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Preliminary findings

The Belgian Economic Potential in the Industry of Defence and Security

BEPIDS Seminar paper: Descriptive Overview of the BE-DTIB

Researchers & project partners

Drs. Gregory Kegels (VUB researcher)
Dr. Grith Ølykke (RMA researcher)
Prof. dr. Caroline Buts (VUB project partner)
Prof. dr. Cind du Bois (RMA project partner)

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Royal Military Academy

ROYAL HIGHER INSTITUTE 150-year think tank for DEFENCE

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VUB VRIJE UNIVERSITEIT BRUSSEL

Contact details

Royal Military Academy

Hobbemastraat 8, 1000 Brussel

Prof. dr. Cind du Bois
cindy.dubois@mil.be

Dr. Grith Ølykke
grithskovgaard.olykke@mil.be

Vrije Universiteit Brussel

Pleinlaan 2, 1050 Brussel

Prof. dr. Caroline Buts
carobuts@vub.be

Drs. Gregory Kegels
gregory.kegels@vub.be

Author's Note:

As is apparent in the discussion of the limitations throughout the paper, the improvement of the data to analyze the BE-DTIB is a continuous process requiring regular updating. Analysis on available data, although incomplete, enables steps to fill-in data gaps and remains preferable to foregoing analysis due to fears of not providing the perfect picture. The current insights provided in this short paper already present a high-level overview of the composition, impact and geographical spread of the wider BE-DTIB. Further deep-dives of the data can outline the strengths and weaknesses of the BE-DTIB in more detail and identify some areas of excellence for research and development in line with the priority aims of Belgian Defence.

This BEPIDS[1] seminar paper was presented on the 13th of December 2023 during a 30-minute presentation at the Royal Military Academy, as part of the 'Belgian Defence Technological and Industrial Base day'. For more information see: link.

[1] *The **B**elgian **E**conomic **P**otential in the **I**ndustry of **D**efence and **S**ecurity project is being researched jointly by the Department of Applied Economics of the 'Vrije Universiteit Brussel' (VUB) and the Department of Economics Management and Leadership of the Belgian 'Royal Military Academy' (RMA). The project receives financial support from the 'Belgian Federal Public Planning Service Science Policy' (BELSPO) and the Belgian 'Royal Higher Institute for Defence' (RHID). The project timeframe spans from Oct 2022 – November 2024.*

I. Background

Necessity for BE-DTIB mapping

The Belgian Defence Industry and Research Strategy (DIRS) has the primary objective to serve as a crucial support mechanism for the Belgian Defence Technological and Industrial Base (BE-DTIB), ensuring the safeguarding of Belgian security interests. Its effectiveness will lie in robust contributions to NATO burden-sharing and active participation in bolstering EU strategic autonomy. Consequently, the key goal of the DIRS is to provide different means of support for entities within the BE-DTIB, enabling them to: effectively engage in multinational cooperation programs like the European Defence Fund (EDF), the Permanent Structured Cooperation (PESCO), and the upcoming Defence Innovation Accelerator of the North Atlantic (DIANA) (1); strengthen their knowledge base, expertise, and research and development capabilities (2); and enhance their capacity to contribute to the production, operationalization, and support of future defense capabilities (3).[2] However, a comprehensive understanding of the BE-DTIB is currently lacking, creating challenges for Belgian Defence and entities within the BE-DTIB. This knowledge gap impedes a clear understanding of others' engagements and hinders the efficient implementation of the DIRS.

Existing definition D(T)IB?

Considering the crucial role of a comprehensive understanding of the BE-DTIB in operationalizing the DIRS, a supporting objective for the DIRS is to map the entities constituting the BE-DTIB. This endeavor prompts an exploration of the term 'DTIB' and its precise meaning, as defining the scope of the term is a prerequisite for mapping the entities within the BE-DTIB. Scholars such as Dunne (1995) [3], Masson et al. (2013)[4], and Rafnsson (2015)[5] highlight the absence of a fixed definition for the concept of the 'national/domestic Defence Industrial Base,' now commonly referred to as the Defence Technological and Industrial Base (DTIB), along with its boundaries. Consequently, the term is interpreted diversely in theoretical studies and empirical analyses.[6] Some studies directly link it to the idea of the 'national or domestic defense industry'[7], while others incorporate foreign suppliers.[8] In practice, the definition of the DTIB used in a study is contingent on the study's objectives and data availability. [9]

While there are variations in defining the boundaries of the DTIB concept, there is a clear and prevailing understanding that the DTIB extends beyond the confines of the 'defence industry'. Various DTIB definitions explicitly incorporate subcontractors and encompass a broader range of products, including those not strictly classified as defense-related or defense-specific.[10] Therefore, in this paper, we opt for the term BE-DTIB instead of the narrower designation of the 'Belgian Defence industry or sector'.

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[2] RHID (2022, p. 3)
[3] Dunne (1995, p. 401)
[4] Masson et al. (2013, p. 1)
[5] Rafnsson (2015, p. 31)
[6] See: Dunne (1995), p. 401.
[7] 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).
[8] Dunne (1995, p. 404)
[9] Dunne (1995), p. 406)
[10] E.g. see: Dunne (1995, pp. 402-404)

II. Concepts: BE-DTIB definition

BE-DTIB definition

We employed a multiple case study approach across countries and institutions to derive common generalizations on the definition and mapping inclusion criteria.[11] Once the inclusion criteria for the mapping were outlined, we developed a definition best fitting the BE-DTIB. This led us to the following definition:

Any entity[12]

- registered in Belgium (CBE) that was established under Belgian law and that is considered a separate legal entity (regardless of its specific legal status and the way in which it is financed);[13]
- with any economic activities[14] occurring on Belgian soil related to 'Defence-use products' and/or 'Security-use products' and;
- which supplies these products to any (i.e. foreign and domestic) 'defence actors' and 'other entities active in the defence market';

is considered part of the BE-DTIB.

To be considered in the mapping, an entity must be established under Belgian law and recognized as a distinct legal entity, with only those entities possessing a 'Belgian legal entity number' in the CBE being considered.[15] Consequently, entities with 'establishment unit' or 'branch office' numbers are disregarded.[16] This also implies that entities registered in the CBE, having a "hollow" representative office, establishment unit, or branch office in Belgium, and established under foreign laws ('foreign entities') are excluded, as they are not considered separate legal entities. However, subsidiaries located in Belgium, operating as distinct legal entities under Belgian law, are encompassed in the BE-DTIB delineations. Given the above criteria, Belgian-based entities under 'foreign control' are not excluded from the BE-DTIB mapping.[17] However, while an entity may be included in the BE-DTIB

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[11] See: Kegels G., De Cock W., Buts C., Du Bois C. (2023) Multiple case study analyses to Define the Belgian Defence Technological and Industrial Base. BEPIDS project. [Preliminary BEPIDS report]. Available at: https://www.geoeconomicsgroup.be/bepids

[12] Why not use the term 'undertaking'? If an entity's economic activities constitutes less than 20% within their total activities, then the EU commission does not consider these as undertakings (See: European Commission Communication 2022/414). Hence, universities and other entities would be excluded from the mapping when employing this term. We employ the more applicable 'Registered Entity', which is in line with the term used by the Belgian Crossroad Bank of Enterprises (See: Article III.16 of the Belgian Code of Economic Law).

[13] = Registered Belgian Entity

[14] = design, development, production, maintenance, targeted research, any other services, including supplying or maintenance of necessary (sub)components. We also consider as an economic activity any research of Higher Education Institutions that are not yet commodified, but hold such intent.

[15] The Belgian legal entity 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)

[16] The 'establishment unit' or 'branch office' numbers consist out of 10 digits of which the first number ranges between 2 to 8. See: Ibid.

[17] Foreign-control' refers here to refers to undertakings where, either alone or jointly with other foreign undertaking(s)/person(s), the (group of) foreign undertaking(s)/person(s) can exert - directly or indirectly, *de facto* or *de jure* - "decisive influence" on the (activity of the) Belgian-based undertaking, i.e. to determine the strategic commercial behavior and decisions of the undertaking such as its budget, business planning, (dis)investment decisions and its management appointment. See: *art. 3(2) of the EU Merger Regulation*

mapping as 'Belgian,' it might not meet the criteria for funding support due to foreign control. This discussion, however, is outside of the scope of this paper.

BE-DTIB Delimitation matrix (see: Figure 1 and Appendix for more)

Concerning the supply-side delimitations of the BE-DTIB:

Defence-use products consist out of three buckets:

- 'Defence-related products' as outlined in the "Common Military List of the EU".
- 'Dual-use products' as outlined in the EU "Dual-Use Regulation", when used for military purposes.
- As there are gaps remaining in these product categories, we opt to assign a catch-all category for products that are not included in these frameworks, but can be considered defence-specific (e.g. external armed security services during operations and other services directly related to military operations). This category is based on products included by others in their mapping analyses (e.g. SIPRI, ASD).[18]

Security-use products refers to:

- Goods and services in the EU civil security taxonomy (e.g. includes defensive cyber).
- 'Dual-use products' as outlined in the EU "Dual-Use Regulation", when used for security purposes.

For the demand-side delimitations we consider the offering of goods and services to

- Defence actors (foreign and Belgian) and;
- Any other entities active in the defence market

139/2004 ; Andres Vaquero, (2019). 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*".

[18] For more info, see: Kegels G., De Cock W., Buts C., Du Bois C. (2023) Multiple case study analyses to Define the Belgian Defence Technological and Industrial Base. BEPIDS project. [Preliminary BEPIDS report]. Available at: https://www.geoeconomicsgroup.be/bepids

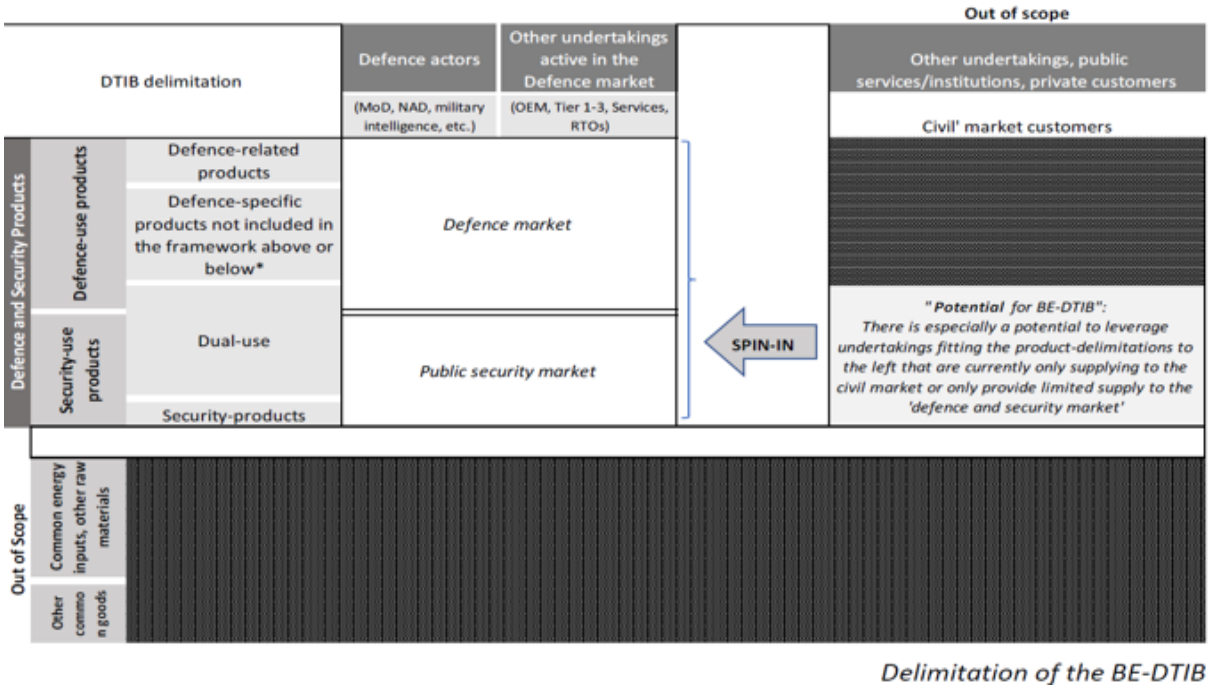

Figure 1. DTIB delimitation matrix.
Source: Own composition based on our definition for the BE-DTIB.

III. Sources for initial mapping of entities

The mapping of the BE-DTIB cannot be deduced from existing national statistics or the NACE-BEL classification system of activities. NACE-BEL serves as the Belgian version of the statistical nomenclature (NACE Rev. 2) employed in the European Union for categorizing economic activities and is the standard reference framework for generating and disseminating economic activity-related statistics in Belgium. However, NACE-BEL incorporates only a limited number of codes (e.g., 20510 for 'Explosive products manufacturing' and 25400 for 'weapons and ammunition manufacturing') that allow for the identification of military goods production. Moreover, the NACE-BEL classification system lacks the capability to differentiate between military and civilian market economic activities in the production of dual-use and dual-product goods.
Hence, we employ the following criteria to set-up an initial mapping of the entities of the BE-DTIB. The mapping builds on a preliminary exercise done by ACOS STRAT-NAD and FPS Economy, which the BEPIDS project has continued in cooperation with both.

1° Defence procurement contracts (awarded)

2° Participation in EDF (or the EDF precursor programs: EDIDP and PADR), EDA projects, EDIRPA, ASAP

3° Referenced by GRIP or the Flemish Peace Institute

4° Part of Defence-relevant associations (Agoria Defence and Security, Skywin, GRIP, BSDI, FLAG, EWA, Pôle MECATECH Defence and Security, Agoria Belgospace, BAG)

5° Contact with NAD, RHID, FPS Ec.

6° Identified by FPS Economy

7° Defence procurement contracts (competed, but not awarded)

8° Known defence-related & dual-use exports (e.g. CERTIDER)

9° Particpated in Defence-related conventions

10° listed in the EU security market list

11 Participation in Defence programs : participation in operational programs (e.g. CaMo) and participation in research programs (e.g. DEFRA).

12° Mentioned in newspaper articles as having DTIB related activities

IV. Data Sourcing, gaps and patches

Data sourcing

The data for this overview are partially drawn from the Belfirst database of Bureau van Dijk (owned by Moody's). The Belfirst database assembles information of Belgian (and Luxembourgian) entities, from the annual accounts reported to the National Bank of Belgium, from information reported to FPS Economy (Crossroads Bank of Enterprises) and from the Belgian Official Journal into a common database. Turnover, assets, employment and the addresses for the head-office location were extracted from the Belfirst. Where unavailable or restricted due to access rights, gaps were manually filled in from the direct sources above.

Due to limited access rights for the Belfirst, which restricted extracts of certain data, we needed to source the entirety of such data from the original source. For instance, addresses for the establishment unit location and NACE-BEL information were collected from the Crossroads Bank of Enterprises "open data extract". The remainder of the current data in the dataset (e.g. 'Sector') were filled in manually based on desk research.

Data gaps and patches

Turnover, employment (impact)

While companies are required by law to report certain information publicly in their annual accounts, there are exemptions. For instance, small companies only have to report publicly when it exceeds either of the following three categories: it has a turnover of 700k EUR, total assets of 350k EUR, or employment of 10FTEs in the reporting year. Even when these limits are reached the reporting for these small companies occurs via the 'micro-model', which gives less information than the other reporting models. Hence, this information is not always reported to the NBB. As a result, the Belfirst database also does not contain such information for these companies.

To retrieve more exact estimations, data for the micro companies can be inferred and filled in based on the averages of the available data for the size type (Micro). Alternatively, a "MAX" designation can be employed according to the threshold exemptions. Hence, each micro company with no data available in the Belfirst is accorded 700k EUR max for turnover. The differences between each method is negligible. While this data inference method can be argued to misrepresent due to the skewing of the data for Micro companies, it provides a more accurate picture of the BE-DTIB as a whole than if these were left as blanks.

The average number of employees for 2022 is derived from the Full-Time Equivalents data. When data for 2022 is not available, it takes the value for the latest available year. Other data gaps (some entities with size 'Micro') are filled in based on taking the Max employment threshold (10) for the size type. Similar to the above, the impact of doing so is negligible on the total figures.

Defence-specific information

There is a lack of publicly available information on the proportion of defence-related activities within the turnover or employment of the entities. Hence, the current estimations for the size of defence-related turnover and employment are based on weighted averages of data inferences from the available DTIB related proportions in the dataset (see: *infra* **Key Figures**). The ongoing BE-DTIB survey asks these proportions from the listed entities and will be used to derive a more exact figure of impact of the BE-DTIB.

Head-office as location

Due to data limitations we were currently only able to assign the impact of the registered entity according to its head-office location in Belgium. A more correct assessment would be to make corrections according to the establishment units' location where the registered entity creates the impact.[19] However, while we have the locations of the establishment units, such data on employment per establishment unit is not available in the data sources employed for the current dataset. While the Federal Public Service Social Security does gather such data per establishment unit of registered entities, this data is not open to the public. As a result, the impact figures per location are suboptimal. To illustrate, many registered entities in Belgium in general have their head-offices in Brussels due to its position as the administrative hub of Belgium and due to it being close to the decision-making institutions, but often have more important facilities activity-wise in the other Regions. The result is a possible overestimation of the impact in Brussels.

V. Results: Key findings based on 3 questions

This section gives a descriptive analysis of the BE-DTIB. To better understand the mapping we illustrate the results via 3 key questions.

1. How many entities are included in the BE-DTIB mapping and what is their impact?
2. In what sectors do we find the most entities and in what sectors is the impact the highest?
3. What is the regional spread of the BE-DTIB?

To limit the length of the article, we excluded from the results a description of coverage by Belgian defence-relevant associations and a description of the foreign ownership. These will be covered in follow-up writings.

Given the data limitations discussed above, the current results should be deemed as indicative and as a means to derive general findings, including where data gaps are pertinent and thus require further attention. Hence, the results are subject to change. When more data has been collected, we suggest updating the findings to achieve a more exact picture concerning the impact of the BE-DTIB.

[19] A more simplified and practical approach consists of making corrections based on the highest employment per Region for the registered entity (based on the data from FPS Social Security). When a registered entity has their head-office in one Region, but creates more employment in one of the other two Regions, the registered entity could be allocated under the Region where it created the most employment and is thus assumed to have the highest actual activities.

1. How many entities are included in the BE-DTIB mapping and what is their impact?

Key figures

Based on the delimitations of the BE-DTIB and the mapping sources described above, we derived 780 separate legal entities (751 industry or services, 18 RTOs, 11 HEI) with in total 1538 establishment units for all their economic activities.[20] In total these have a turnover of 50 Billion EUR, employ about 104k employees and represent 17 Billion EUR of Gross Value Added (GVA) for all their economic activities.[21]

To estimate the portion of DTIB-related activities, we first used proportions from a comparable mapping study done in the Netherlands.[22] We did so for several reasons.

Although there are differences in the industrial fabric of the countries, the Netherlands is the most comparative neighboring country concerning the DTIB, with both the Netherlands and Belgium their DTIB focusing on more specialized niche goods and services, as opposed to France, Germany and the UK that have the industrial infrastructure and financial capacity to drive large weapons system development and production programs. Furthermore, due to the Benelux, the Netherlands and Belgium have more integrated industrial ties and interconnected economies. It also participates more closely in joint military ventures, most notably through the integration of its Navies and its related joint procurement. For all these reasons, it is interesting to use the Netherlands as the key country of comparison, not in the least as in later stages of analysis niches can be compared to each other to see where there is a potential comparative (dis)advantage to add to the capabilities of the EDTIB. Lastly, the mapping study on the NL-DTIB, although slightly wider in its delimitations, correspond well in terms of method and aims to our mapping.

Based on the proportions derived from the NL-DTIB study (see: *Infra)*, we initially estimated a turnover of around 5.3 Billion EUR, direct employment of 12.9k, and 1.9 Billion EUR GVA linked to DTIB-related activities.

We then made estimations via data inferences based on the already available info in the database on proportions of turnover and employment from DTIB-related activities. This data was available for 96 entities.[23] We employed the allocated sector and whether the entity is part of a defence-relevant association to infer estimations on the proportions. Although a common employed data inference method, given the limited data on these proportions, a margin of error for representability remains, requiring that the findings are reassessed when more exact data is available.

Based on this data, the BE-DTIB has an estimated turnover of 5.9 Billion EUR, direct employment of 19.5k and 2.5 Billion EUR linked to DTIB-related activities. This represents around 0.40% of total Belgian employment[24] and around 0.46% of Belgian GVA[25].

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[20] The count of establishment units excludes LargeCaps of which the establishment units only have a limited reference to defence-related activities.

[21] For a comparison to previous Belgian mappings, see: : Kegels G., De Cock W., Buts C., Du Bois C. (2023) Multiple case study analyses to Define the Belgian Defence Technological and Industrial Base. BEPIDS project. [Preliminary BEPIDS report]. Available at: https://www.geoeconomicsgroup.be/bepids

[22] The proportions for the NL-DTIB are the following: 10.55% of total Turnover, 12.48% of total Employment and 10.91% of total GVA of the mapped entities are linked to DTIB-related activities.

[23] Note: Another limitation is that the proportions are not for 2022 alone, but range from 2014 to 2022. Of course this data quality issue impact the usefulness of the findings, stressing the need to capture more recent data.

[24] Calculated based on: Statbel -Employment 2022 data.

[25] Calculated based on: NBB – Regional and National accounts for 2022.

Comparison of the BE-DTIB mapping with the NL-DTIB mapping

When we compare the current mapping with the most recent available mapping of the NL-DTIB, we see that although the BE-DTIB mapping has fewer entities, the impact thereof is estimated to be slightly larger (see: **Figure 2**). Especially in terms of employment, the DTIB activities are estimated to represent 6% more within the total employment in Belgium than in the Netherlands.

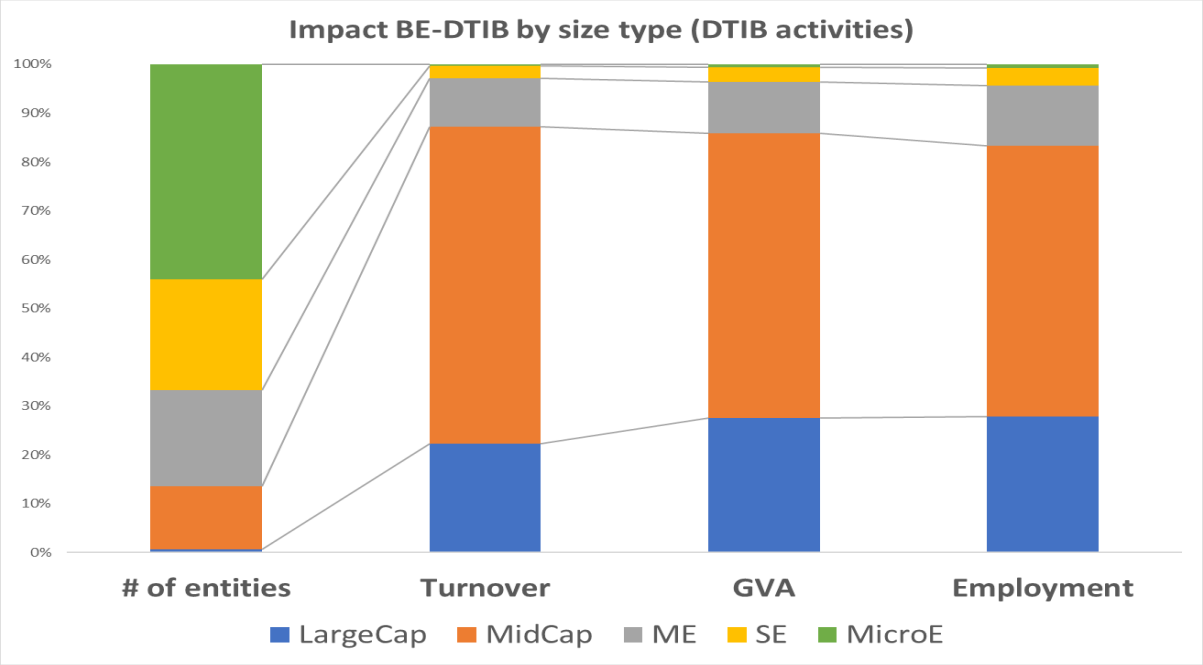
	BE (2022)	NL (2021)*
Employment	104 k	149.5 k
GVA	17.56 B	22.46 B
Turnover	50.46 B	44.92 B
# Entities	780	932
DTIB-Employment	19.6 k	18.7 k
DTIB - GVA	2.57 B	2.45 B
DTIB - Turnover	5.96 B	4.74 B
%DTIB Employment	18.8%	12.5%
%DTIB GVA	14.6%	10.9%
%DTIB Turnover	11.8%	10.5%

Figure 2. Comparison of the BE-DTIB and the NL-DTIB
Source: Own composition based on the BE-DTIB database and the NL-DTIB study done by Berenschot for the Dutch government.*

Of course, while both mappings are comparable, both employ data inferences for their estimations of the impact. Hence, with margins of errors for both the studies, it is more accurate to claim both countries as being in a comparable range. Nevertheless, given the similar set-up and aim, it is significant that the current insights indicate the differences of the figures between both countries are small.

Impact BE-DTIB by size type for DTIB activities

Although the bulk of entities in the mapping are made up of Micro entities (44%), they represent a negligible amount of the estimated impact (less than 1% for turnover, GVA and employment) for the BE-DTIB. On the other hand, MidCaps, which only consists of 12% of the mapped entities, accounts for the bulk of the impact, with it representing 65% of DTIB-related turnover and 58% employment. Also notable is that although there are only 5 entities considered LargeCaps, they have a substantial impact (see: **Figure 3**)



Year 2022	# of entities	Turnover	GVA	Employment
LargeCap	0.6%	22.2%	27.6%	27.9%
MidCap	12.9%	65.0%	58.2%	55.5%
ME	19.6%	9.8%	10.5%	12.3%
SE	22.7%	2.6%	3.0%	3.6%
MicroE	44.1%	0.3%	0.6%	0.7%
	780	**5,958,688,185**	**2,565,524,296**	**19,579**

Figure 3. Impact of the BE-DTIB by size type.
Source: Own composition based on the BE-DTIB database.

2. In what sectors do we find the most entities and in what sectors is the impact the highest?

As noted above, the NACE-BEL only contains a limited number of codes useful for defence or security-related activities. Furthermore, for the production of dual-use products and technologies, these cannot sufficiently be derived from NACE-BEL codes. Therefore, we categorized the entities according to 31 goods and services types they offer relevant for the DTIB.

In terms of entities, the 5 largest categories are Digital, Mechanics, Consulting, Electronics and "Core" Defence and Security (see: **Figure 4**). However, when we look at the impact ranked per employment, we observe that only the categories Digital and "Core" Defence and Security are in the top 5 (see: **Figure 5**). If we look at the impact per entity, "Core" Defence and Security have a higher impact than digital per entity. "Core" Defence and Security consists of 37 entities, resulting in an estimated average impact for employment of 90 employees per entity. Digital has 92 entities which means it has an estimated average impact of 38 employees per entity for DTIB-related activities. A notable outlier is chemicals which has substantial estimated DTIB-related turnover, but little direct employment.

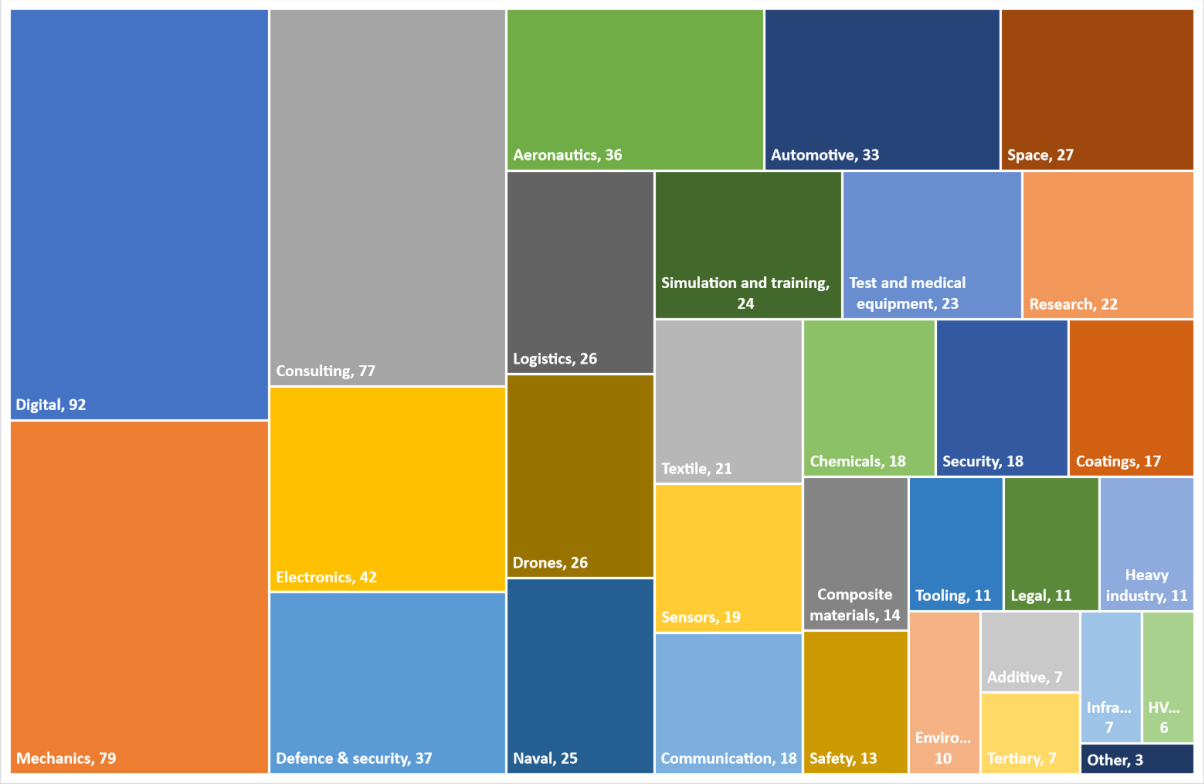


Figure 4. Categorization of the entities by DTIB relevant sector.
Source: Own composition based on the BE-DTIB database.

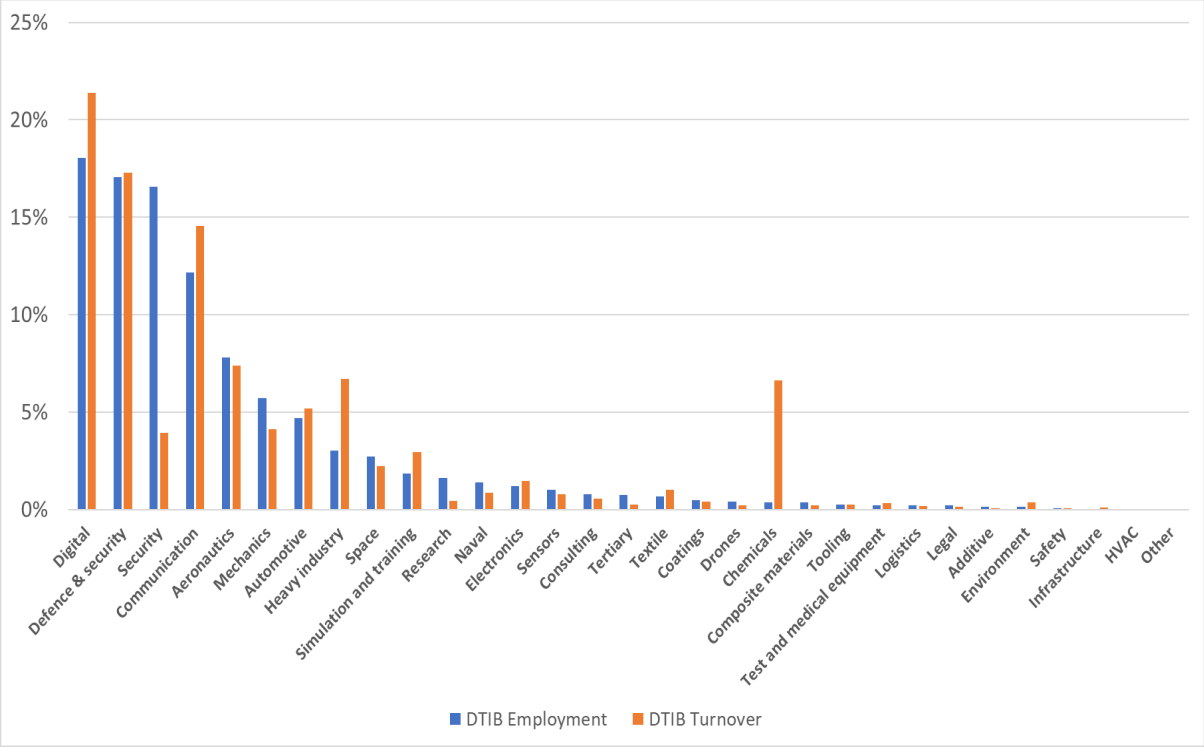


Figure 5. Estimated DTIB impact per sector.
Source: Own composition based on the BE-DTIB database.

3. What is the regional spread of the BE-DTIB?

What is the regional distribution of the entities and their impact on DTIB activities?

The following map (see: **Figure 6**) shows the regional spread of the head-office locations colored by their size type and with the bubbles representing turnover for DTIB-related activities. In terms of entities, there is a cluster concentration in Brussels, Liège, Kortrijk and Antwerp. However, in terms of estimated DTIB-related turnover Antwerp is less significant. Little activity is present in the far-South of the country, as can be observed from the clear Southern line following the N90 highway under which there are only a few entities.

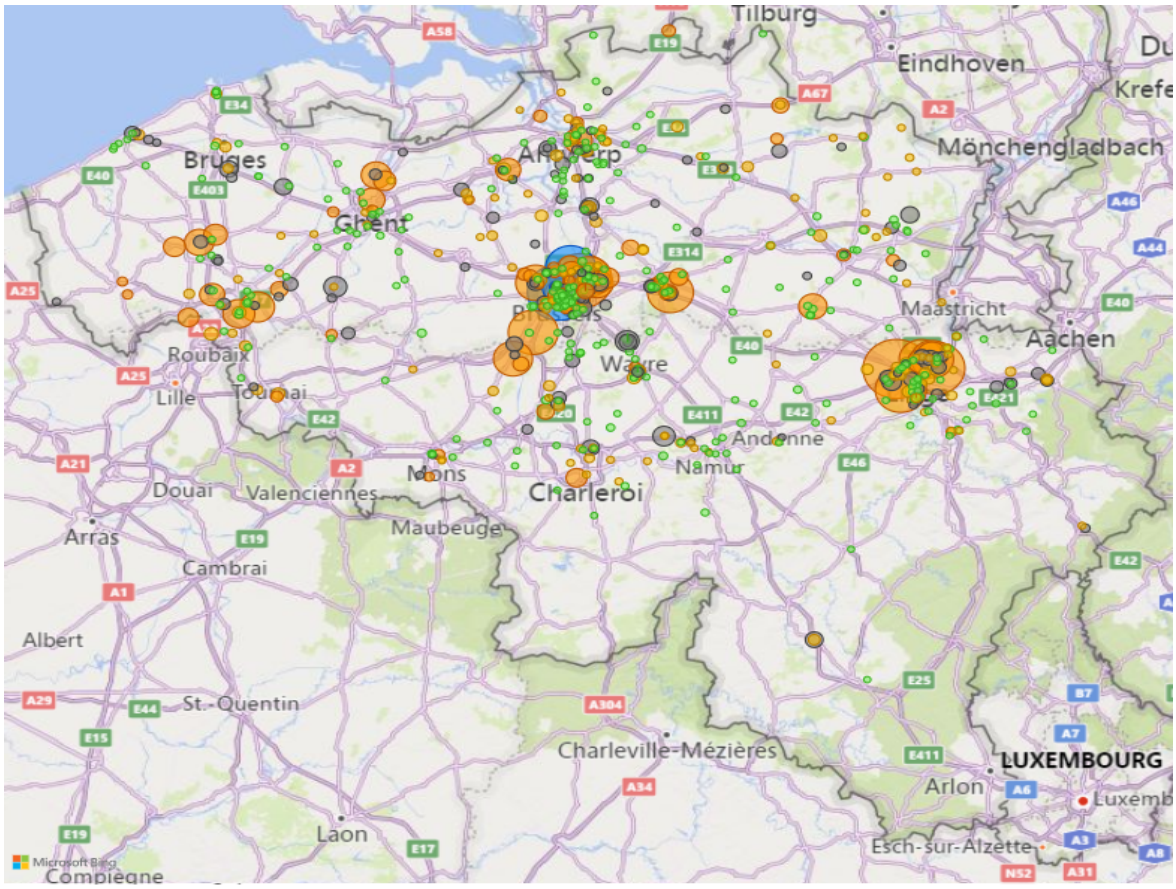


Figure 6. Head-office location of the registered entities colored by size type.
Source: Own composition based on the BE-DTIB database.

When we look at the estimated impact for DTIB activities, we note that these are relatively evenly distributed in absolute terms between the Regions (see: **Figure 7**). The Brussels Capital Region proportionally has the highest impact per entity. Flanders, which has the largest amount of entities (52%), proportionally has the lowest average impact per entity when compared to the other Regions.[26]

[26] Of course, as noted above (see: 'data gaps and patches: head office location'), the impact estimations for the regions are suboptimal, as we were currently only able to assign the impact of the registered entity according to its head-office location in Belgium. The result is that the impact estimations for Brussels are potentially overestimated.

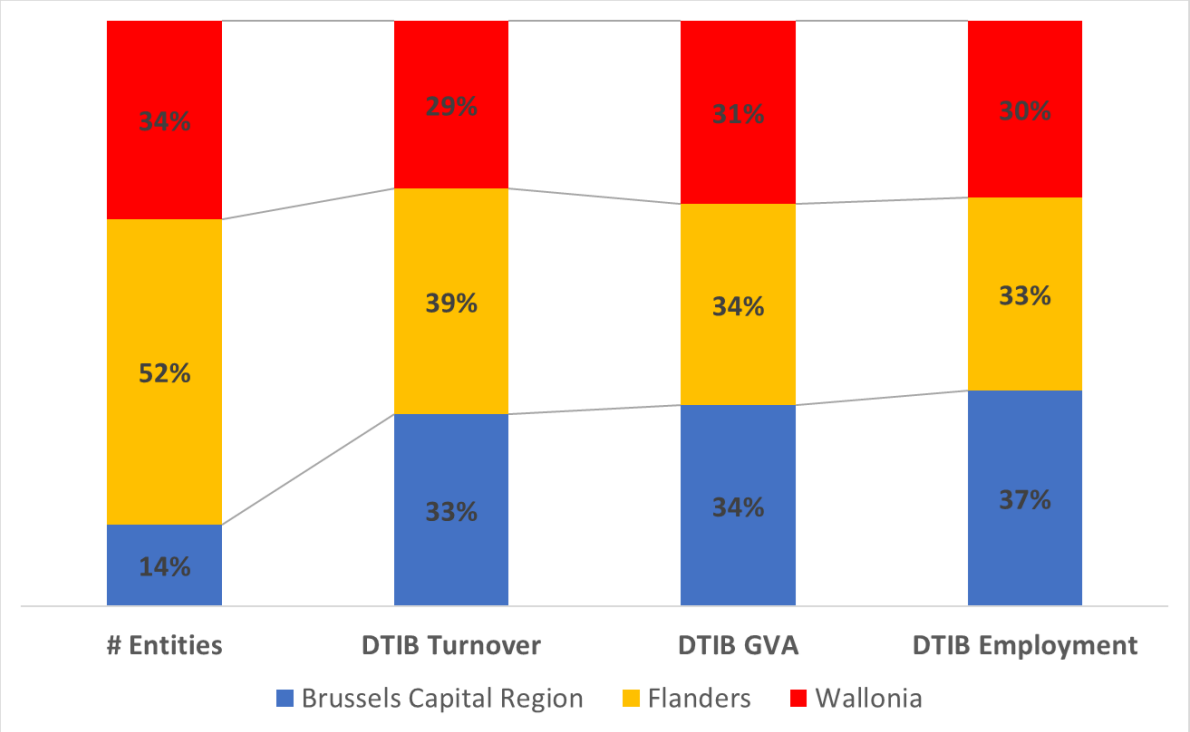


Figure 7. Estimated DTIB-related impact by Region
Source: Own composition based on the BE-DTIB database.

What is the distribution of "substantially" defence-focused entities?

It is hypothesized that entities that are substantially defence-focused are more likely to have their head-offices in Wallonia or Brussels due to less stringent export controls as opposed to those of Flanders. If we use BSDI and GRIP[27] as a representative proxy for entities that are substantially defence-focused, then we see that this claim holds somewhat true.[28] In **Figure 8**, we note that 57% of entities thereof is located in Wallonia or Brussels combined. Impact-wise, Wallonia and Brussels represent 81% of DTIB-related turnover of these entities (see: **Figure 7**).

[27] Note: GRIP is not a business representing organization, but rather a think-tank researching, among other things, the 'armaments sector', which they define as *"Belgian companies whose activity is partly linked to the production of goods and services for military purposes"*.
[28] We consider 'substantially defence-focused entities' here as those entities that consider the defence-market as partly key to their activities. To simplify the analysis, we derive these entities from them being a member of BSDI or being referenced as such by GRIP for 2022.

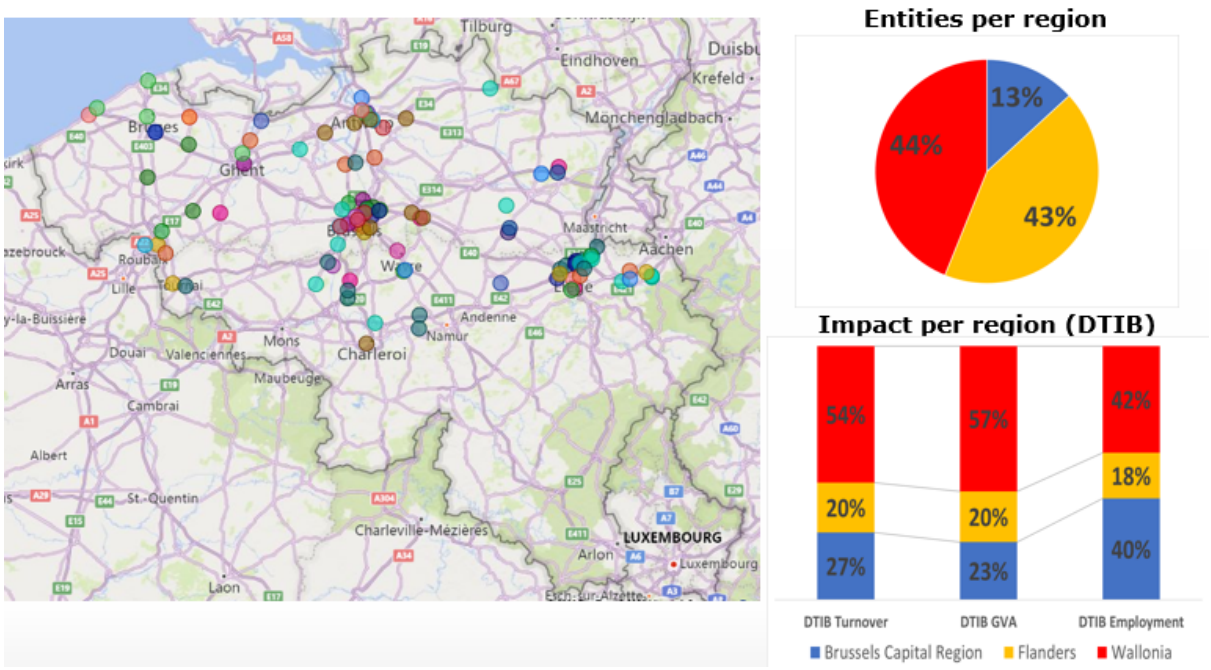


Figure 8. Distribution and impact of "substantially" defence-focused entities.
Source: Own composition based on the BE-DTIB database.

VI. Summary

Based on the currently available data, we derive the following key insights. Midcaps (12% of the mapped entities) represent the bulk of estimated impact for DTIB-related activities. To the contrary, Micro sized entities (44% of the mapped entities) their estimated impact in terms of turnover, GVA or employment is limited. Nevertheless, this large pool of Micro sized entities may carry significant potential for the BE-DTIB and EDTIB if properly supported. How these Micro entities can efficiently be supported is a key avenue for future research.
The entities with product types 'Digital' and 'Core Defence and Security' are the largest impact-wise for DTIB activities within the BE-DTIB.
The impact for the DTIB is relatively evenly distributed across the regions. Flanders has the most entities, but the lowest impact per entity of all the regions.
Lastly, substantially defence-focused entities their head-offices are slightly more present in Wallonia and Brussels, but especially in terms of estimated DTIB-related impact.

From an academic perspective, the paper contributes to the operationalizing of a definition of the BE-DTIB into an empirical mapping and as a means to enhance the knowledge of the EDTIB. Concerning the definition, one may critique here that our working definition, although wide in scope, still misses catching certain entities with potential for the DTIB due to the initial sources employed for the mapping. We note for instance that only few entities with biotechnology products are currently included in the dataset, as they were only few identified from the sources. However, in terms of future potential to provide military-use biotechnology goods and services to defence actors (e.g. human enhancements), Belgium is well placed due to its know expertise in the field.
Furthermore, the comparison of the BE-DTIB with the NL-DTIB serves as another reminder for the need to align on a common definition of the DTIB and to source the necessary data employing the same methodology (definition and inclusion criteria). Such data is essential in order to track the actual

contribution of countries their industrial and technological base to the EDTIB and to enable more effective comparisons between countries. We propose the EDA, which as its core mission has the aim to support the EDTIB, consider setting up a research project to enable such a comparative analysis to enhance its tracking of developments and impact of support mechanisms within the EDTIB. Moreover, such mappings enable comparing the country's DTIB with the entities that expressly consider themselves as being defence-focused, for instance, by being part of defence-focused business associations.[29]

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[29] Note: Notwithstanding differences in products types and positioning in the OEM to tier 3 structure (with entities lower in the tier structure and more dual-use type products less likely to consider the defence-market as key to their activities), we hypothesize that gaps will be larger in countries with less friendly investment climates for entities considered defence market-related. Of course, as stated, such a comparative analysis can only be made once DTIB mappings are done for several EU member states employing a common methodology.

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APPENDIX

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 (e.g., diving/construction/coatings)
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"

Source: Directive 2009/43/EC of the European Parliament and of the Council of 6 May 2009 simplifying terms and conditions of transfers of defence-related products within the Community. ("*Transfer directive*"). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0043

> Note: *"The list of defence-related products is defined in the Annex to Directive 2009/43/EC. The Annex is updated regularly to ensure that it strictly corresponds to the Common Military List of the European Union. The current version of the Annex was adopted by Commission Directive (EU) 2019/514 of 14 March 2019 and corresponds to the Common Military List of the European Union adopted by the Council on 26 February 2018."*

Defence-specific "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'.*[30]

Source: Own composition based on the analysis of gaps in the frameworks and inclusion by other mappings.

Dual-use products: broad categories of the EU dual-use regulation

0 – Nuclear materials, plant and equipment	5 – Telecommunications and "information security"

[30] SIPRI (n.d.).

1 – Special materials and related equipment	6 – Sensors and lasers
2 – Material processing	7 – Navigation and avionics
3 – Electronics	8 – Marine
4 – Computers	9 – Space and propulsion

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. ("*EU Dual-use regulation*"). https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02021R0821-20220505&from=EN

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")

Source: European Commission, Directorate-General for Migration and Home Affairs. (2022). *EU security market study: final report.* Publications Office of the European Union. https://data.europa.eu/doi/10.2837/19472