence Technological and Industrial Base through Multiple Case Study Analysis.

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Abstract

While other EU countries have strategies in place to enhance their Defence Technological and Industrial Base (DTIB), Belgium has only recently initiated a strategy to support projects vital to Belgian Defence. One of the causes of this delayed policy response is, in part, due to the lack of a complete mapping of the Belgian DTIB. A prerequisite to being able to map the entities within the BE-DTIB is to first define what the term BE-DTIB encompasses.

Hence, our research employs a multiple case study approach examining several existing mappings of selected countries and institutions to derive common generalizations for the DTIB definition and its inclusion criteria. While there are limited similarities between the selected case studies, we find that there is a lack of generalizability between mapping studies (delimitations, data sourcing, scope, terms). This hampers comparative analyses between countries. Based on the generalizable insights and our aim of the mapping, we developed a definition for the BE-DTIB and outline inclusion criteria for an entity to be considered part of it.

Keywords: *Defence Technological Industrial Base (DTIB), defence strategy, case studies, defence industry*

JEL Codes: *L00, O57*

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Introduction

The current geopolitical situation highlights the importance of developing a strong European Defence Technological and Industrial Base (EDTIB) to increase a defensive rebalancing of power and the EU's strategic autonomy.[6] Hence, Belgium also needs to enhance the potential of its Defence-related Technological and Industrial Base (BE-DTIB) to contribute to developing the necessary capabilities. Until recently, Belgium had no Defence industrial or innovation strategy to support its DTIB. The Belgian Defence Industry and Research Strategy (DIRS), which was introduced in 2022, thus marks a fundamental shift towards a more proactive involvement. With this, Belgium follows other EU countries that have recently established Defence industrial and innovation strategies (cfr. Denmark[7], The Netherlands[8]).

The primary objective of the DIRS is to act as a support mechanism for the BE-DTIB to secure Belgian defensive interests. This is most efficiently obtained by better contributing to its NATO burden sharing commitments and by aiding in enhancing EU strategic autonomy.
Hence, the key goal of the DIRS is to ensure that entities that are part of the BE-DTIB receive the necessary support to: compete in multinational cooperation programs such as the European Defence Fund (EDF), the Permanent Structured Cooperation (PESCO) and the upcoming Defence Innovation Accelator of the North Atlantic (DIANA) (1); enhance their knowledge base, expertise and capacity for research and development (2); enhance their ability to participate in production, operationalization and support of future defence capabilities (3).[9]

A clear and complete picture of the BE-DTIB is however currently lacking. This knowledge gap makes it difficult for Belgian Defence, and for the entities within the BE-DTIB, to grasp which stakeholders are included and gather an overview their relevant activities. Hence this information gap hampers the efficient implementation of the DIRS.

Given that a clear understanding of the BE-DTIB is needed to operationalize the DIRS, a key objective for the DIRS is to map the entities that encompass the BE-DTIB. This raises the question of what exactly the term 'DTIB' refers to. A prerequisite to map the entities within the BE-DTIB is

[6] See: Council of The European Union (2022, p. 24, 35, 43-50)
[7] The Danish Government (2021)
[8] The Dutch government (2018)
[9] RHID (2022, p. 3)

to first define what the term encompasses. As noted by Dunne (1995)[10], Masson et al (2013)[11] and Rafnsson (2015)[12], there is no fixed definition for the concept of the 'national/domestic Defence Industrial Base' (now more commonly referred to as the Defence Technological and Industrial Base), nor on its delimitations. As a result, the term has been employed differently across theoretical studies and empirical analyses.[13] For instance, some studies equate the term directly with the notion of the 'national or domestic defence industry'[14], while others include foreign suppliers as well.[15] In practice, the definition of the DTIB employed in a study will depend on the goal of the empirical analysis and on data availability.[16]

Despite differences on the delimitations of the DTIB concept, there persists a general notion of the DTIB as being broader than the concept of the 'defence industry', as different DTIB definitions commonly refer explicitly to subcontractors and encompass a wider product range (i.e. includes products not directly considered defence-related or defence-specific).[17] Also in this article, we use the term BE-DTIB instead of the more limited denomination of the 'Belgian defence industry'.

The aim of this article is exactly to formulate a definition of the 'BE-DTIB' and to define the criteria for an entity to be part of it. For this, we outline three further research questions: What entities can be included under the term BE-DTIB and what term is most applicable to refer to these entities? (1); Which criteria determine whether the entity is considered 'Belgian'? For instance, can 'foreign-controlled'[18] entities be considered part of the 'domestic' (in our case: 'Belgian') DTIB? (2); What are the product and customer delimitations to identify which 'Belgian entities' are part of the BE-DTIB? (3)

Next, we outline the methodological framework. Thereafter, we discuss the key takeaways from the case studies and subsequently use these insights to formulate delimitations for the BE-DTIB. Lastly,

[10] Dunne (1995, p. 401)
[11] Masson et al. (2013, p. 1)
[12] Rafnsson (2015, p. 31)
[13] See: Dunne (1995, p. 401)
[14] E.g. Balis and Heidenkam (2014, pp. 1-2) equate the term national 'DTIB' with (a broad notion of) the term 'defence industry'. They exclude "dedicated services companies with a large share of defence business" (e.g. Serco plc and Babcock for the UK).
[15] Dunne (1995, p. 404)
[16] Dunne (1995), p. 406)
[17] E.g. see: Dunne (1995, pp. 402-404)
[18] 'Foreign-control' refers here to refers to separate legal entities where, either alone or jointly with other foreign entities/person(s), the (group of) foreign entities/person(s) can exert - directly or indirectly, *de facto* or *de jure* - "decisive influence" on the (activity of the) Belgian-based entity, i.e. to determine the strategic commercial behavior and decisions of the entity such as its budget, business planning, (dis)investment decisions and its management appointment. See: *art. 3(2) of the EU Merger Regulation 139/2004* ; Andres Vaquero, (2019); European Commission (2008). The notion of control is also outlined in Belgian law in *article 1:14 of the Belgian Code for Companies and Associations*. However, we employ the EU notion of 'control' as understood under the EU Merger Regulation. The recent Foreign Direct Investment Screeningmechanism for Belgium similarly refers to the *EU Merger Regulation* to define the term 'control'. See: art 2, 1° in the *Cooperation Agreement 30 November 2022 to Establish a Mechanism for the Screening of Foreign Direct Investments*".

we discuss the limitations, potential next steps for researchers and policy makers, and highlight the key takeaways of our research.

Methodology

Multiple case studies

We employ a multiple case study approach (see Table 1) to derive common generalizations of the definition and to map inclusion criteria.

The case study approach is most suited here for several reasons. First, a quantitative approach lacks the ability to provide the needed insights to derive generalizations. Second, even when papers discuss the DTIB, defence industry or sector, they often do not contain a definition on what it entails. As a result, finding the definition they implicitly use requires further analysis, often through a common snowballing approach by looking at the literature the author(s) employed. Third, due to the former point, a large-scale systemic literature review is not a suitable approach. Fourth, common industry classification framework or market structure frameworks cannot be employed sufficiently. It is well-known in the field of Defence Economics that classification frameworks cannot be employed sufficiently, as there are only a few codes specifically for Defence products. On the other hand, market structure frameworks are too narrow as these focus on similar goods or services. Hence, the market structure framework cannot be employed for the DTIB in itself, as it consists of non-interchangeable goods or services and different industry types, but only to further compartmentalize it. Lastly, the case study approach offers an edge for theory building as cross-case analysis between cases facilitates revealing commonalities, while accounting for the contextual differences between the cases.[19] The latter is also outlined in the multiple case study analysis protocol in Cresswell (2013), which we employ as the framework for this paper (Table 1).[20] The framework consists of outlining the research question, as we have done above (1); to select relevant cases (2); collect data and provide a descriptive write-up (3); report the findings after a stuctured analysis of the cases (4,5,6); and finaly to build generalizations from the insights (7). We further outline the key steps of the multiple case study protocol in the subsection below.

[19] Hunziker and Blankenagel (2021); Burns (2009, pp. 264-265).
[20] Cresswell (2013, pp. 94-96).

SET-UP	(1) Define the research question and purpose of the study.
	(2) Select cases relevant to the research question and purpose.
	(3) Data collection (and descriptive[21] write-up of the cases.)
ANALYSIS	(4) Analysis of the cases to identify patterns, themes, or categories that are common across cases.
	(5) Compare and contrast cases to identify commonalities and differences, and to develop generalizations or theories.
	(6) Report findings: report a summary of individual cases and draw cross-case conclusions to form a cross-case report.
THEORY-BUILDING	(7) Develop generalizations or theories from the insights of the findings.

Table 1: Qualitative multiple case study analysis protocol. Source: Adapted from Cresswell (2013).

Once the inclusion criteria for the mapping are outlined, a definition is developed that best fits the BE-DTIB. The development of the definition takes into account the goal of the mapping analysis, namely the operationalization of the DIRS. Given these specific aims, the definition cannot necessarily be derived completely from the case study analysis insights, but must also take into account the objectives of Belgian Defence. One such aim is to increase the participation of Belgian entities in the EDF and build a knowledge base in niche domains (see *supra*). Hence, the employed definition must be broad enough to include dual-use technology companies, Research & Technology Organizations (RTOs) and even universities for which defence-related economic activities are not a key aim, but contribute to developing and improving technologies for capabilities (e.g. semiconductor companies, university spin-offs).

Selection of cases

[21] As the write-up of the cases is descriptive, the terminology between cases is not consistent. The purpose is to describe the term employed within each case and to derive commonalities or differences between the cases within the analysis section.

Given the lack of conceptual clarity on the domestic or national DTIB, our research draws on insights from the mappings and employed definitions by other countries, by prior Belgian studies, as well as from non-country cases derived from other international actors in the field (see Table 3).

We select relevant cases according to a similarity assessment procedure (see: Table 2 below and Section 3 in the online attached annex). For the country cases we look at all NATO and EU member countries discussed in the book of Hartley and Belin *'The Economics of the Global Defence Industry'* (2020), as well as the Netherlands.[22] It is worth mentioning some of the key limitations to the similarity table assessment. First, countries not discussed in the book of Hartley and Belin (other than the Netherlands) are not included in the similarity analysis. Other NATO or EU member states may bear greater similarities to Belgium than certain cases currently identified for more in-depth analysis. However, there are limited other academic in-depth discussions on countries' DTIBs. While we collect mapping analyses by other countries for our similarity assessment, the mapping analysis of the Netherlands provides the only recent one similar in scope to the purpose of the book of Hartley and Belin. Hartley and Belin's book stands as the most recent comprehensive 'work of reference' on this subject. Hence, our research utilizes Hartley and Belin (2020) as a foundation for further research.

Hence, the country cases were purposefully selected according to their similarity to Belgium, i.e. more specifically to the similarity to Belgian Defence and the BE-DTIB. For this purpose, we employ a mix of absolute (4), relative (5) and descriptive (1) criteria to derive whether cases are similar, neutral, or dissimilar (see: Table 2).[23] By employing this mixture of criteria we identify cases that, although at first glance may seem dissimilar due to differing absolute values, share similar ratios interpreted from a relative basis. This is, for instance, the case for Germany and Canada. These countries both have larger values for their criteria than Belgium in absolute terms, but share similar ratio's. Germany, of course, has larger values for its active forces, all forces, estimated DTIB employees and DTIB turnover. However, when looking at these numbers from a relative perspective, such as by dividing the active forces size by the total labor force, then the ratios correspond to those of Belgium (see: Table 2).

Subjectivity must be avoided where possible when comparing for similarity. To avoid subjectivity, the values for Belgium are set as the referent value the other cells in the column compare to.[24] Using this method, the absolute and relative criteria are allocated to either similar or dissimilar to Belgium.

[22] While we searched for mapping analysis of other countries to insert within our similarity assessment, the Netherlands was the only recent one similar in scope to the purpose of the book of Hartley and Belin.

[23] See the annex separate to this paper.

[24] We employ the automatic similarity coloring tool in excel, which allocates either colors to cells in a columns according to the comparative values in the set.

Nevertheless, the descriptive criteria remains a subjective assessment based on the reading of the source material. Of course, the comparison for the absolute and relative criteria depends on the units within the set. If the set would be expanded to more countries, resulting in a change of thresholds, then it is expected that other countries are considered more similar.

The similarity table results in four cases reaching the 'similar' threshold, namely the Netherlands, Sweden, Canada and Germany (in order of similarity to Belgium). A case is considered similar when it reaches a similarity score of 6. Below (Table 2), we listed the assessment for the cases with an outcome reaching the similarity threshold, coded per criteria to the similarity to Belgium.

Country	A1	R1	A2	A3	R2	R3	R4	D1	A4	R5	Ssc.
Canada	0	1	0	1	1	1	1	1	0	1	7
Germany	0	1	0	0	1	1	1	1	0	1	6
Sweden	1	1	1	1	0	1	1	1	1	0	8
Netherlands	1	1	1	1	1	1	1	1	1	1	10

Absolute criteria:
A1: <Defence active forces size>; A2: <All Defence forces size>; A3: <DTIB employees>; A4: <DTIB turnover>
Relative criteria:
R1: <Defence active forces as a % of total labor force>; R2: <DTIB employees as a % of labor force>; R3: <Defence expenditure as a % of GDP>; R4: <Defence expenditure as a % of government expenditure>; R5: <DTIB turnover as a % of GDP>
Descriptive criteria:
D*1:<DTIB: private / state-owned / Mixed and Mostly Private / Mixed and Leaning State-Owned>*

1 = Similar; 0 = not similar; Ssc. = Similariry score

Table 2: Similar cases to Belgium in the similarity assessment table. Source: Own composition based on the similarity assessment.

The selection of the non-country case studies (SIPRI and ASD) also stems from Hartley and Belin (2020)[25], which is again used as a starting point for further desk research and content analysis.

Last, to the best of our knowledge, we select all prior Belgian mapping studies of the past 5 years. Notably, while other studies focus on Belgian Defence spending and industrial policy, there have until recently been no concerted efforts to map or discuss inclusion criteria for the wider BE-DTIB. We exclude analyses of the Belgian defence-related business associations. These are, where needed, referred to in the analyses of the selected Belgian mapping studies.

Similar Countries	Prior BE mapping studies	Non-country cases
• Canada[26] • Germany[27]	• Groupe de recherche et d'information sur la paix et la sécurité – GRIP[30]	• Stockholm International Peace Research Institute – SIPRI[34]

[25] Hartley (2020, pp. 161-179)
[26] Statistics Canada (2018); ISED (2018); ISED (2020); ISED (2022)
[27] Ostwald and Legler (2015)
[30] GRIP (2022)
[34] SIPRI (n.d.); Béraud-Sudreau et al. (2022); SIPRI (2023)

• Sweden[28] • The Netherlands[29]	• Vlaams VredesInstituut[31] • De Beurme, Q.[32] • ACOS Strat-NAD[33]	• Aerospace, Security and Defence Industries association of Europe – ASD[35]

Table 3: Cases analyzed per category. Source: Own composition based on researched case studies.

Analysis of cases & theory building

We employ 10 guiding questions (see Table 4) to guide the descriptive write-up and to guarantee consistency in the analysis of the different case studies. The findings are reported in cross-case summary tables to facilitate comparison and to identify commonalities and differences. Subsequentially these tables are employed to derive generalizations and develop theories.[36]
The descriptive write-up of the case studies can be found in section 1 of the online attached annex.

GQ1	*What inclusion and exclusion criteria do the different studies employ to categorize an entity as being part of the (domestic) DTIB*?*
GQ2	*Are foreign owned or foreign controlled entities** included in the mapping?*
GQ3	*What methodology did the cases employ to derive the list of entities**.*
GQ4	*What term* did the analyzed case employ for the mapping (DTIB, Defence Industry, Defence and Security Sector, etc.)?*
GQ5	*Are research entities** included in the mapping criteria?*
GQ6	*What is the size of the mapping (amount of entities**)?*
GQ7	*What term* did they employ to refer to the entities included in the mapping (company, enterprise, undertaking, entities, etc.)?*
GQ8	*What is the indicated EUR in sales (or revenue or turnover) of the mapping? Are figures given referring explicitly to 'defence and security-related' sales? If not, can these be derived from the delimitations and supported assumptions?*
GQ9	*What is the indicated amount of employment of the mapping? Are figures given referring explicitly to 'defence and security-related' employment?*
GQ10	*What generalizations do we find when comparing the cases? Are the definitions, inclusion criteria and data-sources employed standardized enough for comparability?*

[28] Statens Offentliga Utredningar (2022)
[29] Schotel et al. (2022)
[31] Cops and Viaene (2022)
[32] De Beurme (2021)
[33] ACOS Strat-NAD (2022)
[35] ASD (2021); ASD (2022)
[36] Chmiliar (2009, pp.583-584)

**DTIB or other term employed for the mapping as assessed in GQ4.*
***entities or other term employed to refer to the entities in the mapping as discussed in GQ7.*

Table 4: Guiding questions for the case study analyses. Source: Own composition based on Chmiliar (2009).

RESULTS

Key takeaways of the case study analyses

This section summarizes the key findings of the case studies organized by research question. Table 4 summarizes key points from these case studies. As we noted above, only limited generalizability can be derived from these cases. Appendix A1 summarizes the stated or derived definition from the case studies, according to the term they employed (e.g. Defence Industry, DTIB, Defence Market, Armaments sector). For the detailed case study descriptions and analyses, we refer to the online annex to this paper.[37] The discussion section further elaborates on insights derived from these cases relevant for the development of the BE-DTIB delimitations.

We observed the following similarities:
First, research institutions are overall included within the delimitations of the case studies **(GQ 5)**. Only one case excludes RTOs. Two other cases do not include RTOs in their actual list, but the mapping criteria allow their inclusion if they fit the other delimitation criteria.
Second, foreign controlled entities are not excluded within the delimitations of any of the analyzed case studies **(GQ2)**. These observed generalizations are adopted in our delimitations, which we outline in the Discussion section.

However, for the remaining factors generalizability is absent:
First, there is no commonality on the term employed for the mapping **(GQ4).** The cases refer to the defence industry (3), the defence and security industry (2), defence market (1), Defence Technological and Industrial base (1), etc. The cases with corresponding terms have no alignment in their delimitations.

Moreover, the cases utilize different terms to refer to the included entities (company, enterprise, undertaking) **(GQ7)**. However, in fact these refer to any separate legal entity, which are registered within the country, matching the delimitations. Therefore, while the terms differ and carry legal distinctions in reality, they refer to the same in the case studies. Hence, any entities registered within the country (i.e. established under its domestic law) fitting the (product or customer) delimitation criteria can be considered for the mapping. The only case that differs is the FPI case study, where the term company also refers to an establishment unit, rather than to a separate legal entity.

[37] See: Annex.

Additionally, the inclusion criteria or delimitations employed are widely different **(GQ1)**. There is insufficient alignment between the product-delimitations and some cases focus only on the demand-side while not clearly delimiting the products (see: Appendix A1). For instance, The Netherlands case study has clear delimitations only for the customer-side. It equates 'defence-materials' with goods and services supplied to the Armed services and 'security-products' with those supplied to the (Public) Security services, without clearly delimiting these terms from the product perspective. Conversely, SIPRI does delimit both the customer- and product-side, but remains narrow in scope for both. ASD, on the other hand, has wider supply-side delimitations for defence products by explicitly including sub-suppliers within the OEM to tier 3 structure, but does not include security products. The Swedish case has the clearest framework for delimiting the product-side, namely by employing the common military list as found in the EU transfer directive and the dual use items in the EU Dual-Use regulation. However, it does not delimit the customer-side.

Last, there is currently no readily available data from which information can be derived, also not for aggregate figures. Hence, entities are identified based on top-down lists received from the country's Defence authorities or Defence industry association(s), are sourced through bottom-up desk research, or through a combination of both **(GQ3)**.[38] Concerning this, interesting insights can especially be derived from data and reporting issues and different sourcing methods discussed in the Belgian case studies.

GRIP indicates the difficulties in delimiting the sector as no delimitations can be derived from the NACE-BEL[39] classification of economic activities, nor from any other national statistics. The NACE classification system only has limited codes for defence-related activities. There are also no means to differentiate between defence and civil market economic activities concerning dual-use products. Lastly, the NACE-BEL codes are allocated to the main (and in some cases) secondary economic activity of the legal entity. Therefore, entities with only limited defence-related activities cannot be identified via the NACE codes.

The Flemish Peace Institute (FPI) discusses the limitations of using export licensing data of defence-related goods. To begin, not all defence-related products necessitate approval for export or transfer licensing. Additionally, there are companies that are directly engaged in projects with Belgian

[38] In the top-down approach, the inclusion of entities is derived from the procurement list of the armed forces and/or industry organizations. Conversely, the bottom-up approach involves utilizing data such as national statistics, surveys, or qualitative inclusion criteria derived with bottom-up sourcing, which includes desk research involving the analysis of websites and newspaper articles to determine the inclusion of an entity within the delimitations. A methodology is deemed overall bottom-up when it incorporates certain top-down sources, such as a procurement list received from the armed forces, along with multiple qualitative inclusion criteria that necessitate bottom-up sourcing.

[39] NACE-BEL, the Belgian adaptation of the statistical nomenclature known as NACE Rev. 2 used across the European Union for categorizing economic activities, serves as the foundational framework for producing and sharing statistics related to economic activities within Belgium.

Defence, either through participation in acquisition programs for new military equipment or through material maintenance. These companies may be disregarded if company identification is based on export and transfer license data, since these activities are not subject to export or transfer licence approval. Finally, SMEs and research institutions involved in consortia focusing on targeted R&D of defence capabilities will only apply for export permits when these projects are in the final stages. Therefore, the FPI study intentionally tries to include all entities located in Flanders that supply Belgian Defence or other Belgian defence companies with defence-related products as outlined in the Belgian export licensing regime, which is based on the EU Transfer Directive. Furthermore, while the figures of exports and intra-EU transfers of military and dual-use goods are published monthly by the regional governments, the entities involved are not mentioned. As access to the data per entity is restricted, researchers cannot use the reports to identify entities.

De Beurme (2021) instead identifies entities via the list of companies the Belgian military procures from. This approach is also not without limitations. Firstly, sub-contractors are not taken into account, as it only identifies companies directly delivering to the Belgian military. Secondly, all procurement types to the Belgian military are initially included, after which companies not deemed as having potential for defence-related cooperation partnerships are excluded. Nevertheless, companies remain in the list that are not normally considered defence-related.[40]

Due to these abovementioned limitations, the ACOS Strat-ICM-NAD[41] analysis instead relies only on qualitative inclusion criteria to build its mapping. That is, they outline multiple sources from which to include entities for the mapping, while not specifically delimiting the product or customer side.

From the above it is clear the definitions, inclusion criteria and data-sources employed are by no means aligned enough for comparability **(GQ10)**.

Hence, we note that the values of the cases for the number of entities **(GQ6)**, defence-relevant turnover **(GQ8)** and defence-relevant employment **(GQ9**), are not optimal for direct comparisons. Aside from deriving broad differences and accounting for the various delimitations and sourcing scopes, comparative insights are limited. As there is no generalizability for the terms, delimitations and sources, we employ insights from the case studies and employ these to develop a broad definition for the BE-DTIB.[42]

[40] E.g. Sodexo, which provides non-mission food and cleaning services to Belgian Defence, are included in the final mapping. See: De Beurme (2021, p212).

[41] ACOS Strat-ICM-NAD refers to the National Armaments Director team, which is part of the Integrated Capability Management subdivision of the Assistant Chief of Staff Strategy. The Assistant Chief of Staff Strategy is in charge of executing and researching the strategic plans of Belgian Defence and directly reports to the Vice-Chief of Defence.

[42] We describe and analyze the cases in more depth in the online annex attached separately to this paper.

Case-study	*GQ1 (delimit)*	*GQ2 (FO)*	*GQ3 (meth)*	*GQ4 (mapping term)*	*GQ5 (RTO)*	*GQ6 (#)*	*GQ7 (entity term)*	*GQ8 (€)*	*GQ9 (emp.)*	*GQ10 (comparability)*
Canada	PD	Y	TD & BU	'Canadian Defence Industry'	Y	664	Enterprise	6.6 B	27k	Limited (only commonalities for GQ2 and GQ5)
Germany	PD & CD	Y	BU	'German Defence and Security Industry'	Y	n.a.	Undertaking	23.2 B	135k	
Sweden	PD	Y	TD	'Swedish Defence Market'	Y*	2780	Company	9.6 B	29.7	
The Netherlands	CD & HD	Y	TD	'NL Defence and Security-related Technological and Industrial Base'	Y	932	Undertaking	4.7 B	20k	
GRIP	PD & Qic	Y	BU	'Belgian Armaments sector'	N	89	Companies	1.8 B	4.8k	
FPI	PD & Qic	Y	BU	'Flemish Defence-related industry'	Y**	33	Company (really: entity)	442 M	1k	
De Beurme, Q.	CD	Y	TD	'Belgian Defence Industry'	Y	829	Company	184 B (all ec.activities)	219k (all ec.activities)	
ACOS STRAT-NAD	Qic & HD	Y	BU	'Belgian Defence and Security Industry'	Y	638	Enterprise	750 M – 2.25 B	3 – 9k	
SIPRI	PD & CD	Y	BU	'Arms sales market'	Y**	100	Company	500.76 B	n.a.	
ASD	(PD & CD) & HD	Y	TD	'European Defence sector' & 'European Defence Technological and Industrial Base'	Y	3000	Company	118.3 B	467k	

*Not specified, but the delimitations allow it.
**Mapping criteria allow inclusion, but no RTOs included in actual list.
Abbreviations:
PD = Product-delimited; CD = Customer-delimited; Qic = Delimited with Qualitative inclusion criteria; HD = Hierarchical delimitations (OEM to Tier 3); FO = includes Foreign Owned entities; TD = Top-down methodology; BU = Bottom-up methodology; RTOs = mapping criteria allows for inclusion of Research entities; Y = Yes; N = No; () = Yes, but not detailed.

Table 5: Case studies – Summary of commonalities and differences. Source: Own Composition based on the analyses of the case studies.

DISCUSSION: BE-DTIB delimitations

Included entities and applicable term (RQ1)

As noted above, some of the case studies enable the inclusion of research entities in their mapping. However, the majority of cases include these under the term 'companies' or 'enterprises'; terms that would suggest excluding not-for profit research entities. Two cases refer to undertakings, which is more inclusive for such entities. An undertaking is defined by the EU Courts as *"any entity engaged in an economic activity, regardless of its legal status and the way in which it is financed".*[43] An 'economic activity', in turn, is defined as *"any activity consisting in offering goods or services on the market".*[44] In other words, any entity qualifies as an undertaking as soon as it carries out economic activities. It is thus clear that research and technology organizations (RTOs), universities, and associations qualify as being an undertaking when they engage in an 'economic activity'. However, we do not opt to choose the term undertaking for the mapping. First, the cases do not employ this term as understood by State aid rules. Second, even if this was the case there remains an issue on the cut-off threshold on what is considered an undertaking; while universities rarely have no economic activities, they are not considered undertakings by the EU Commission when their economic activities constitute less than 20% within their total activities.[45] Furthermore, many entities may not currently have economic activities, but carry such potential in the future. We think of recently established entities part of newly formed consortia for EDF-projects.[46] Moreover, as noted in the analysis section above, we ascertain that while the cases employ different terms, they simply refer to any entity registered as a separate legal entity within the country fitting the other delimitations. Hence, we employ the more encompassing term 'entity', more specifically 'a registered legal entity established under the country's law'.[47]

[43] Enirisorse SpA v Sotocarbo SpA (2006, §28); Congregación de Escuelas Pías Provincia Betania v Ayuntamiento de Getafe (2017, §41)

[44] Commission v Italy (1987, § 7); Commission v Italy (1998, § 36)

[45] See: European Commission Communication 2022/414; The primary activities of educational and research organizations, such as public-supported education, R&D for general understanding, and research where the results are publicly or broadly disseminated, are considered non-economic activities. See: Commission Framework for State aid for R&D&I, paragraph 20.

[46] The same could be argued for defence-related or dual-use university projects that have potential to monetize their research findings through setting up a spin-off. However, we only include these within the BE-DTIB mapping as an entity once they have established such a separate legal entity. A mapping of ongoing projects with potential for the DTIB is certainly relevant, but constitutes a subcomponent of the mapping of the relevant separate legal entities that are part of the DTIB.

[47] This term is also employed by the Belgian Crossroad Bank of Enterprises to refer to separate legal entities in their database. See: Article III.16 of the Belgian Code of Economic Law

Criteria under which the entity is considered Belgian (RQ2)

As discussed in the sections above, foreign controlled entities are generally included within the delimitations. Drawing from the generalizability concerning the delimitation seen in the case studies above, the term 'Belgian' will refer to ***any entity registered in Belgium (in the Belgian Crossroads Bank for Enterprises - CBE), that was established under Belgian law and that is considered a separate legal entity.*** Hence, there is no exclusion of Belgian-based entities that are under 'foreign control' for the mapping of the BE-DTIB. While an entity can hence be included in the BE-DTIB mapping as 'Belgian', it may nonetheless not fulfil the criteria to receive funding support due to foreign control of the entity.

In line with the Flemish Peace Institute study (only includes entities with economic activities taking place in the Flemish region[48]), we only consider those entities that have economic activities occurring on Belgium soil. 'Activities' indicates that this should not be a one-time act, but a sustained activity on the market, and through which competition with other entities arises. Hence, legal entities with no consistent economic activities in Belgium are not considered within the delimitations of the term 'Belgian'. This is similar to SIPRI which does not include holding companies in its mapping, as these have no relevant economic activities.[49]

As the entity needs to be established under Belgian law and has to be a separate legal entity, only those entities in the CBE with a 'Belgian business registration number' are considered.[50] Hence, entities with 'establishment unit' or 'branch office' numbers are not considered.[51] This also means entities registered in the CBE (due to having either a "hollow" representative office, establishment unit or branch office in Belgium), but which are established under foreign laws ('foreign entities') are not considered, as these are not considered separate legal entities. But subsidiaries located in Belgium (which are a separate legal entity established under Belgian law) are included in the BE-DTIB delimitations.

[48] The Flemish region is one of the three regions of Belgium. The other regions are the Brussels-Capital Region and Walloon region.
[49] Béraud-Sudreau L. et al (2020, p. 2)
[50] The Belgian business registration number, also refered to as a 'company, enterprise or undertaking registration number' is a unique identification number existing out of 10 digits of which the first number is either a 0 or 1. See: FPS Economy (2023)
[51] The 'establishment unit' or 'branch office' numbers consist out of 10 digits of which the first number ranges between 2 to 8. See: Ibid.

Product & customer delimitations (RQ3)

Limitations of 'defence-related products' for the delimitations of the BE-DTIB

'Defence-related products' under EU-law refers to the products listed in the Annex of the EU Transfer Directive,[52] which corresponds to those included in the Common Military List of the EU (see: Appendix A2). The directive employs the term 'undertakings' to refer to entities offering the delimited goods and services. When an undertaking complies with the general outlined, it can be listed as a 'certified defence undertaking'.[53] Non-certified undertakings offering the goods and services listed within the annex of the Transfer Directive can therefore be described as (non-certified) 'defence undertakings'.

However, only relying on the 'defence-related product' list in the Transfer Directive as the delimitation for the mapping would provide rather limited insights on the wider DTIB, given that it excludes dual-use products and other products important for Defence that are not directly considered defence-related. For instance, entities focusing on Cyber are also vital to include in a DTIB mapping, as these are key for the required capabilities of Defence. Cyber products are to some extent included under the category 'software' (ML21) in the EU Common Military List. However, entities with security-focused cyber solutions (e.g. defensive capabilities such as 'cyber surveillance items'[54]) would in many cases be overlooked by relying only on 'defence-related product' delimitations.

Given the above, similar to the case study for the Netherlands, we consider both 'defence-use products' and 'security-use products', as well as outline the customer delimitations. For the 'defence-use products', we mainly draw on delimitations derived from the EU Transfer Directive and the EU Dual-use regulation.[55] Based on SIPRI delimitations, we further expand this category with a 'catch-all' basket for products that are not included in either the Transfer Directive or in the EU Dual-Use regulation. While security products are included in several case studies, there are no clear frameworks outlined in the case studies for the product delimitations of security products. Hence, we employ existing EU taxonomy that delimitates the product side of the (public) security market.

[52] Art 3 in the "Transfer Directive" - Directive 2009/43/EC
[53] Art 9 in the "Transfer Directive".
[54] 'Cyber-surveillance items' refers to *"dual-use items specially designed to enable the covert surveillance of natural persons by monitoring, extracting, collecting or analyzing data from information and telecommunication systems"*. These are included in the EU 'Dual-Use' Regulation (2021/821).
[55] The Swedish case study, discussed in more detail in the separate annex available online, also employs these framework for their product-side delimitations.

Supply side delimitation

We define ‘defence-use products’ as:

i. goods and services that have a defence-specific nature, i.e. ‘defence-related products’ and;
ii. other goods and technologies that are not primarily military focused, but which can be employed for military purposes, i.e. ‘Dual-use products for military purposes’.

The list and categorization of these ‘defence-related products’ and ‘dual-use products’ are respectively based on the Common Military List of the EU found in the Annex of the EU Transfers Directive (Directive 2009/43/EC) and on the EU Dual-Use regulation (2021/821) (respectively see: Appendix A2 and A4).

However, gaps remain in these product categories, namely for goods and services that can be considered ‘defence-use products’, but are not captured by the above. To illustrate, military uniforms and clothing of a non-protective nature are not specially included in the corresponding product lists of the frameworks above. Non-protective military operational clothing, we argue, should also be seen as part of the defence-use products. For instance, the development of new camouflage patterns is clearly targeted mainly for defence-use and while sales do occur to the civil market, this is not the key target market for these products. Hence we opt to assign a “catch-all” category for ‘defence-specific products’ (see: A3), which are not included in either the Common military list or in the EU Dual-Use list. The majority of these listed goods and services are also included under the product delimitations employed by SIPRI for ‘arm sales’.

We define ‘security-use products’ as:

i. goods and services that have a security-specific nature, i.e. ‘security products’ as listed in the EU civil security taxonomy (see: Appendix A5)[56] and;
ii. other goods and technologies that are not necessarily developed for public security use, but can be employed toward such purposes, i.e. ‘Dual-use products employed for security purposes’ (see: Appendix A4).

[56] European Commission DG Home (2022a); Ibid (2022b)

Demand-side delimitation

The BE-DTIB customers consist of:

i. foreign and Belgian 'Defence actors' (Ministry of Defence, National Armaments Directorate, Military intelligence, any of the other components or parts of the armed forces that can procure goods or services) and;
ii. any 'other entities that are active in the DTIB-related value chain'.

The first aspect of the customer delimitations matches the customer delimitations employed by SIPRI. However, only looking at this excludes sub-suppliers. Hence, the second part of the customer delimitations includes sub-suppliers to the entities delivering these products to Defence actors. We base this expansion on the hierarchical model employed by ASD, which includes Prime contractors, Tier 1, Tier 2 and Tier 3 suppliers.[57]

In line with the definition employed in the case study of the Netherlands[58], we included defence and security products (see: *supra*), but employed these towards the product delimitations rather than towards the customer delimitations. Differently from the NL case study, we do not include 'Public Security actors' (non-military intelligence services, police, and other public security organizations such as EUROPOL or INTERPOL), under the term DTIB. While the Netherlands case study employs the abbreviated term NL-DTIB, they in fact explicitly refer to the 'Defence- and (Public) Security-related Technological and Industrial Base.'

Definition of the BE-DTIB

As we outlined above, 'defence-use products' and 'security-use' products are included within the supply-side delimitations. However, what about common products necessary for security of supply or critical materials? Should these be not included under the D(T)IB concept? The original concept of the DIB, employed in the original US Defence Production Act defined it as "*domestic sources which are providing, or which would be reasonably expected to provide, materials or services to meet national defense requirements during peacetime, national emergency, or war"* [59]; with *domestic sources* being considered businesses that have activities at, or source components and parts from

[57] See: Cauzic et al. (2009, p. 21); Briani et al. (2013, p. 15) for the source that ASD employs for this model.
[58] *Any Dutch undertaking (companies, these companies their subcontractors/suppliers, any knowledge institutions and provider of services) that is active in terms of design, development, production or maintenance of 'defence materials' (for the Marines, Land component or aerospace) or 'security products', including cyber (targeting the societal security market - e.g. for EUROPOL, the intelligence services, police, military police and other public security organizations) is considered part of the NL DTIB.*
[59] FEMA (2018, p. 19)

within the US or Canada.[60] This broad understanding persists in the US until today, with the only adjustment being that the term now more commonly only refers to US-based sources.[61] Within this understanding of the concept, the goods and services provided by the domestic DIB range from complex weapons systems to general commercial products such as laptop computers.[62] Similarly, Dunne's hierarchical typology employs a broad understanding. It splits the D(T)IB into three groups: any activities related to lethal equipment and weapons systems (1); strategic yet non-lethal products such as fuel (2); and other common products such as food (3).[63] The reason for this broad scope is to not omit products that are essential to military manoeuvrability, but which may not be considered defence-related. As Dunne notes: *"weapons systems could not operate without the strategic products, fuel and transport, and soldiers could not survive without food"*.[64] The issue is then not so much conceptual, as the supply-side can include all goods and services, but how to delimit the inclusion from a practical perspective. Towards this end, Dunne adds another component to consider to what extent a company can claim to be part of the D(T)IB. Companies that are either highly dependent on defence budgets or have a high impact on servicing defence requirements have a stronger claim to be considered part of the D(T)IB.[65] Hence, the definition seems to be flexible and practical enough to exclude any companies that have a low importance in servicing defence requirements and those that have a low dependence on defence budgets. Given this understanding, the DTIB represents all legal entities that provide the needed goods, services and technologies, required for the continuity of the armed forces their activities. The customer-side of the DTIB considers direct supplies to the armed forces or indirectly by providing goods, services or technologies required by entities in in the value chain to develop such products. The DTIB thus includes 'defence-use products' and 'security-use products' (including 'dual-use products'), as well as other non-specific products *required* by the armed forces or the DTIB value chain. While what is considered required for non-specific products will always carry an aspect of subjectivity, this can be delimited to significant or continuous supply to the armed forces or within the DTIB value chain (e.g. Security of supply of critical materials and base components, but also general services with personnel handling sensitive info). After all, not all goods and services are equally critical. Non-strategic goods and services, which are not directly tied to security of supply to defence or the value-chain, can be more easily interchanged. Hence, legal

[60] FEMA (2018, p. 19) ; Neenan and Nicastro (2023, pp. 4-5)
[61] Nicastro (2023, p.1)
[62] Nicastro (2023, p.1)
[63] Dunne (1995)
[64] Dunne (1995, p402)
[65] Dunne (1995, p402)

entities offering non-strategic goods and services should be excluded from any DTIB mapping to not dilute the effectiveness of operationalizing the concept.[66]

Drawing on a literal translation of the term 'base'[67], some may postulate that the term DTIB also contains certain entities not (yet) active in 'defence-use products' or 'security-use products', if they do or could provide the technological and industrial underpinning (knowledge, skilled workforce, related technological building blocks) that these can be developed from.[68] For instance, a strong civil aeronautics sector provides a 'base' from which a military aeronautics sector can be expanded or developed through 'spin-ins'. In other words, the research outcomes or existing knowledge from the civil sector can be employed with some adjustments for the development of 'defence-use products'. In times of heightened geopolitical crisis or actual war, this civil sector could also be drawn upon to produce goods required by 'Defence actors'. The closer the military and civil sides are integrated, the less retraining of the workforce and changes in their facilities are necessary.

To avoid dilution of the definition, we define the DTIB as comprising entities engaged in economic activities within the outlined product-delimitations and supply these to the delimited customers. Hence, legal entities with industrial assets that may carry potential for the DTIB, but which only supply to the civil market, are not included. Hence, we distinguish here between the actual and the potential DTIB. While the actual BE-DTIB only consists of domestic sources that provide goods, services and technologies required by armed forces to fulfil their responsibilities, either through direct supply or by being part of the value chain; *the potential BE-DTIB also includes domestic sources that have the potential to do so, i.e. they have the technological innovation capabilities and/or industrial capacity to contribute, but do not do so at the moment or which currently do provide goods, services and technologies but have the potential to increase their impact.* 'Potential', however, is context dependent. In stable threat environments it can be limited to maximizing dual-use R&D spill-overs and spin-ins, while in (prospective) wartime the potential concerns the wider industrial base that could be called upon to produce a wide range of required materiel (e.g. commercial truck makers shifting to producing armoured vehicles or commercial clothing manufacturers producing textiles for the armed forces) and the technological base (universities, RTOs, innovative companies) to churn out innovations for the war effort.

[66] This exclusion does not apply, however, to services that explicitly target defence actors and the DTIB value chain. For instance, consultancy companies that provide explicit and substantial services to defence actors and within the DTIB value chain are useful to include in any operationalization of the concept. While these can be argued to be 'non-critical', they often act as an important lever with companies in value chains often growing dependent on their built up expertise in a particular subject matter.

[67] Oxford dictionary: Base - *"a conceptual structure or entity on which something draws or depends"*

[68] See: COM (2021)

From all the above, we understand the BE-DTIB generally as: *domestic sources that provide goods, services and technologies required by armed forces to fulfil their responsibilities, either directly or by being part of the value chain.*

More specifically, the definition of the BE-DTIB for the mapping refers to:

Any entity,

i. registered in Belgium in the Crossroad Bank of Enterprises (CBE);
    a. that was established under Belgian law and;
    b. that is considered a separate legal entity (regardless of its specific legal status and the way in which it is financed); [69]

ii. with economic activities[70] occurring on Belgian soil;

iii. which supplies 'defence-use products' or 'security-use products', including 'dual-use items and technologies' to any (i.e. foreign or domestic) 'Defence actors' or as inputs or components to 'other legal entities active in the DTIB value chain' OR;

iv. which *significantly or continuously* supplies 'any other products' directly to any 'Defence actors' or as significant inputs (e.g. critical materials), components or services to 'other entities active in the (global) DTIB value chain'.

is considered part of the BE-DTIB.[71]

[69] If the cumulative steps under point I are met, we refer to this as a 'Registered Belgian Entity'.

[70] 'Economic activities' refers to any activities related to the offering of goods and services on the market, such as design, development, production, maintenance, targeted research, any other services, including supplying or maintenance of necessary (sub)components. This also includes applying to NATO (e.g. DIANA), EU (e.g. EDF) or national funding support for defence-focussed research and development projects. After all, also in this case these are obtained through offering services on the market.

[71] We note that this perspective seems to correspond closely to the reasoning employed to define the delimitations for 'Military equipment' and 'Sensitive equipment, works and services' in the EU 'Defence and Security' directive (2009/81/EC): *Military equipment' means equipment specifically designed or adapted for military purposes and intended for use as an arm, munitions or war material; 'Sensitive equipment', 'sensitive works' and 'sensitive services' means equipment, works and services for security purposes, involving, requiring and/or containing classified information". The directive is applicable to the supply of military equipment, including any parts, components and/or subassemblies thereof (a); the supply of sensitive equipment, including any parts, components and/or subassemblies thereof (b); as well as to works, supplies and services directly related to the equipment referred to in points (a) and (b) for any and all elements of its life cycle (c); and works and services for specifically military purposes or sensitive works and sensitive services (d)."* See: Directive 2009/81/EC on defence and security procurement.

Conclusion

This research aims to define the BE-DTIB by outlining its delimitations and the criteria for an entity to be considered as part of it. From analyzing selected case studies, we find that any separate legal entity registered in the country can be considered, regardless of possible foreign-control, when fitting within the product and customer delimitations. However, concerning these delimitations there is no generalizability between the analyzed cases. As there is no clear consensus that can be derived, we outline delimitations based on insights from the case studies with broader inclusion criteria. Similar to the Netherlands case study, we consider both defence and security products for the supply-side, which we delimit using existing EU frameworks (see Appendix A2, A4, A5). Based on SIPRI product-delimitations we assign a "catch-all" category for 'defence-specific products' (see Appendix A3), which are not included in either of the EU frameworks. For the customer-side, we draw on the definition of SIPRI and expand this by including sub-suppliers within the OEM to tier 3 structure as outlined by ASD. We further expand this with broader conceptual insights regarding the DTIB.

Overall, there is limited generalizability to derive a clear common definition. The lack of a common definition and sourcing methodology for domestic DTIBs hampers comparability between countries. Due to this reason, the SIPRI 100 figures remain the most current tool to analyze general trends, even between countries. Of course, the SIPRI figures are limited in scope as they are meant to track the biggest players. They can therefore not be used for more detailed comparative analysis of countries' DTIBs. An optimal solution to improve comparability and insights on the EDTIB would be for the EDA (or DG Defis) to push for developing clear delimitations that can be employed as reporting standards for national authorities to collect standardized figures for their DTIB. Alternatively, more defence additions within the sectoral NACE codes would also facilitate aggregate analysis, as well as facilitate identifying entities within domestic DTIBs. As noted above, current frameworks (NACE, CPV, Export and transfer reporting) are insufficient to employ for mapping analyses.

Given the case study methodology and limited cases analyzed, future research can improve the external validity of the findings by broadening the scope through a more extensive structured review of the literature and of hands-on mapping analyses. Furthermore, it may be interesting to include in how concepts (defence industry, D(T)IB) have evolved over time due to changes in Defence requirements and responsibilities (e.g. the increased focus on dual-use products due to the changing battlefield or on security products for defensive cyber). Due to scope, we have not discussed

segmenting the DTIB into relevant subcategories or markets.[72] Follow-up research could also expand on proposing a standardized data collection and analysis method to increase generalizability between analysed cases.[73]

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[72] E.g. See: Kleczka et al. (2021), which analyzes the European armored vehicle industry from a competition policy perspective; For more info on defining markets according to competition policy, see: DG COMP (2021); OECD (2012); European Commission (1997).

[73] E.g. One option is to do so based on the structure-conduct-performance model employed in industrial policy analysis. See: Hartley (2018, pp. 32-33) for a discussion on this.

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APPENDIX

Case-study	***Term***	***Derived or stated definition***
Canada	'Canadian Defence Industry'	*Any enterprise established under Canadian law is considered part of the Canadian Defence Industry when it has any sales of defence goods and services within the 'defence categories' outlined in the CDAMIS.*
Germany	'German Defence and Security Industry'	*Any undertaking in Germany classified with its main economic activity (i.e. activity that represents the largest proportion of the value added of the enterprise) linked to the 'group of defence and security industry goods', and providing these to certain customers (Bundeswehr, security services, operators of critical infrastructure and sensitive systems or installations), is considered part of the German Defence and Security Industry.*
Sweden	'Swedish Defence Market'	*Any Swedish-based company that is active in the 'defence market', the market for 'defence products', namely the goods and services that are of a 'defence-specific nature' or 'goods and services that are subjected to specific requirements such as security of supply'.*
The Netherlands	'NL Defence and Security-related Technological and Industrial Base'	*Any 'Dutch undertaking' (i.e. companies, these companies their subcontracters/suppliers, any knowledge institutions and providers of services registered in the Netherlands) that is active in terms of design, development, production or maintenance of 'defence materials' (for the Marines, Land component or aerospace) or 'security products', including cyber (targeting the societal security market - e.g. for EUROPOL, the intelligence services, police, military police and other public security organizations) part of the NL DTIB.*
GRIP	'Belgian Armaments sector'	*Belgian companies whose activity is partly linked to the production of goods and services for military purposes, i.e. companies that have an activity of production of goods or services specifically related to the development, manufacture, deployment or maintenance of weapons systems.*
FPI	'Flemish Defence-related industry'	*Any entity with its economic activities taking place in the Flemish region concerning the development, manufacturing or customization, maintenance or export of products employed for military purposes, i.e. defence-related goods and technologies.*
De Beurme, Q.	'Belgian Defence Industry'	*Any company registered in Belgium supplying to Belgian Defence (based on the procurement office list from Belgian Defence), except for those with activities that are not considered to be conducive to potential cooperative partnerships with Belgian Defence concerning research, development or innovation practices which were excluded from consideration.*
ACOS STRAT-NAD	'Belgian Defence and Security Industry'	*Any enterprise registered in Belgium matching the outlined qualitative inclusion criteria.*
SIPRI	'Arms sales market'	*The market for 'military goods and services' to 'military customers'.* With 'military customers defined as: foreign and domestic components of the armed forces (army, navy, air force, paramilitary, special forces), the ministry of defence itself, as well as any agency responsible for military intelligence, reconnaissance and surveillance. With 'military goods and services' being defined as: those that have a specific military purpose in their design (i.e. only military-specific equipment and related components thereof are included under the term) 'Military goods' and only military-targeted services directly related to the armed forces their military operations are considered under the term 'military services'.
ASD	'European Defence sector' & 'European Defence Technological and Industrial Base'	*The European Defence sector is the combination of the following (sub)sectors: : military aeronautics, land, naval, and military space.*[74] Military aeronautics: *broad range of manned and unmanned aerial systems, from combat aircraft and drones to transport aircraft and helicopters, including tier 1-3 suppliers.* Land: *main battle tanks, armoured vehicles, artillery, guided ammo, integrated systems and components for the battlefield, protection of soldiers and infrastructures, including tier 1-3 suppliers* Naval: *full spectrum of vessels, including aircraft carriers and nuclear submarines, including tier 1-3 suppliers* Military Space: not emphasized (but equally OEM to tier 3)

A1: Overview of the Case studies: employed 'term' for the mapping and their 'definition'. Source: Own composition based on the analyses of the case studies.

[74] ASD (2020), Facts and Figures, p20.

ML List ('defence-related products')	
ML1 – Smooth-bore weapons with a caliber of less than 20 mm	ML12 – High-speed kinetic energy weapon
ML2 – Smooth-bore weapons with a caliber of at least 20 mm	ML13 – Armored or protective equipment
ML3 – Ammunition and tempering devices	ML14 – "Specialized equipment for military training" or for simulating military scenarios
ML4 – Bombs, torpedoes, rockets, missiles, other explosive devices and charges	ML15 – Imaging or countermeasure equipment
ML5 – Fire conduction, and related monitoring and warning equipment	ML16 – Wrought irons, castings and other unprocessed products specially designed for equipment
ML6 – Ground vehicles and component	ML17 – Other equipment
ML7 – Chemical agents	ML18 – Equipment and components for the 'production' of products
ML8 – Energetic materials	ML19 – Directed energy weapon systems (DEW systems)
ML9 – Warships (surface ships or underwater vehicles)	ML20 – Cryogenic and "superconducting" equipment
ML10 – "Aircraft"	ML21 – "Software"
ML11 – Electronic Equipment	ML22 – "Technology"

A2: Inventory of Munitions (ML list): There is a yearly update of products in these categories in the 'EU Common Military List'. Source: Common Military List of the European Union adopted by the Council on 26 February 2018.

'Defence-specific products' – "catch-all"
Military operational clothing of a "non-protective" nature
Military-targeted services directly related to the armed forces their military operations e.g. - use of external armed security services in conflict zones and during missions;* - facility management services;* - training services;* - intelligence services;* - logistics services* - Other consultancy and research services targeted at defence *(* the following are also expressly included by SIPRI under the product delimitations of 'arms sales')*

A3: Defence-specific products "catch-all basket". Source: Own composition based our analysis of gaps of goods and services to be considered 'defence-specific products', derived from the case study analyses and the needs of Belgian Defence for the BE-DTIB mapping.

Broad categories of the EU Dual-Use Regulation ('dual-use products')	
Category 0 - Nuclear materials, plant and equipment	Category 5 - Telecommunications and "information security"
Category 1 - Special materials and related equipment	Category 6 - Sensors and lasers
Category 2 - Material processing	Category 7 - Navigation and avionics

Category 3 - Electronics	Category 8 - Marine
Category 4 - Computers	Category 9 - Space and propulsion

A4: Categories of the Dual-Use Regulation (2021/821). Source: Regulation (EU) 2021/821 of the European Parliament and of the Council of 20 May 2021 setting up a Union regime for the control of exports, brokering, technical assistance, transit and transfer of dual-use items.

'Security products'	
Access control/authentication/authorisation	Integrated product security functions
Alarm/warning systems	Laboratory equipment for gathering and forensic analysis of samples
(Big) data analytics	Monitoring tools and services
Biometric systems	PPE/Safety equipment
CBRN detection and neutralisation products	Screening & detection
Communication	Search devices and tools
(Security-related) Consultancy services	Security applications
Digital security products and services (cyber)	Security & protection services by human personnel
Document inspection	Sensors/pre-sense detection devices
General equipment	Surveillance systems
Guarding and physical protection (non-human)	Tracking
Identification/Recognition	Training
	Weapons (light, "non-military")

A5: Security product categories according to the EU civil security taxonomy. Source: DG Home (2022b), EU civil security taxonomy and taxonomy explorer.