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0. Summary

This report overviews functionalities provided by 'The Big Table' (TBT), a software tool designed to support nuclear trade analysis for IAEA safeguards. TBT allows analysts to perform steps preparatory to the retrieval and analysis of data records pertinent to case studies on nuclear trade. Trade data records stem from open source web data services on global trade and are retrieved by Harmonized System codes, i.e. commodity descriptors used by traders to declare imports and exports to customs authorities.

The report is structured in two main Parts.

The *first Part presents elements of nuclear trade analysis*. It introduces web data services on global trade. By an illustrative example, it sketches how global trade data are used in the context of trade-related case studies. A collection of reference documents for IAEA safeguards and export controls consulted by trade analysts is presented. These include trade regulatory documents, technical handbooks and the Harmonized System itself. The concept of *correspondence tables* between references documents is then introduced. Correspondence tables identify related items appearing in different reference documents. Correspondence tables create a complete view on items, covering regulatory aspects from several perspectives as well as items' technical descriptions. In view of trade analysis, correspondence tables provide Harmonized System descriptors for export-controlled items to enable the retrieval of trade data from web data services.

The *second Part of the report deals with implementation aspects and more directly with TBT*. It covers software and hardware requirements to run TBT, its installation and set-up. It explains how the collection of reference documents is searched by text and by correspondence tables; how to select items of interest to a given trade case study; how to compile selected items into an Excel table for documentation purposes; how to map items to Harmonized System codes; how to export Harmonized System codes in formats to run queries on web data services. A Section is dedicated to TBT content managers: it illustrates the interface to the database that stores reference documents and correspondence tables. By this interface, existing content is managed and enriched, for example, by analysts' notes on items and correspondences. Finally a wrap-up Section recaps on TBT's workflow.

The report concludes by comparing TBT to related information tools developed in the context of export controls. Future developments on TBT are outlined pointing to new application areas.

1. Introduction

The Big Table (TBT) is a software tool designed to:

- Browse and search a collection of *reference documents* listing and describing items relevant to IAEA safeguards, export controls and case studies on nuclear-related trade.
- By the above process, select items of interest to specific *case studies related to nuclear trade*.
- Map selected items to *Harmonized System* codes (HS, [1]). HS is the taxonomy of goods developed by the World Customs Organization (WCO) used by exporters and importers to declare commodities to customs. These declarations are at the basis of *global trade data* published in *web data services* [2]. HS codes are instrumental to the retrieval of trade data records.
- Export HS codes in formats suitable to query web trade data services and retrieve records about trade of interest for analysis.

In short, TBT offers functionalities for analysts to perform steps preparatory to the retrieval and analysis of data records pertinent to case studies on nuclear trade.

TBT does not provide access to trade data services, nor tools to analyze data records. Data retrieval and analysis are performed outside TBT¹.

The report is structured in two main Parts. The first Part (Section 2) presents key elements for nuclear trade analysis. The second Part (Section 3) deals with implementation aspects and more directly with TBT.

In the first Part, Section 2.1 introduces web data services on global trade. For an extended review, the reader is referred to [2]. Section 2.2 sketches how global trade data are used in the context of trade-related case studies. An illustrative case on the trade of export-controlled machine tools is presented. We will refer to this case throughout the second Part of the report as a guide to goal-directed use of TBT. Section 2.3 presents a collection of reference documents related to IAEA safeguards and export controls consulted by trade analysts. These include trade regulatory documents, technical handbooks and the Harmonized System itself. The concept of *correspondence tables* between references documents is introduced in Section 2.4. Correspondence tables identify related items appearing in different reference documents. *Correspondence tables are at the core of TBT*: they create a complete view on items, covering regulatory aspects from several perspectives (i.e. IAEA's, export licensing, customs controls) as well as items' technical descriptions. In view of trade analysis, correspondence tables provide HS descriptors for these items to enable the retrieval of trade data from web data services.

In the second Part of the report, Sections 3.1 to 3.3 cover software and hardware requirements to run TBT, its installation and set-up (*Settings* command). Section 3.4 describes TBT's *Search* command. It explains how to search the collection of reference documents by text and by correspondence tables; how to select items of interest to a given trade case study; how to compile these items into Excel tables for documentation purposes; how to map items of interest to HS codes; how to export HS codes in formats useful to run queries on web data services. Section 3.5 is for TBT *super-users*, i.e. content managers. It illustrates the interface to the database that stores reference documents (as *lists of items*) and correspondence tables. By this interface, super-users manage and enrich existing content, for example, by adding analysts' notes on items and correspondences. This Part of the report closes with Section 3.6 re-capping on TBT's workflow.

Section 4 provides a comparison between TBT and related information tools developed in the context of export controls.

The report concludes by outlining future developments on TBT and pointing to new application opportunities in the area of export controls.

¹ TBT includes, though, a web browser to connect to subscribed trade data services.

2. Elements of nuclear trade analysis

This Part of the report starts by introducing web data services on global trade. It then sketches how global trade data are used in an illustrative case study. A collection of reference documents related to IAEA safeguards and export controls consulted by trade analysts is then presented. The collection is best searched by correspondence tables identifying related items appearing in different reference documents. In view of trade analysis, correspondence tables provide Harmonized System descriptors of items to enable the retrieval of trade data from web data services.

2.1. Web data services on global trade

Data services on global trade referred to in this report are *open source*. The data are available to anyone either for free or by a subscription fee. In contrast to other sources on trade (such as news and specialized press on trade), the information provided by trade data services has a regulatory origin as it stems from declarations made by traders to *customs*. Customs data are collected at national level and, by decision of individual States, published in *transactional* or *statistical* formats.

Transactional data are largely equivalent to declarations made by importers/exporters to customs. Declared data fields subject to disclosure may include:

- A code classifying the commodity traded; e.g., according to the HS product nomenclature;
- Free text description of the commodity;
- Quantity, expressed in weight or number of items;
- Value;
- Date of shipment;
- Country/port of import/export;
- Party names.

The scope of transactional services can be national or multi-national (Figure 1, [2]). These services are offered mostly by private companies against subscription fees. Data services can be delivered online or off-line, but online services are the most common.



Figure 1 – Countries for which transactional data are available (imports and/or exports) are marked on the map by a square. The size of the square is proportional to the number of years of data available, ranging from 1 to 14, starting with 1995. For details, see [2].

Statistical data on trade are derived by aggregating transactions data by country, trade flow (import or export), period of time (months, years) and product categories as specified by the HS. A typical data record includes:

- Reporting country (the exporting or the importing country);

- Partner country in trade;
- Trade flow (import or export);
- Category of commodities (HS);
- Time period (months or years);
- Cumulative value of the trade for the above fields;
- Cumulative quantity of trade for the above fields.

The scope of statistical data services is in most cases multi-national. As an example, COMTRADE [3], by the United Nations Organisation, offers the largest geographical coverage, including 150 reporting countries with annual series of data. COMEXT [4], by the Statistical Office of the European Union (EU), is a second example. Focused on European reporting countries, COMEXT provides monthly records on EU trade.

Statistical trade data are offered by international organizations, governmental organizations and national statistical offices, often for free or for limited fees. Private companies provide access to these data as pay services. The cost of the service is justified by valuable combinations of data sets, advanced interfaces to search and retrieve the data, meta-data information, and additional or more timely data.

As with services on transactions, the data is collected at the national level, together with the aggregation of the data. Statistical data are published respecting data confidentiality requirements whose definition is country-specific.

The practical use of global trade data, both in transactional and statistical format, is straightforward except for the specification of HS codes needed to retrieve the data. This requires not only a good understanding of how the HS goods' taxonomy is organized, but also knowledge of customs procedures and statistical practices in data processing which can be specific to each country, commodity, trade flow or range of values. This is illustrated in the next Section by means of an example.

2.2. Addressing trade case studies: general steps and one example

Global trade data can be used in the conduct of trade case studies. A case study may start with a piece of information or a hypothesis about trade activities between entities (e.g., countries, companies) on items subject to IAEA safeguards, export controls, or other proliferation-sensitive items.

The goal of a case study is to consult web data sources on global trade to:

- Confirm or deny the information/hypothesis;
- Find new, related information.

Example. *A case of trade in high-precision machine tools with unclear end-use has been reported by the press. Articles report that several high-precision machine tools have been exported from Country A to Country B over a period of a few month. Is the alleged trade confirmed by global trade data sources?*

Before consulting web trade data services, a preliminary step is to identify clearly items of interest to the case study at hand. This is supported by expertise on items and a set of *reference documents* (↪ 2.3) where materials and equipment subject to controls are listed, defined and described.

Example. *Machine tools subject to export controls are listed in the Nuclear Suppliers Group 'Guidelines for Transfers of Nuclear-Related Dual-Use Equipment, Materials, Software and Related Technology' [5]. Machine tools of interest here include turning machines (item 1.B.2.a. in [5]), milling (1.B.2.b.) and grinding machines (1.B.2.c.) for removing and cutting metals, ceramics or composites. The main parameters for a machine tool to meet the specifications given in [5] are (i) the number of angular or rotary axes that can be moved*

simultaneously with the perpendicular or linear axes and (ii) the overall positioning accuracy of the machine. Nuclear-related uses of machine tools include the manufacturing of nuclear explosive device components (e.g., hemishells) and of uranium enrichment equipment components (e.g., end caps for centrifuges) [6]. Non-nuclear uses include the manufacturing of automotive components, pressure vessels, storage tanks, fuel pumps, compressor and turbine components, small arms, marine propellers, and aircraft structures [6]. Large machine tools find application in the aircraft, shipbuilding, and off-road vehicle industry [6].

With items of interest identified, it is necessary to map these items to HS descriptors in order to retrieve relevant trade data². Mapping items of interest to nuclear trade to HS is not trivial, because:

- HS codes only approximate target items.
- Exporters may (intentionally or not) declare trade to customs authorities in HS categories aside from the correct ones.

Expert analysts must determine on a case-by-case basis which HS codes to use to best address the case study at hand. Factors to take into account include: the accuracy of HS codes with respect to the targeted items, the expected volume of trade for reporting countries, and the likelihood of intentional or unintentional incorrect declarations. A starting point for the selection of HS codes is given by already existing *correspondence tables*. Developed by experts of the HS, these tables map items listed for export controls to HS codes. A table we make reference to is the EU 'Correlation Table' [7] (CT) developed by the European Commission, DG TAXUD. CT maps to HS items listed for export controls [9] by EU Member States (see 2.3 and 2.4).

Example. Machine tools (turning, milling, grinding machines) are associated to a number of HS codes by the EU Correlation Table. These are reported in Table 1. None of these codes is specific to export-controlled machine tools. For example, no precision parameter is indicated in the HS explanatory notes. Indeed HS is a taxonomy designed to describe generic categories and the most common from the trade point of view. This limitation implies that trade data retrieved by HS codes need then to be analysed by trade-related criteria that can, in favourable cases, reduce the inherent data ambiguity. See follow-up point in the Example.

HS Code	HS Explanatory note
8457.10.	Machining centres for working metal.
8457.20.	Unit construction machines "single station", for working metal.
8457.30.	Multi-station transfer machines for working metal.
8458.11.	Horizontal lathes, incl. turning centres, for removing metal, numerically controlled.
8458.91.	Lathes, incl. turning centres, for removing metal, numerically controlled (excl. horizontal lathes).
8459.10.	Way-type unit head machines for drilling, boring, milling, threading or tapping metal.
8459.21.	Drilling machines for working metal, numerically controlled (excl. way-type unit head machines).
8459.31.	Boring-milling machines for metals, numerically controlled (excl. way-type unit head machines).
8459.51.	Milling machines for metals, knee-type, numerically controlled.
8459.61.	Milling machines for metals, numerically controlled (excl. way-type unit head machines, boring-milling machines, knee-type milling machines and gear cutting machines).
8460.11.	Flat-surface grinding machines, for working metal, in which the positioning in any one axis can be set up to an accuracy of at least 0,01 mm, numerically controlled.

Table 1 – Possible HS codes for declaring trade of machine tools to customs.

² By definition, trade data referred to in this report do not generally include trade undeclared to customs. Some countries include such trade when discovered.

<i>HS Code</i>	<i>HS Explanatory note</i>
8460.21.	Grinding machines, for working metal, in which the positioning in any one axis can be set up to an accuracy of at least 0,01 mm, numerically controlled (excl. flat-surface grinding machines and gear cutting, gear grinding and gear finishing machines).
8464.20.	Grinding or polishing machines, for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold-working glass (excl. machines for working in the hand).
8464.90.	Machine-tools for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold-working glass (excl. sawing, grinding or polishing machines and machines for working in the hand).
8465.92.	Planing, milling or moulding -by cutting- machines, for working wood, cork, bone, hard rubber, hard plastics or similar hard materials (excl. machines for working in the hand and machines of subheading 8465.10).
8465.93.	Grinding, sanding or polishing machines for working wood, cork, bone, hard rubber, hard plastics or similar hard materials (excl. machines for working in the hand).
8465.99.	Machine-tools for working wood, cork, bone, hard rubber, hard plastics or similar hard materials (excl. machines for working in the hand, machines of subheading 8465.10, sawing machines, planing, milling or moulding -by cutting- machines, grinding, sanding or polishing machines, bending or assembling machines, drilling or morticing machines and splitting, slicing or paring machines).

Table 1 – Possible HS codes for declaring trade of machine tools to customs (*cont.*).

With HS codes selected, a plan of queries on trade data services is designed taking into account the questions addressed by the case study and the range of services available on trade data. Parameters that come into play are: the geographical coverage of the case study, the time frame addressed, the type and granularity of the data required (i.e., transactional or statistical, § 2.1), and the cost (if any) of accessing the data. For example, querying for statistical data requires the specification of the following dimensions:

- A reporting country;
- HS codes related to the items of interest;
- A trade flow (import, export);
- A time period.

Example. *We query trade data services for Country A exports to Country B. HS codes for queries are listed in Table 1. The time period is a few consecutive months in a given year.*

Queries return the list of partner countries for which trade on the query dimensions exist, specifying value and quantity of the trade over time. Results of queries are presented in tabular form for analysis and interpretation. The criteria adopted for the analysis are, in general, specific to the commodities at hand. One informative *generic* criterion is the ‘trade unit value’, defined as the ratio between value and quantity traded for a given HS, in a temporal point (e.g. month or year), between traders (countries or companies). For limited quantities traded, the trade unit value approximates the declared price at which commodities have been traded. Knowing the market price for items targeted in a case study, one can compare it with the trade unit values of retrieved data records. Data points compatible with the market price of targeted items are highlighted as points of interest. These may confirm alleged information or provide new insights in the case study.

Example. *Table 2 and Table 3 show value and quantity of exports declared by Country A to B on HS codes of interest in the time frame of the case study (M, ..., M+4). The data could refer to the alleged trade of machine tools in that the trade unit value (Table 4) is compatible with market prices for export-controlled machine tools.*

HS Code	Unit	HS Explanatory note	Value in United States Dollars				
			M	M+1	M+2	M+3	M+4
8457.10	USD	Machining Centers For Working Metal	0	1076148	0	0	0
8458.11	USD	Horizontal Lathes For Removng Met Numrcal Controld	870106	0	0	0	0
8459.31	USD	Boring-Milling Mach Remove Met Numerical Controlld	757020	1868760	0	0	0
8459.61	USD	Milling Mach N Knee Type Remov Met Numerical Contl	0	2815177	0	0	2737801

Table 2 – Value (USD) of Country A exports to Country B.

HS Code	Unit	HS Explanatory note	Quantity				
			M	M+1	M+2	M+3	M+4
8457.10	NO	Machining Centers For Working Metal	0	2	0	0	0
8458.11	NO	Horizontal Lathes For Removng Met Numrcal Controld	2	0	0	0	0
8459.31	NO	Boring-Milling Mach Remove Met Numerical Controlld	2	2	0	0	0
8459.61	NO	Milling Mach N Knee Type Remov Met Numerical Contl	0	1	0	0	1

Table 3 – Quantity (number of items) of Country A exports to Country B.

HS Code	Unit	HS Explanatory note	Unit Value (United States Dollars)				
			M	M+1	M+2	M+3	M+4
8457.10	USD	Machining Centers For Working Metal	0	538074	0	0	0
8458.11	USD	Horizontal Lathes For Removng Met Numrcal Controld	435053	0	0	0	0
8459.31	USD	Boring-Milling Mach Remove Met Numerical Controlld	378510	934380	0	0	0
8459.61	USD	Milling Mach N Knee Type Remov Met Numerical Contl	0	2815177	0	0	2737801

Table 4 – Unit value (USD) of Country A exports to Country B.

Several of the methodological steps presented in this Section are supported by TBT. This will be explained in depth in Section 3.4. The following Sections 2.3 and 2.4, expand on reference documents and correspondence tables used in TBT.

2.3. Reference documents

The identification of items relevant to trade case studies requires the consultation of a collection of reference documents where export-controlled items are listed and described. The collection of documents includes *regulatory documents* and *technical handbooks* on controlled items, as well as the Harmonized System. TBT includes the reference documents listed in Table 5 hereby briefly introduced. While all regulatory documents are public, some handbooks are for IAEA use, and others have been developed for States Members to the Nuclear Suppliers Group (NSG), as specified in Table 5. To respect document access rights, the TBT distribution bundle includes only regulatory documents and the Harmonized System. Technical handbooks must be available at the installation site to be visible in TBT (3.2).

- **INFCIRC 540c Annex II of the Additional Protocol (AP)** [10] lists especially designed or prepared equipment (single-use) and non-nuclear material for the reporting to the IAEA

of exports under AP³. This list of items is based on the 1995 version of the 'Trigger List' set by the Zangger Committee and adopted by the NSG. **INFCIRC 540c Annex II HB** [11] is a handbook developed for IAEA on items in AP Annex II. It expands the definitions given in [10], describes the items' appearance as manufactured or packaged, and lists HS codes applicable to the items.

- The IAEA publishes as **INFCIRC 254 1** the NSG 'Guidelines for the Export of Nuclear Material, Equipment and Technology' [12] (referred to as NSG Part 1 or the Trigger List) and as **INFCIRC 254 2** the NSG 'Guidelines for Transfers of Nuclear-related Dual-use Equipment, Materials, Software and Related Technology' [5] (NSG Part 2). By 'dual-use' items it is meant items that have nuclear and non-nuclear applications, as defined by the NSG. Both NSG lists are updated regularly. **INFCIRC 254 1 HB** [13] and **INFCIRC 254 2 HB** [6] are handbooks developed for these lists.
- In 1991 Annex 3 of the IAEA's Ongoing Monitoring and Verification established a list of nuclear and nuclear-related items whose export was either prohibited to Iraq or subject to controls. The list, referred as Iraq Goods Review List (GRL) or **GRL Annex III** [14], includes both single-use items (i.e., especially designed or prepared for the processing, use or production of special fissionable material) as well as dual-use items. **GRL Annex III HB** [15] is the associated handbook: items' definitions are expanded by an introductory note, a description of the typical appearance of the item, health and safety cautions associated with it, typical nuclear uses, and site-specific photos taken by IAEA inspection teams in Iraq. This list includes items that have been removed from NSG export controls lists because they have become too common to be controlled. In specific cases these can still be used as indicators of activities of interest to safeguards.
- The European Union **EC Reg 428/2009 Annex I** [9] implements internationally agreed dual-use controls including the Wassenaar Arrangement, the Missile Technology Control Regime, the Nuclear Suppliers' Group, the Australia Group and the Chemical Weapons Convention. This document provides a single list of items and technology drawn from export controls lists, including the NSG Guidelines, Part 1 and Part 2.
- Besides general export controls lists, it is relevant to consult lists that restrict the export of specific items to particular destinations to implement, for example, resolutions adopted by the United Nations Security Council. This is the case with **EC Reg 423/2007** [16], the European Council Regulation concerning restrictive measures against Iran⁴. In addition to EC Reg 428/2009 Annex I, Regulation 423/2007 (and amendments) lists items whose export to Iran is either prohibited (Annex I) or requires authorization (Annex II).
- Trade data available from web services are retrieved by **Harmonized System** [1] codes. HS is the reference taxonomy for commodities adopted by customs adhering to WCO, trade associations and statistical offices in the majority of countries. HS is based on about 5,000 commodity groups organized within 22 Sections in a hierarchy made up of: Chapters, Headings, and Subheadings. Each level in the hierarchy is identified by an HS code and an explanatory note. Codes are 2-digit for Chapters, 4-digit for Headings and 6-digit for Subheadings. In addition, national subdivisions of the HS exist which describe traded goods at a finer level of detail.

Figure 2 sketches the relationship between documents in terms of *types of items* listed in each document. Rectangles represent sets of items referred to by documents. Across the document collection, these can be equal, disjoint or overlapping.

- By definition, regulatory documents refer to the same items as their handbooks, and hence appear in the same rectangle.
- Except for few items, **INFCIRC 540c Annex II** is the same as to the **INFCIRC 254 1**: these lists identify single-use items, i.e. items especially designed or prepared for nuclear use (the Trigger List).
- The nuclear-related dual-use is covered specifically in **INFCIRC 254 2**, a set disjoint to **INFCIRC 254 1**.

³ Article 2.a.(iv).

⁴ The latest version of this Regulation is [17].

- **GRL Annex III** includes both single and dual-use items and more. It is as an extension of the union of **INFCIRC 254 1** and **INFCIRC 254 2**.
- **EC Reg 428/2009 Annex I** covers a very large list of items derived from export-control regimes in addition to the NSG. It includes some items covered by **GRL Annex III**, but not all of them.
- **EC Reg 423/2007 Annexes I and II** identify items that either are not part of EC Reg 428/2009 Annex I or have different technical specifications.
- The **Harmonized System** is here represented as the outmost box as, in principle, all items can be described in terms of the HS, although sometimes only very imprecisely.

<i>Document</i>	<i>Access</i>	<i>Color</i>
INFCIRC 540c Annex II (1997)	Public	Yellow
INFCIRC 540 Annex II HB (2004)	IAEA	Orange
INFCIRC 254 1 rev9 (2007)	Public	Cyan
INFCIRC 254 1 HB (2002)	NSG	Teal
INFCIRC 254 2 rev7 (2006)	Public	Blue
INFCIRC 254 2 HB (2003)	NSG	Dark Blue
GRL Annex III (2002)	Public	Bright Green
GRL Annex III HB (1998)	IAEA	Dark Green
EC Reg 428/2009 Annex I (2009)	Public	Red
EC Reg 423/2007 Annexes I, II (2007)	Public	Pink
Harmonized System (2002)	Public	Black

Table 5 – TBT’s collection of reference documents.

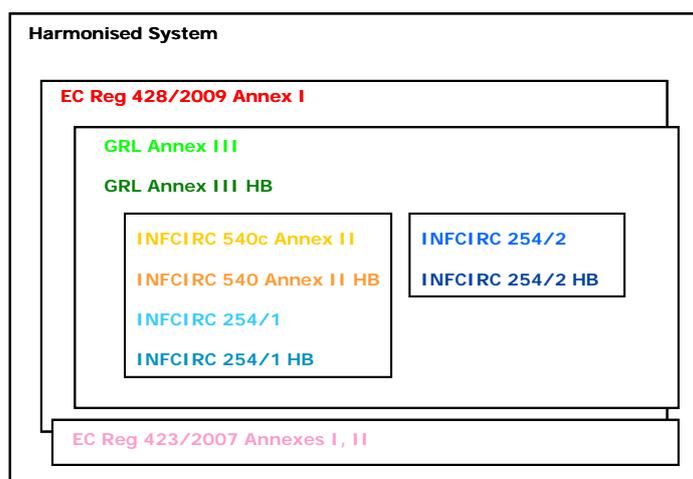


Figure 2 – Relationship between reference documents in terms of items covered.

As we will see in Section 3.4, reference documents appear in TBT in two formats:

- as PDF documents; and
- as lists of items.

The *list of items* format is a table in a *database* with records made of the following fields:

- *Code* (mandatory; alpha-numeric identifier of the item, as per native document);
- *Title* (mandatory; as per native document);
- *Description* (optional; as per native document);
- *Note* (optional; as per native document); and
- *User note* (optional; as specified by an analyst).

The itemization of documents has been performed manually, respecting the hierarchical structure of lists of items in the original documents. Apart from the optional *User note*, the fields' content is derived verbatim from the original documents. Because of the hierarchical arrangement of items, the only mandatory fields for each item are *Code* and *Title*. Indeed certain items exist only as context for other items defined at lower levels in the hierarchy.

A document can be visualized as a tree, where (i) the root being the document name (ii) branches intermediate items (*Code* and *Title*) and (iii) leaves fully defined items (*Code*, *Title* and *Description*).

2.4. Correspondence tables between reference documents

As a whole, TBT's document collection describes items from different perspectives, and with different levels of information. Regulatory documents 'define' controlled items. Handbooks provide information on the items' manufacturing process, appearance and uses. The HS provides indications of customs categories that more likely are used by exporters of listed items. It is then relevant for an analyst to search, read and use documents in a cross-referenced way to get a complete picture on items. This was the drive to develop TBT. TBT's primary purpose is to identify, present and manage correspondences between items described in the collection of reference documents. It also helps to identify HS descriptors relevant to a particular item in view of retrieving trade data records from web data services.

Trade analysts can search items in the document collection either by text or by *correspondence tables*. In general terms, correspondence tables relate items listed in different documents of the collection. Some tables identify equivalent items appearing in different reference documents. Other correspondences associate items with HS codes for use in trade data retrieval and analysis. In TBT correspondence tables are either *native* or *derived*. Native correspondences are made by experts by comparing pairs of documents. For example, the EU 'Correlation Table' [7] between EC Reg 428/2009 Annex I and HS is native and has been made by the European Commission, DG TAXUD. Derived correspondences are obtained by *composing existing correspondences* (whether native or derived). Given three documents D_1 , D_2 , D_3 and two correspondences $D_1 \rightarrow D_2$, and $D_2 \rightarrow D_3$, a third correspondence is derived between D_1 and D_3 by: $D_1 \rightarrow D_3 = D_1 \rightarrow D_2 \rightarrow D_3$. This is useful in different ways. *First*, and in view of trade analysis, it is of interest to make relevant HS codes available to items *whatever* the reference document they appear in. For example, the HS codes associated by the Correlation Table to nuclear-related items in EC Reg 428/2009 Annex I can be 'inherited' by the same items listed in INFCIRC 254, 1 and 2. *Second*, the composition operator facilitates the incorporation of revisions of regulatory documents that are already part of the collection. It suffices to define in TBT the correspondence between the new and old version of the document. This is rapidly done using comparison tables that accompany the revisions of regulatory documents.

Figure 3, left, shows as solid lines native correspondences between pairs of documents. The European CT is indicated, relating EC Reg 428/2009 Annex I to the HS. In Figure 3, right, dashed lines show derived correspondences connecting INFCIRC 254, 1 and 2, to the HS. These are obtained by composing native correspondences: the ones connecting INFCIRC 254, 1 and 2, to EC Reg 428/2009 Annex I, and the CT [8]. We have derived and embedded in TBT all meaningful correspondences between documents in the collection for these to be immediately available to analysts.

For instance Figure 4 shows correspondences connecting items listed in INFCIRC 540c Annex II to related items in all documents of the collection. IAEA trade analysts can access technical information on items to be declared under AP, as well as HS codes for these items to retrieve data from web data services on global trade. In this case INFCIRC 540c Annex II is the *focus document* (the 'starting point') for the verification of export declarations to IAEA under AP; the other documents in the collection provide complementary, useful information.

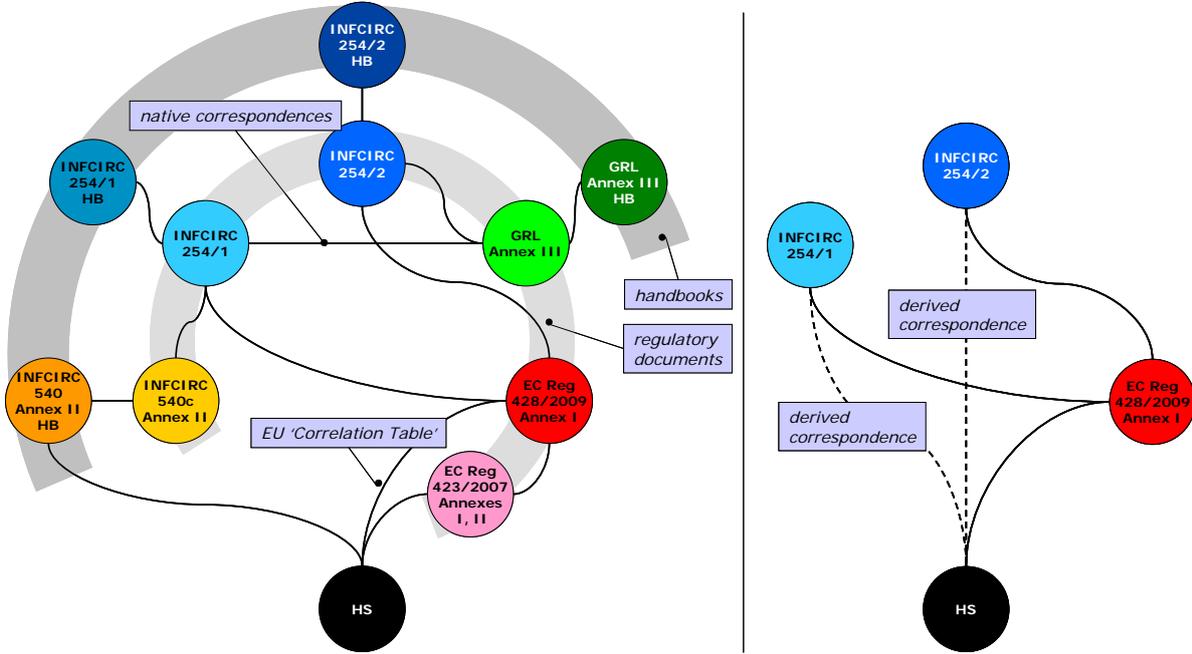


Figure 3 – Left: Native correspondences between reference documents. Right: Correspondences derived (dashed lines) by composing native correspondences (solid lines).

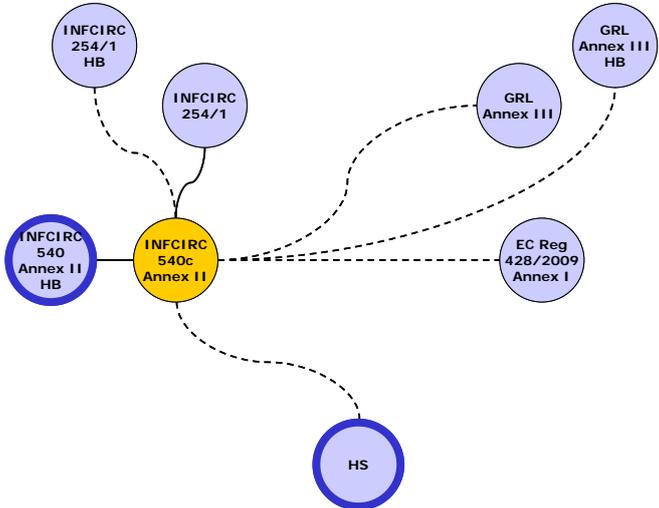


Figure 4 – Correspondences (native and derived) from INFCIRC 540c Annex II to other documents in the collection.

A strong point in TBT is that any document in the collection can be taken as a focus document and retrieve complementary information from the other documents through correspondence tables. This feature enables serving different analyst profiles.

For example, Figure 5 captures the perspective of EU licensing authorities for export-controlled items. For the rating of export license requests, a focus reference document is EC Reg 428/2009 Annex I. From there, analysts need to access handbook information on items under licensing to support the rating process. For nuclear and nuclear-related items, the handbooks on INFCIRC 254

1 and 2 are relevant. In TBT these can be accessed directly through correspondences attached to EC Reg 428/2009 Annex I items. In a sense, these correspondences create a *virtual handbook* on items listed in EC Reg 428/2009 Annex I.

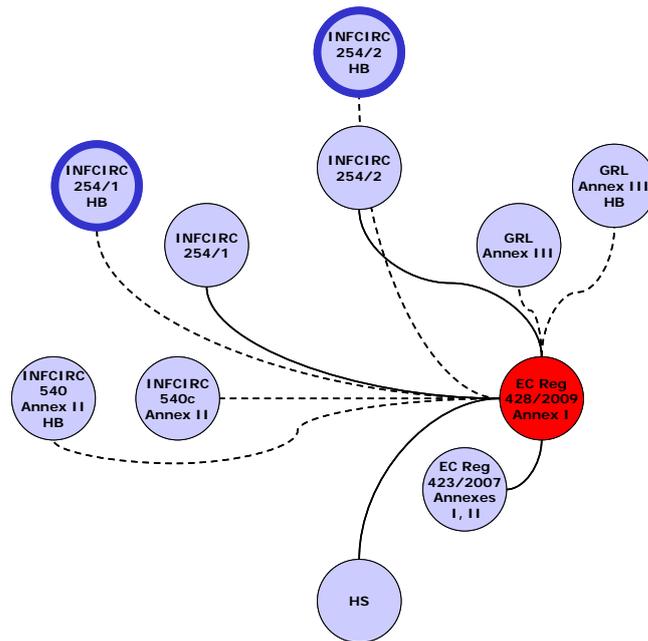


Figure 5 – Correspondences (native and derived) from EC Reg 428/2009 Annex I to other documents in the collection.

Figure 6 illustrates yet another perspective, this time related to EU customs controls. In this case the focus document is the Harmonized System, because HS descriptors appear in declarations of goods to be exported. Through HS descriptors and the CT correspondence table customs officers get an indication on whether goods under export *could* be listed under EC Reg 428/2009 Annex I. Further, customs can access handbook information on these items and get descriptions of their typical appearance, and health and safety cautions associated with them.

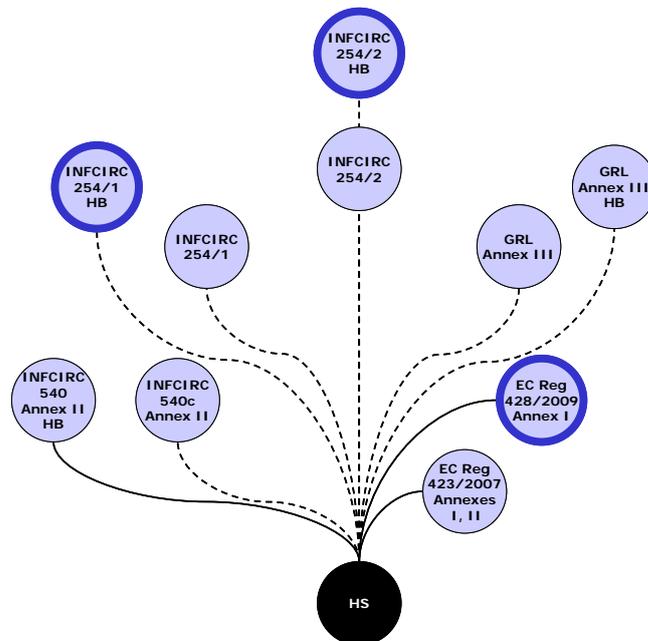


Figure 6 – Correspondences (native and derived) from Harmonized System to other documents in the collection.

These few examples show how TBT could support several information and decision processes related to export controls on ‘listed items’ besides IAEA’s perspective.

3. The Big Table tool

This second Part of the report focuses on 'The Big Table' (TBT) as tool to:

- Browse and search the collection of reference documents presented in Section 2.3.
- Select items of interest to case studies related to nuclear trade. We will make reference to the illustrative case on machine tools introduced in Section 2.2.
- Map selected items to Harmonized System codes using correspondence tables presented in Section 2.4.
- Export HS codes in formats suitable to query web trade data services and retrieve records about trade of interest for analysis.

This Part of the report is intended for TBT users. It is best read while running TBT. A summary table of TBT's main commands is found in Appendix 3.

3.1. Software and hardware requirements

TBT is an application running under Windows NT, 2000, XP, 7 (preferred: XP service pack 3). Acrobat Reader 7.1 (or later) is needed to visualize the PDF documents. TBT needs 0.15 GB RAM to run. The program size on disk is 4.49MB. TBT also requires:

- The database that stores the document collection in itemized form. The full database size is 150MB.
- PDF files of the document collection. The full size is 180MB.
- Screen dimension: 17' (preferred). Screen resolution: 1280 by 1024 pixels (preferred).

The preferred screen dimension is due to TBT using a multi-panel layout (see 3.4). This fits better in screens of desktop computers. A special TBT version is available for laptop computers with smaller screens.

TBT's source code is registered in the JRC software catalogue as Nr. 2883.

3.2. Installation and start

TBT distribution bundle includes the software installer ('The Big Table.msi'), the database ('TBT.mdb') and the folder of PDF documents ('Documents').

To run the installer, system administrator rights are required⁵. The installer copies TBT's executable in a user-defined location⁶ and creates a shortcut icon to the executable on the desktop (Figure 7, left).

⁵ The installer registers software libraries (dlls) needed by TBT. The main ones implement plug-ins, namely an Acrobat reader to show PDF documents and an Excel sheet to compile tables of items.

⁶ By default under C:\Program Files\The Big Table.

To complete the installation, the database and documents' folders need to be copied in a user-defined location, for example, under a folder named TBT:

- ...\\TBT\\Database\\TBT.mdb
- ...\\TBT\\Documents\\

The Documents folder in the distribution bundle includes only regulatory documents and the Harmonized System. Limited-access technical handbooks [6][11][13][15] need to be available at the installation site, and be copied under Documents, respecting the following file naming convention:

- INFCIRC 540 Annex II HB (2004): ...\\AnnexII-AP-HB\\AnnexII-AP-HB.pdf
- INFCIRC 254 1 HB (2002): ...\\INFCIRC-254-1-HB\\TLH.pdf
- INFCIRC 254 2 HB (2003): ...\\INFCIRC-254-2-HB\\NSG-DU-Handbook-Rev1-07-03.pdf
- GRL Annex III HB (1998): ...\\AnnexIII-Iraq-HB\\AnnexIII-Iraq-HB.pdf

With the database and the Documents folder copied, TBT can be run (double-click on its icon). The *Start* window opens (Figure 7, right). To quit TBT, click on **Exit**.



Figure 7 – Left: TBT's executable icon. Right: *Start* window.

3.3. Settings command

The first time TBT is run after installation, the location of the database and of the documents' folder need to be specified. This is done in **Settings** (Figure 8, top frame 'Data').

After this operation, the *Search* and *DB* commands become available on TBT's *Start* window.

Other parameters in *Settings* control the 'Layout' of the *Search & View* window, the format for the 'Export' of items' *Codes*, the format of items' export to Excel (↪ 3.4.3), and color conventions used in *Search & View* (↪ 3.4.2).

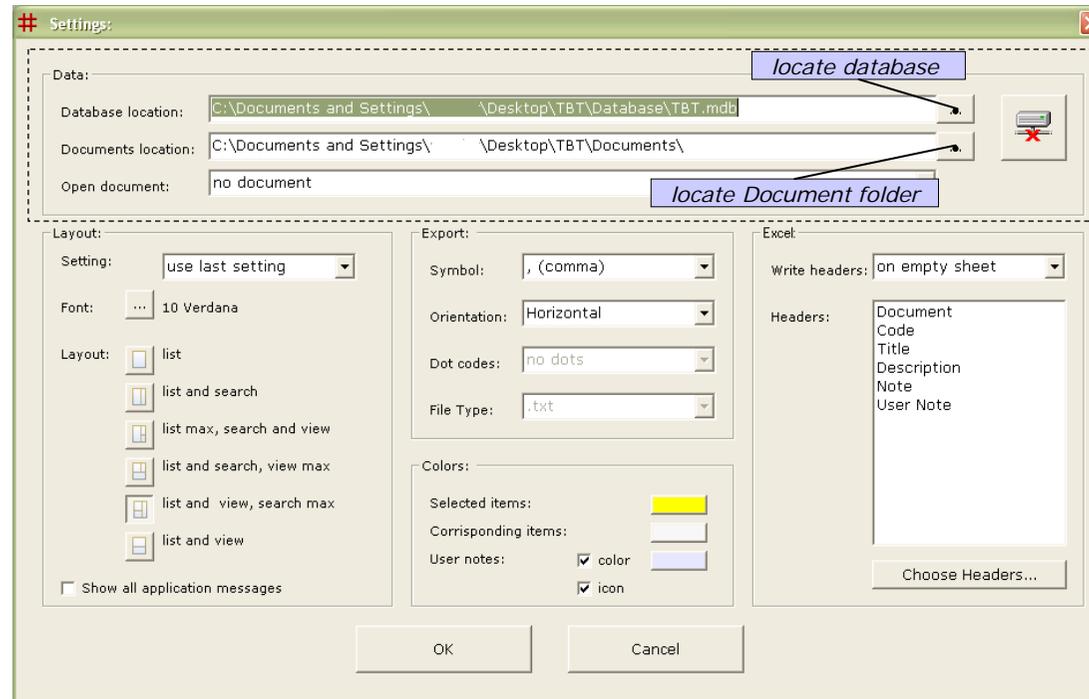


Figure 8 – Settings window.

3.4. Search command

The *Search* command opens the window to **Search & View** TBT's document collection (Figure 9).

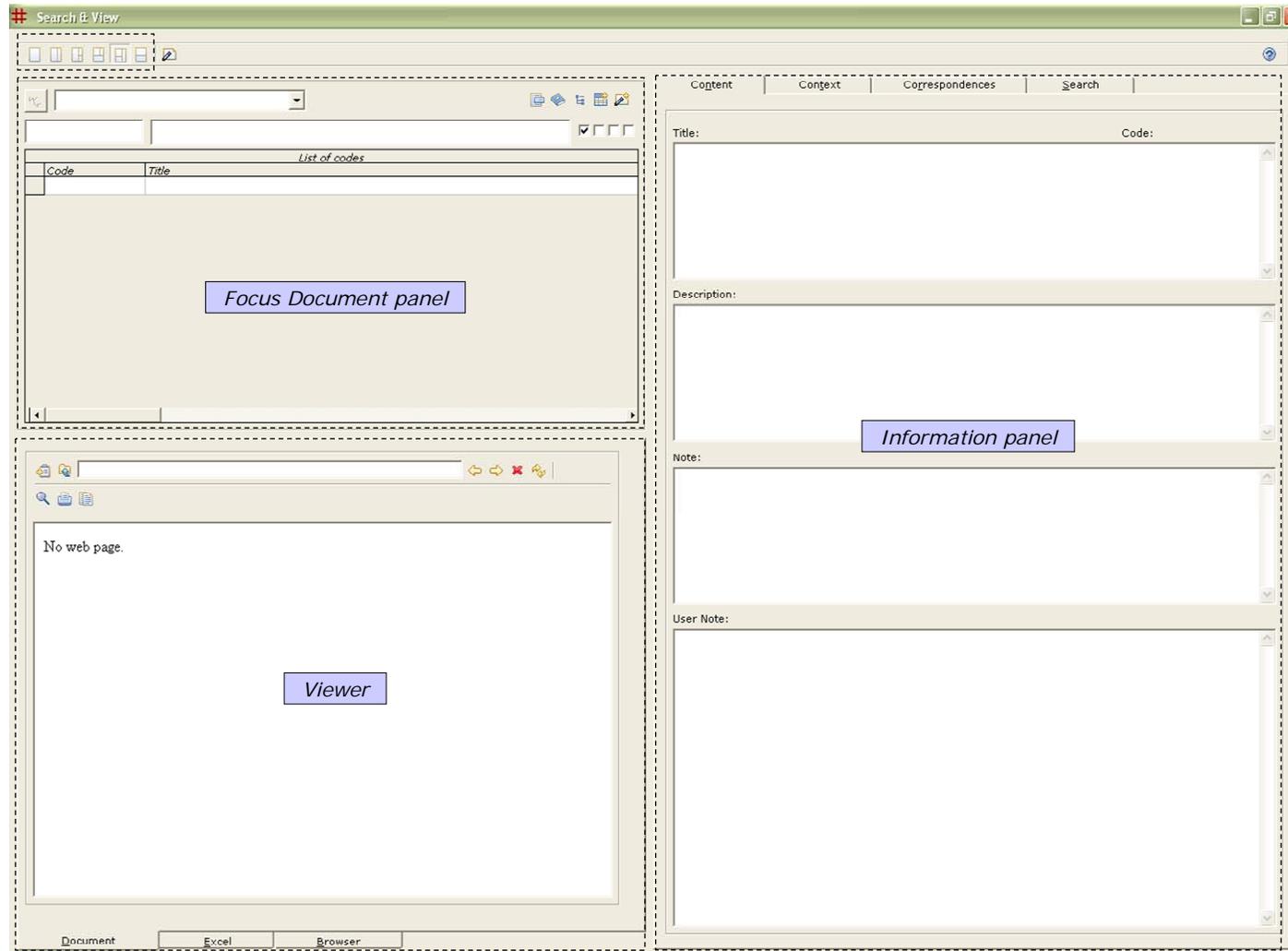


Figure 9 – Search & View window.

Search & View is organized in three panels:

- The *Focus Document* panel – Is to browse and search by text items listed in a specific document of the collection.
- The *Information* panel – Shows information on items selected in *Focus Document*, such as corresponding items in the document collection. It is also used to search multiple documents by text.
- The *Viewer* – Shows the PDF page of an item selected in *Focus Document*. It also embeds an *Excel* sheet to compile tables of items of interest to a trade case study and a *Browser* to connect to web data services on global trade.

The information shown in the panels is synchronized, meaning that actions performed on a given panel (e.g., selecting an item) have effect on what is displayed in the other panels.

The panels can be configured in different layouts. A layout expands or hides panels. The user can switch to a convenient layout by the toolbar located top-left on *Search & View* (Figure 10). For example, the layout shown in Figure 9 is the second from the right on the toolbar.



Figure 10 – Toolbar to select panel layouts.

A brief explanation of each panel is now given.

3.4.1. Focus Document panel

The *Focus Document* panel shows a reference document to work with in itemized form. The document is selected by the pull-down list located top left on the panel (in Figure 11, left, the document is INFCIRC 254 2). Selecting a document loads its list of items in this panel and the corresponding PDF document in the *Viewer* (see 3.4.3).

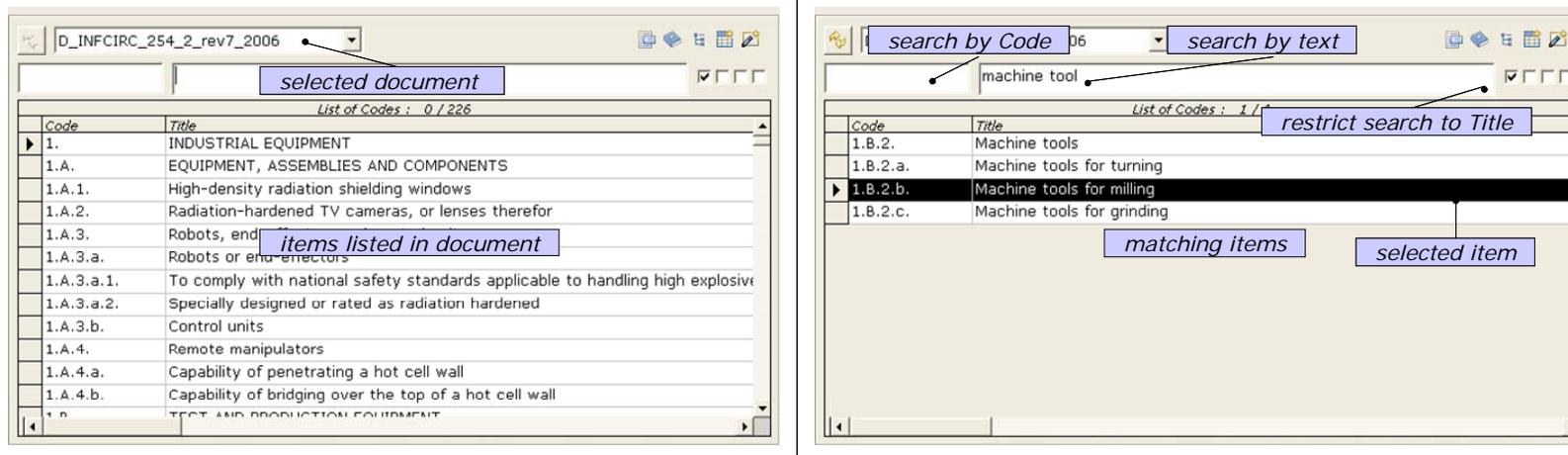


Figure 11 – Focus Document panel. Left: List of items in the focus document. Right: Text search on the focus document retrieves matching items.

The focus document can be searched by typing text in the long entry box (Figure 11, right, 'machine tool' is typed). Matching items are returned as the text is typed-in. Text search can be restricted to selected fields (*Title*, *Description*, *Note*, *User Note*) by the check-boxes next to the text entry box. To search on items' *Codes*, the entry box on the left-hand side is used. Selecting an item on the *Focus Document* list:

- Shows in the *Information* panel item's related information (see 3.4.2).
- Loads in the *Viewer* the PDF page where the item is defined (see 3.4.3).

Multiple items can be selected in the *Focus Document* list by <CTRL-Mouse-Left>. Actions can be performed on selected items by the toolbar located top-right on the panel (Figure 12). Specifically, clicking on:

- The *Content* icon opens new windows (one for each selected item) showing the item's *Code*, *Title*, *Description*, *Note* and *User Note* (Figure 13, left).
- The *Book* icon opens new windows (one for each selected item) showing the PDF page where the item is defined (Figure 13, right).
- The *Correspondences* icon opens a new window showing corresponding items to the selected ones in the whole document collection. See 3.4.2 for an explanation about how correspondences are presented.

- The *Add to Excel* icon copies selected items to the *Excel* tab in the *Viewer Panel*. In a nutshell, this is to compile tables of items of interest and to document work carried out in TBT on a given case study. See 3.4.3 for an explanation on the *Excel* tab.
- The *Add to Clipboard* icon copies selected items to the *Clipboard*. Briefly, this is to have items of interest in a memory area to process them further. See 3.4.4 for an explanation on the *Clipboard*.

Note that these *icons* appear in different combinations also on the *Information* panel's tabs, and on the *Clipboard*. In all contexts, clicking on these icons has effects on selected items consistent with what explained above.



Figure 12 – Toolbar on *Focus Document* panel: *Content*, *Book*, *Correspondences*, *Add to Excel* and *Add to Clipboard* icons.

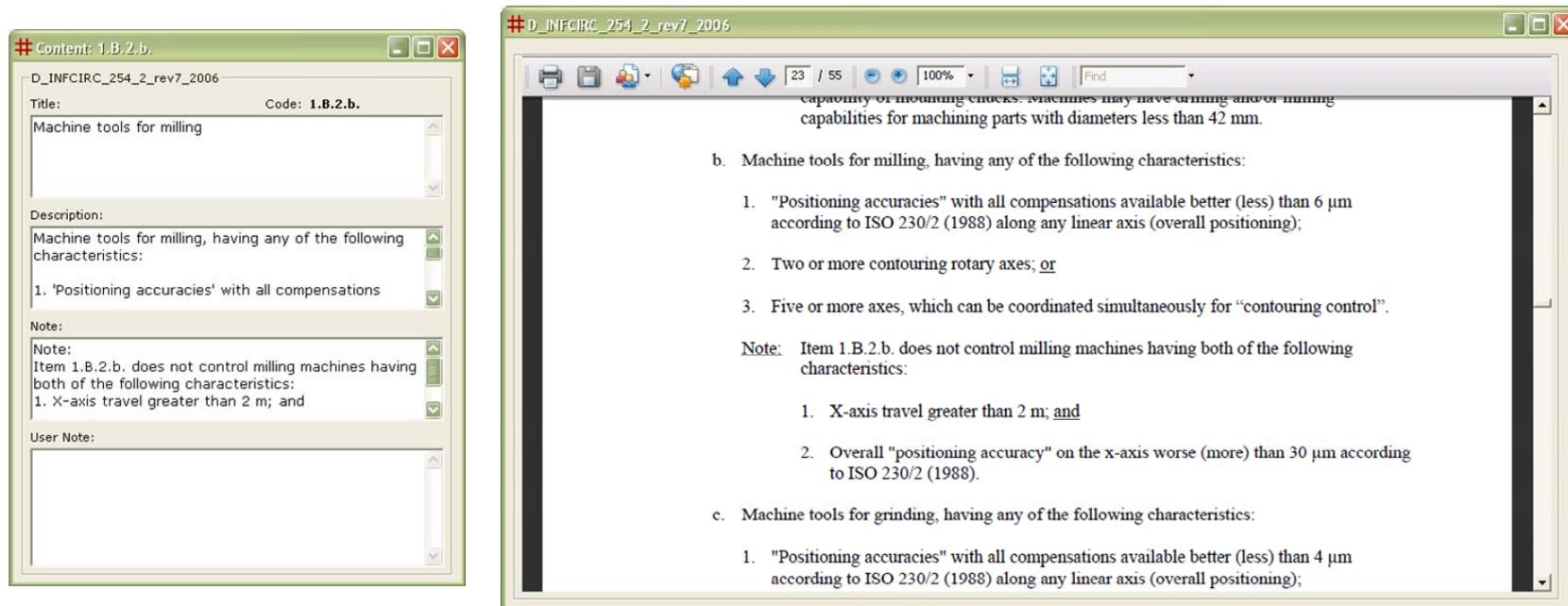


Figure 13 – Left: Window on *Content* of a selected item. Right: Window on *Book* (PDF) page of a selected item.

3.4.2. Information panel

The *Information* panel is made of four tabs named:

- *Content*;
- *Context*;
- *Correspondences*;
- *Search*.

For an item selected⁷ in *Focus Document* (e.g., '1.B.2.b. Machine tools for milling'), **Content** displays its *Title*, *Description*, *Note*, *User Note* (Figure 14, left).

Context shows *where* the item is defined in the document structure (Figure 14, Right). Depending on the document's native structure, by the position of an item in a document, analysts may get a view of the processes to which the item contributes. *Context* displays the document as a tree of items (see 2.3) with the selected⁸ item highlighted in color (see 3.3). The tree can be expanded to full-size or collapsed by the second and first icons in the toolbar top-right on this tab (Figure 15). The *Clear* icon clears the selection on the tree. The *Book* icon opens the PDF document in a separate window. Note that *Context* cannot be used to select items: it is a tab for display only.

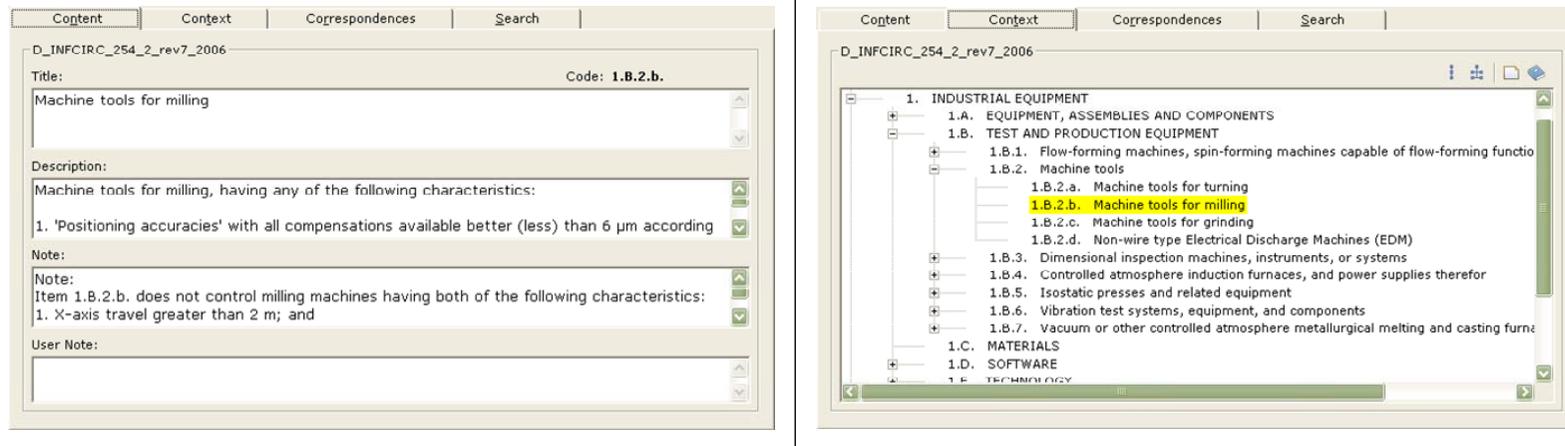


Figure 14 – Information panel. Left: *Content* tab. Right: *Context* tab.

⁷ For multiple selections in *Focus Document* (obtained by <CTRL-Mouse-Left>), *Content* refers to the last selected item.

⁸ For multiple selections in *Focus Document*, *Context* highlights all selected items, i.e. *Context* is additive.



Figure 15 – Toolbar on the *Context* tab: *Collapse Tree*, *Expand Tree*, *Clear* and *Book* icons.

For an item selected⁹ in *Focus Document* (again: '1.B.2.b. Machine tools for milling'), the **Correspondences** tab shows corresponding items in the whole document collection (see 2.4 on *Correspondence tables*). Correspondences are shown as a tree (Figure 16): the root of the tree is the item selected in the focus document, branches are documents in the collection, leaves are corresponding items in a given document. Items in the tree are represented by their *Codes*.

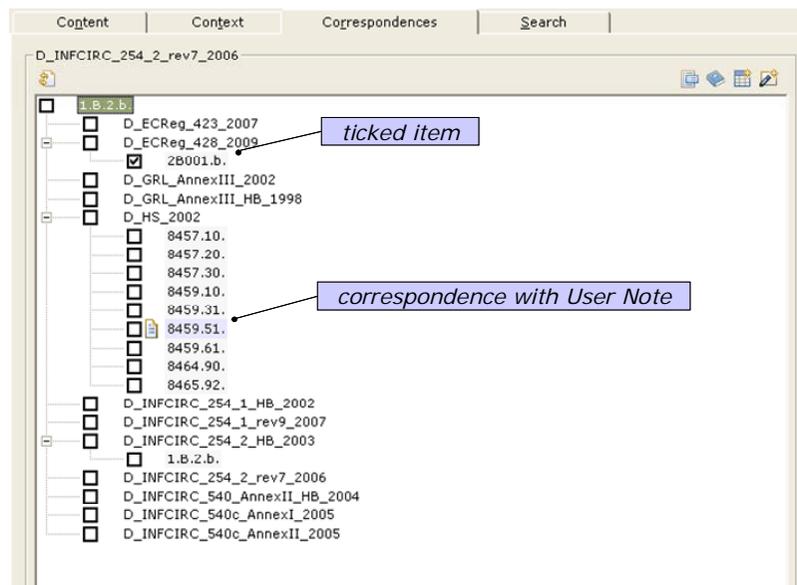


Figure 16 – Information panel. Tab on *Correspondences*.

To see an item's *Content*, two possibilities are in place. The first is to tick the check-box next to the item (2B001.b. in Figure 16), then click on the *Content* or *Book* icons located on the toolbar top-right on the tab. These actions pop-up independent windows displaying the item's *Content* or the PDF page of the item in the source document (Figure 17, showing '2B001.b Machine tools for milling ...' as defined in EC Reg 428/2009). This *Content* display modality applies simultaneously to all items ticked in the tree. Alternatively, to see a single item's *Content*, one can right-

⁹ For multiple selections in *Focus Document*, *Correspondences* shows corresponding items for all selected items, i.e. *Correspondences* is additive.

click on the item to get it highlighted and then *pivot* on it (click on the *Pivot* icon located top of the tree, Figure 18, right). This sets the item as new root for the *Correspondences* tree, loads the related document as *Focus Document*, with the item selected¹⁰.

Other actions that can be performed on items ticked on *Correspondences* are the copy of items to *Excel* (☞ 3.4.3) or to the *Clipboard* (☞ 3.4.4).

Finally correspondences may have *User Notes* attached. These appear as small icons next to correspondences (as for item 8459.51 in Figure 16). A right-click on the icon opens the *User Note* for reading (Figure 19). *User Notes* capture analyst annotations on the relevance of a given correspondence. For example, a *User Note* indicates that HS code 8459.51 becomes a relevant descriptor for trade of high-precision milling machines when the trade unit value is high. *User Notes* visible in Search are read-only. They can be edited by TBT's *super-users* (i.e., content managers) through the *DB* command (☞ 3.5).

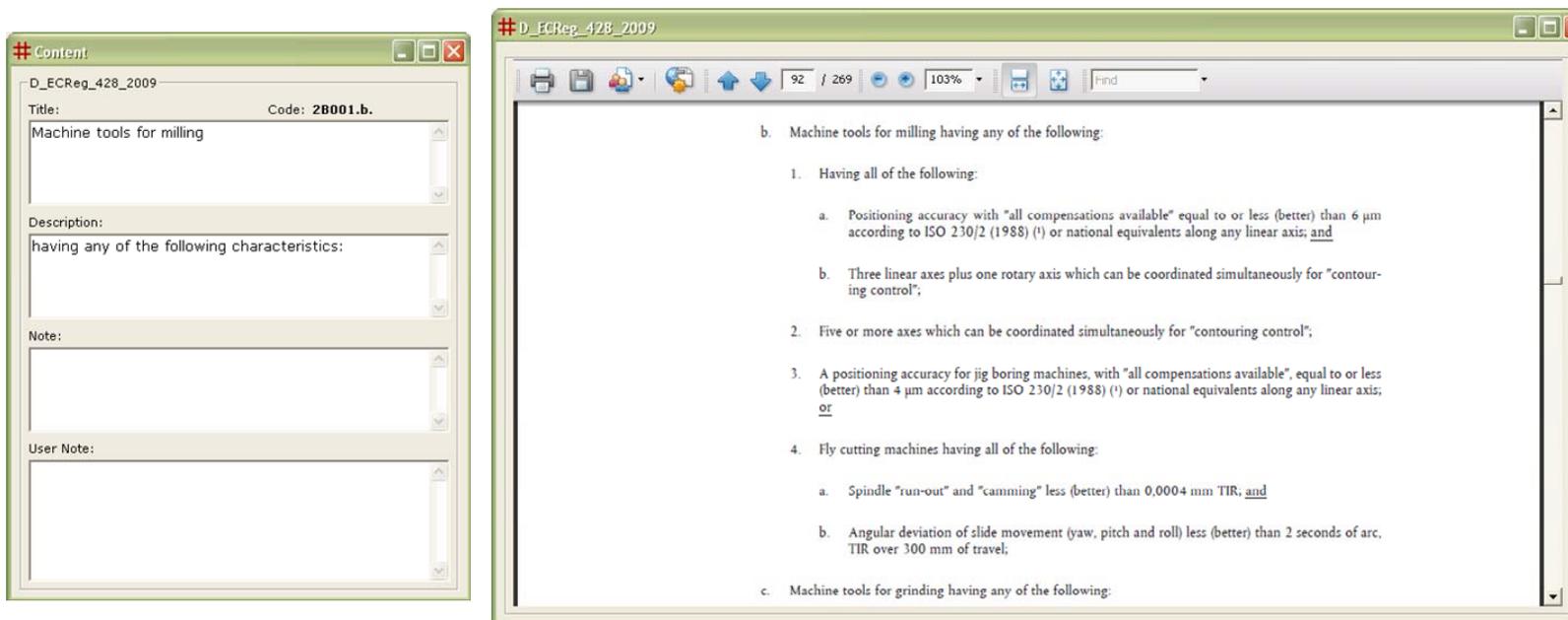


Figure 17 – Information panel. Left: *Content* window for an item selected in the *Correspondences* tree. Right: *Book* window for an item selected in the *Correspondences* tree.



Figure 18 – Left: Toolbar on the *Correspondences* tab: *Content*, *Book*, *Add to Excel* and *Add to Clipboard* icons. Right: *Pivot* icon.

¹⁰ The pivot operation can be performed only on a single item at a time.



Figure 19 – *User Note* on a correspondence.

Search is the last tab in the *Information* panel (Figure 20, left). It is used to perform a text search on *multiple documents* in the collection. A query is composed by the icons on the left part of the tab (Figure 20, middle). By these, one can create a new query, save it, load a previously saved query, and more. Text search can be restricted to selected fields (*Title, Description, Note, User Note*, Figure 20 right). On the right part of the tab, the documents to be searched are to be ticked¹¹. When the query is run, the result is returned on the right part of the tab as a tree (Figure 22). Branches are single documents, leaves are matching items. Items are represented by their *Codes*. To see an item's *Content*, two possibilities are in place. The first is to tick the check-box next to the item, then click on the *Content* or *Book* icons located on the toolbar top-right on the tab (Figure 23). These actions pop-up independent windows displaying the item's *Content* or the PDF page of the item in the source document. This *Content* display modality applies simultaneously to all ticked items in the tree. Alternatively, to see a single item *Content*, one can double-click on the item: this loads the related document as *Focus Document*, with the item selected: the *Content, Context* and *Correspondences* tabs are then synchronised with the item selected¹².

Other actions that can be performed on items ticked on the tree of query results are: viewing their *Correspondences*, and copy them to *Excel* (3.4.3) or to the *Clipboard* (3.4.4).

Note: *Search* complements the search by correspondence tables which is the distinguishing feature of TBT. *Search* is useful, for instance, to search by text the Harmonized System text. In general a text-based search of the HS will lead to the identification of HS codes other than those suggested by correspondence tables. Some may be relevant to address a specific trade-related case study. In general, correspondence tables provide a good starting point as they reflect expert judgement on the relationship between items and the HS. On the other hand, not all HS codes presented by correspondence tables may be relevant to a case study at hand. Their relevance need always to be evaluated on a case-by-case basis.

¹¹ When the top check-box 'Documents' is ticked, the whole document collection is searched.

¹² In practice, this operation is equivalent to the *Pivot* operation on the *Correspondences* tab.

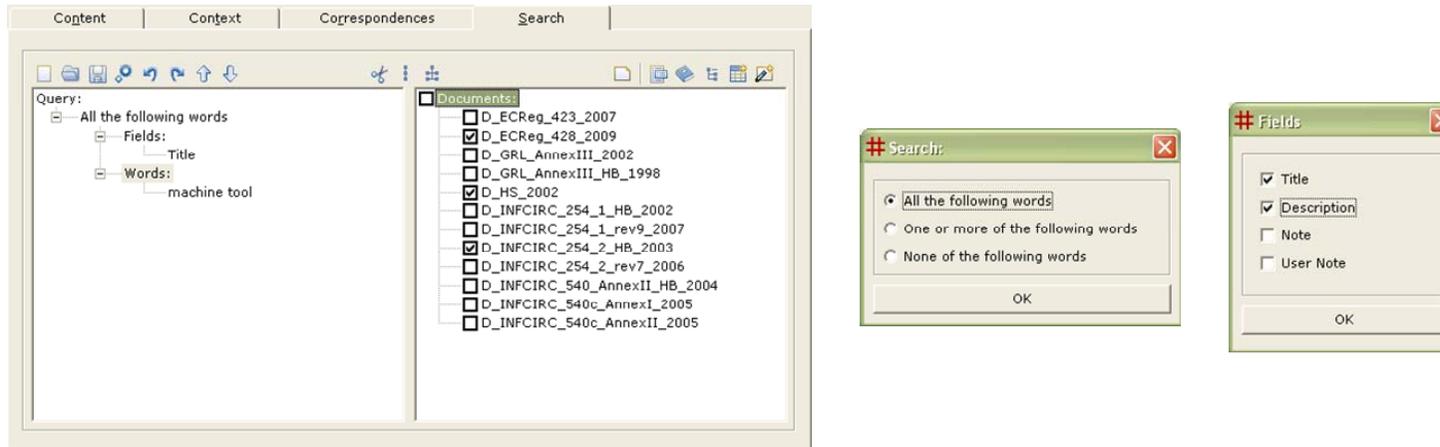


Figure 20 – Left: Information panel. Tab on Search. Middle, Right: Query parameters.

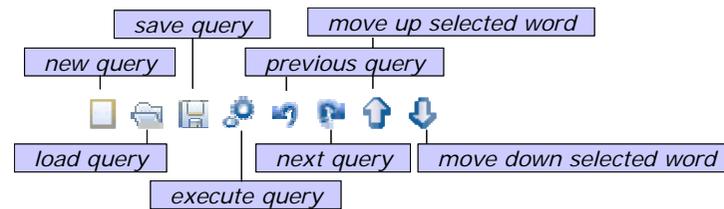


Figure 21 – Left toolbar on the Search tab: icons related to queries.

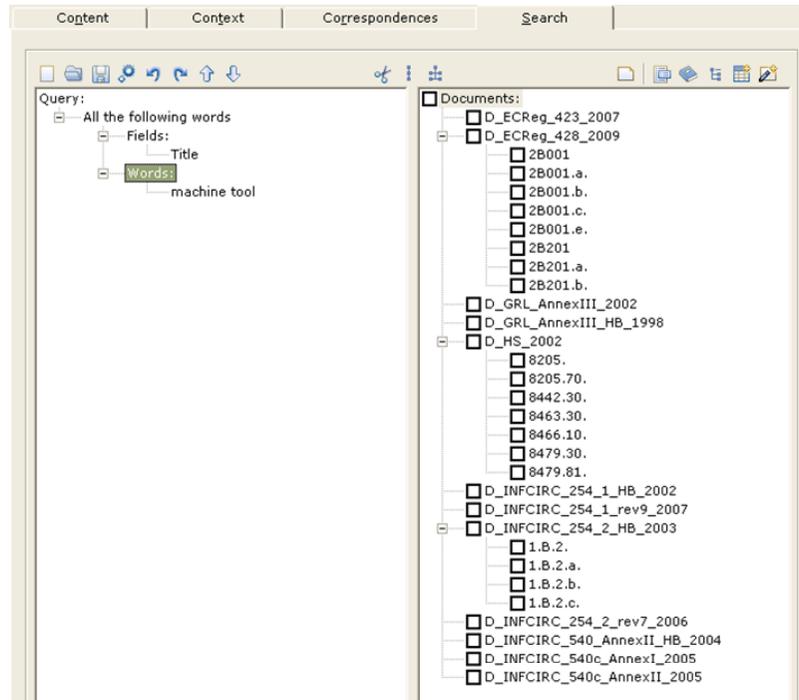


Figure 22 – Information panel. Tab on *Search*. Result of query.



Figure 23 – Right toolbar on the *Search* tab: icons related to query results.

3.4.3. Viewer panel

The *Viewer* panel is organized in three tabs named:

- *Document*;
- *Excel*;
- *Browser*.

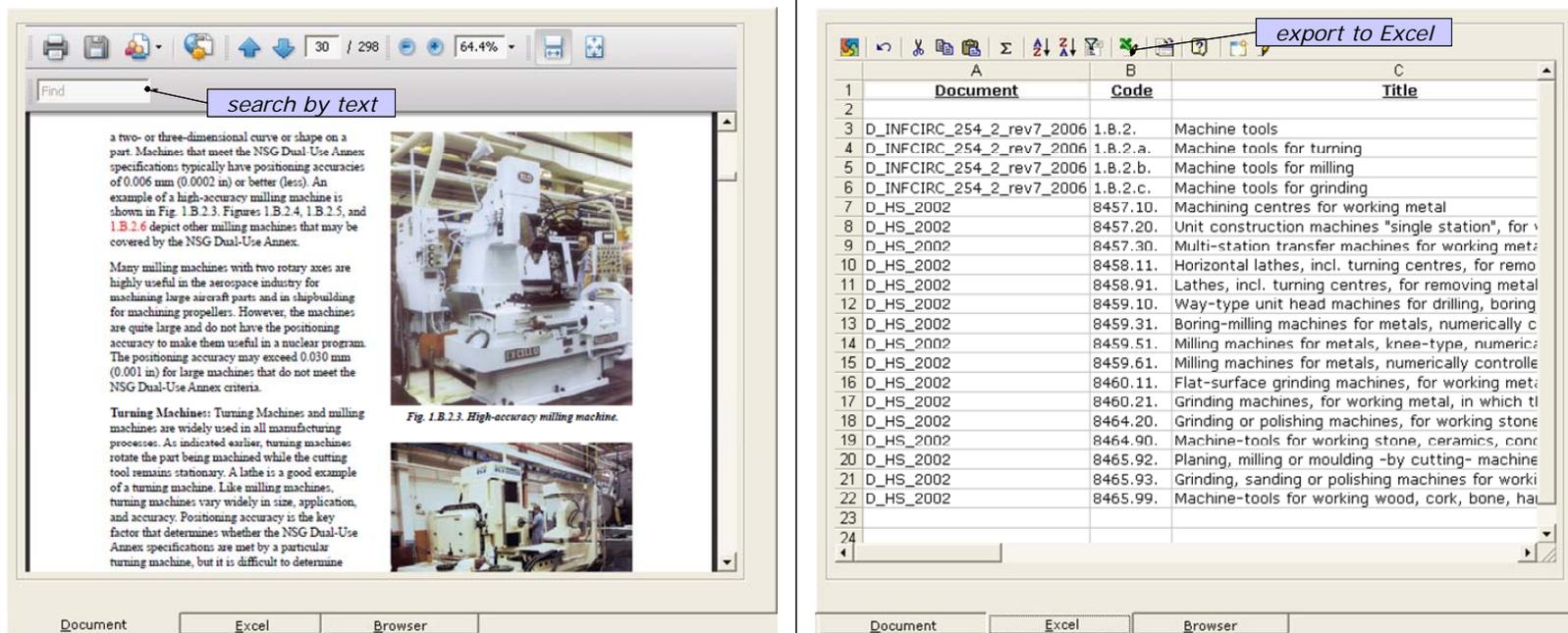


Figure 24 – Viewer panel. Left: *Document* tab. Right: *Excel* tab.

Document displays the PDF file corresponding to the *Focus Document*. It shows the initial page of the document when this is first loaded from the pull-down list in *Focus Document*. When an item is selected in *Focus Document*, *Document* displays the page where the item is defined. For example Figure 24, left, shows a page from INFCIRC 254 2 HB on machine tools.

Document is implemented by an Acrobat Reader plug-in¹³. Depending on the Acrobat version installed on the computer, *Document* offers different functionalities over the PDF file, a common one being search by text. Note this search is full-text over the entire PDF file. It differs from the text search run in *Focus Document* or in *Search* which: (i) can be restricted to any combination of the fields *Title*, *Description*, *Note*,

¹³ This dll is registered when TBT is installed.

User Note and (ii) takes place only on the list of items part of the document. For this reason, text search run in *Focus Document* or *Search* is expected to be more precise than a full-text search on the PDF file when searching for items. Text search on the PDF file is useful to search parts of the documents other than the list of items. For example, handbooks' Sections on appearance or uses of items can be searched only as PDF because these parts are not included in items' descriptive fields *Title*, *Description*, *Note*, *User Note*.

Finally it is noted that *Document* is only a display tab: selecting an item in a PDF document does not affect what is shown in the other panels (*Focus Document* or *Information* panels).

The **Excel** tab is used to compile tables of items (Figure 24, right). It is to document work carried out in TBT. A table may comprise a selection of items of interest to a case study and HS codes used to retrieve data records from web services on global trade.

By default, a table reports for each item an identifier of the document of origin, its *Code*, *Title*, *Description*, *Note* and *User Note*. This default format can be customized in *Settings* (see 3.3).

Items are added to Excel by first selecting them and then click on the *Add to Excel* icon. Because items can be selected in different panels or tabs (namely, in *Focus Document*, in *Correspondences* or as a result of a *Search*), the *Add to Excel* icon appears in all these places: by convention, TBT copies to Excel items selected in the panel or tab where the *Add to Excel* icon is clicked.

Excel is implemented by an Excel plug-in¹⁴. It provides a limited number of Excel functionalities (e.g., sort by text). To save the table, one needs to export it to Excel (click on Export to Excel icon). Otherwise, the table is lost when closing the *Search & View* window.

Browser is a standard web browser. It can be used, for instance, to start a web data service on global trade.

Browser can have 'Favorites' including websites or other documents of interest to the user. Favorites are stored under TBT's *Documents* folder in a directory named *_Browse*.

Favorite websites are listed in a file named *Documents_Browse\websites.txt*. Sites added here appear as Favorites. Typically, this can be the list of subscribed web data services on global trade (Figure 25, left).

Favorite documents are to be copied under *Documents_Browse\Docs*. For example, the *Catalogue of WEB Data Services on Global Trade* [2] (Figure 25, right).

Browser can also be used to browse for local files and view other documents.

Browser is embedded as tab in the *Viewer* panel, but it can also be spawned as independent window by clicking on the *Double-page* icon.

¹⁴ This dll is registered when TBT is installed.

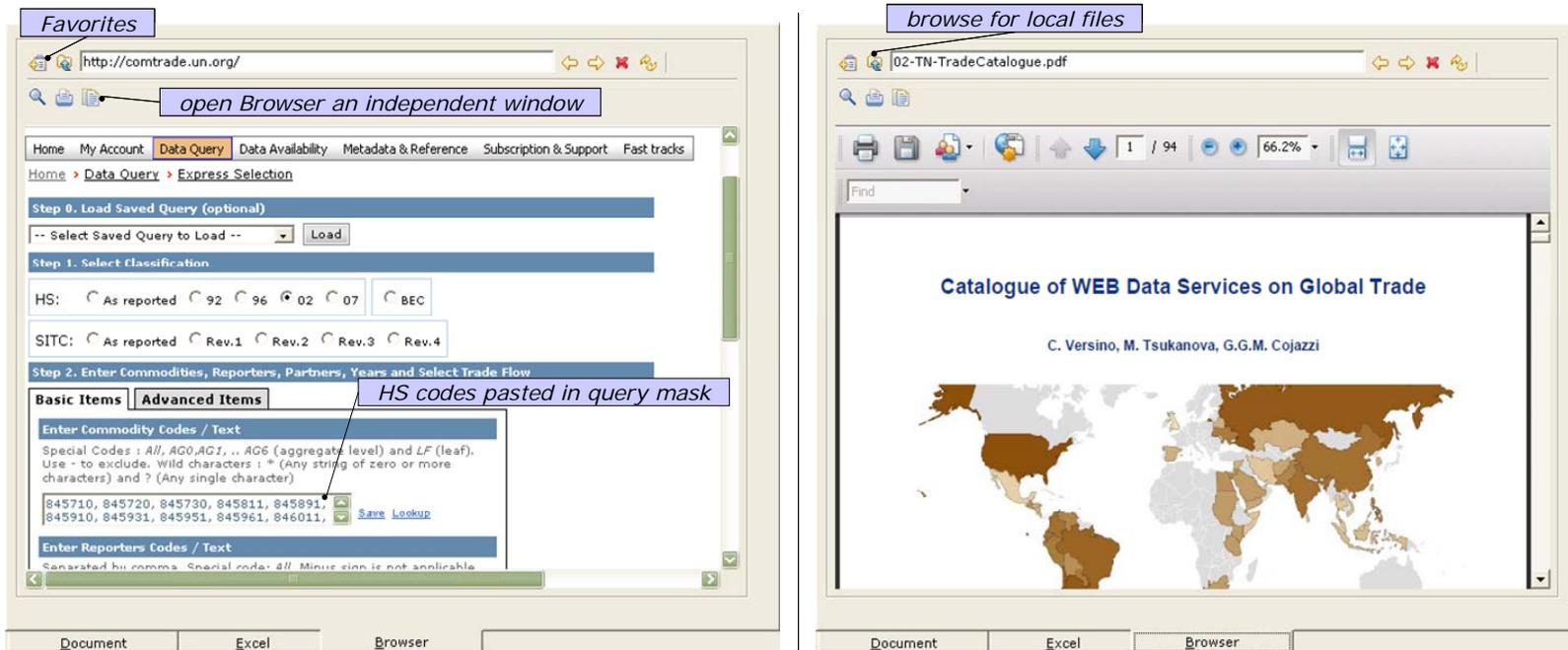


Figure 25 – Viewer panel. Browser tab. Left: Connected to a web service on global trade. Right: A favorite document.

3.4.4. The Clipboard

The last tool available in *Search & View* is the *Clipboard* (Figure 26). It is a memory area where items of interest are collected for further processing. Its main purpose is to format HS codes of interest in a way that they can be used directly to query web data services.

Items are added to the *Clipboard* from *Search & View* by first selecting them and then click on the *Add to Clipboard* icon. Because items can be selected in different panels or tabs (namely, in *Focus Document*, in *Correspondences* or as a result of *Search*), the *Add to Clipboard* icon appears in all these places: by convention, TBT copies to the *Clipboard* items selected in the panel or tab where the *Add to clipboard* icon is clicked.

To open the *Clipboard* content, click on the *Clipboard* icon (Figure 27) located on the top-left toolbar close to the layout selector.

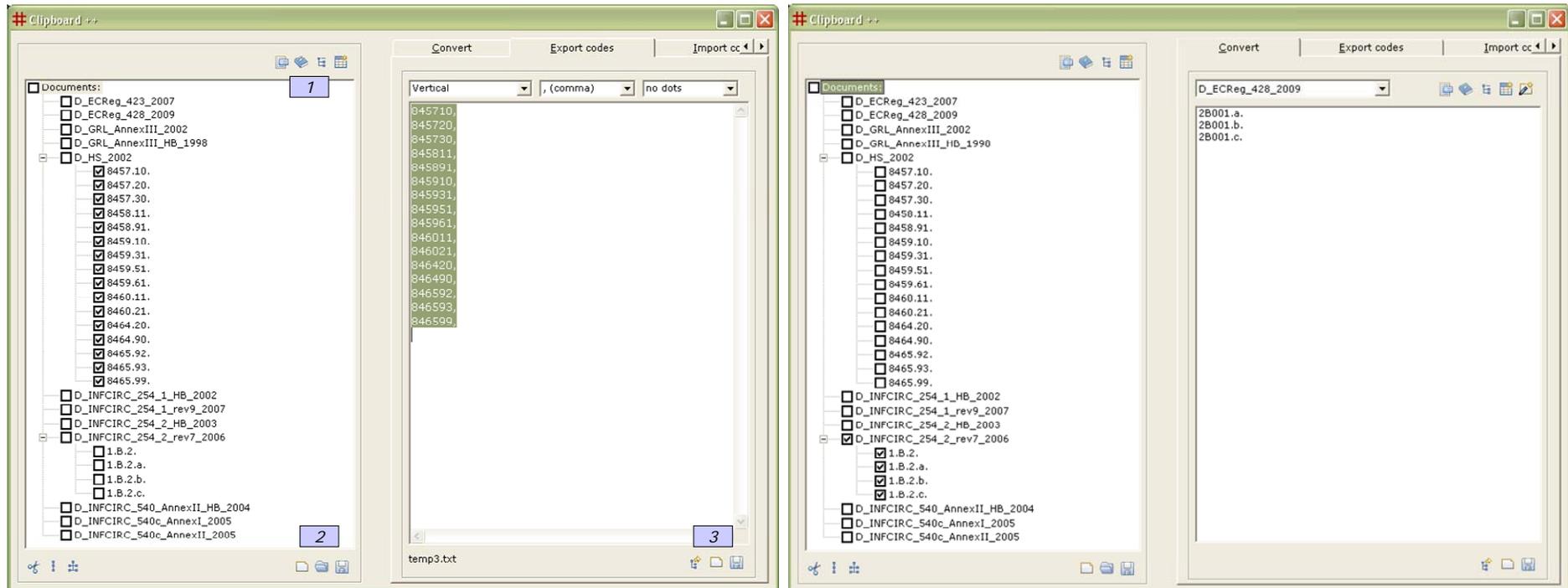


Figure 26 – The *Clipboard*. Left: *Export codes* tab. Right: *Convert* tab.



Figure 27 – The *Clipboard* icon.

The *Clipboard* is made of a left and right panel.

The left panel shows items sent to the *Clipboard* from *Search & View*. They are presented in a tree like the one used in the *Search* tab. On this panel one can:

- Select items on the tree by their checkboxes and see their *Content*, *Book PDF page*, *Correspondences* or *Add them to Excel* by the top-right toolbar (marked '1' in Figure 26, left).
- Clear, save or load the tree content from/to file by the low-right toolbar (marked '2' in Figure 26, left).

The right panel is to perform operations on *Codes* ticked on the left panel tree. Each operation is implemented by a specific tab and is initiated by clicking the first icon in the low-right toolbar (marked '3' in Figure 26, left). Specifically:

- *Export codes* is to format ticked HS *Codes* so that they can be copied and pasted in query masks on web data services on global trade. *Codes* can be formatted in a horizontal or vertical layout, with different characters used as *Codes'* separators, and with/without dots within a *Code*. An example is shown in Figure 26, left. Selecting these formatted *Codes* and copying them (CTRL-c), allow to paste them in a web data query mask as shown in Figure 25, left. This is useful when querying on a medium-to-large set of HS codes. Exported codes can be also saved to a text file.
- *Convert* is to translate ticked *Codes* by correspondence tables towards a specific document in the collection. For example, Figure 26, right, shows *Codes* related to machine tools in INFCIRC 254 2 converted to equivalent items listed in EC Reg 428/2009. Converted codes can be saved to a file, specifically, a text file with one code per line.
- Sometimes it is useful to *Import Codes* into TBT (could be saved *Codes* from a previous TBT work session). Codes to import are read from file (text file with one code per line). Selected imported codes can then be *Add(ed) to Clipboard* and worked on the left panel tree by the toolbar marked '1' in Figure 26.

3.5. DB command

The **DB** command is for administrative tasks on TBT's database. The database includes a collection of tables to store:

- Documents in itemized forms (one table per document);
- Correspondences between pairs of documents (one table per correspondence).

DB access is reserved to TBT's *super-user* and *administrator*. The **super-user** manages the content of *existing* DB tables for documents and correspondences. The **administrator** has the same rights as the super-user and more: the administrator creates tables to add new documents to the collection or new correspondences; derives correspondences based on existing ones (see 2.4), duplicates document tables to host document revisions; defines which documents are visible from the Search & View interface; establishes links between document tables and PDF documents; creates DB back-ups; and more.

In what follows the super-user tool is described. The administrator tool is under development (see 5).

The **super-user tool** is designed to add or remove content to existing *DB* tables on documents and correspondences. It comprises two tabs, named:

- *List of Codes*;
- Correspondences.

List of Codes is to manage documents' tables (Figure 28). The super-user selects a document's table to work with by the pull-down list located top-right on the tab.

A document table is a list of items, each item being described by the following fields:

- *Code*: editable with restrictions (must be a unique identifier of the item within the document);
- *Title*: editable;
- *Description*: editable;
- *Note*: editable;
- *User note*: editable;
- *Page number*: editable, is the page number of the PDF document where the item is defined.

A document's table can be searched by code or text using the text entry boxes located top-left on the tab.

An item's content is edited by first selecting it in the document's list of items and then click on the *Edit* icon in the lower panel of the tab. This makes editable in the *Details* frame the item's *Code*, the four bottom boxes *Title*, *Description*, *Note*, *User Note* and the *Page* number. In *Edit* mode:

- Edits are saved only when clicking on *Modify* (or *Add*, see below).
- *Clear* clears all fields, *Code* included. This is used to create an entry in the table for a new item.

- *Add* saves the content as a new item in the table. The system checks that the item's code does not exist already in the table. Otherwise the item is not added.
- *Delete* removes the current item from the document table. Warning: this is an irreversible operation.

To exit *Edit* mode, click on the *Edit* icon again.

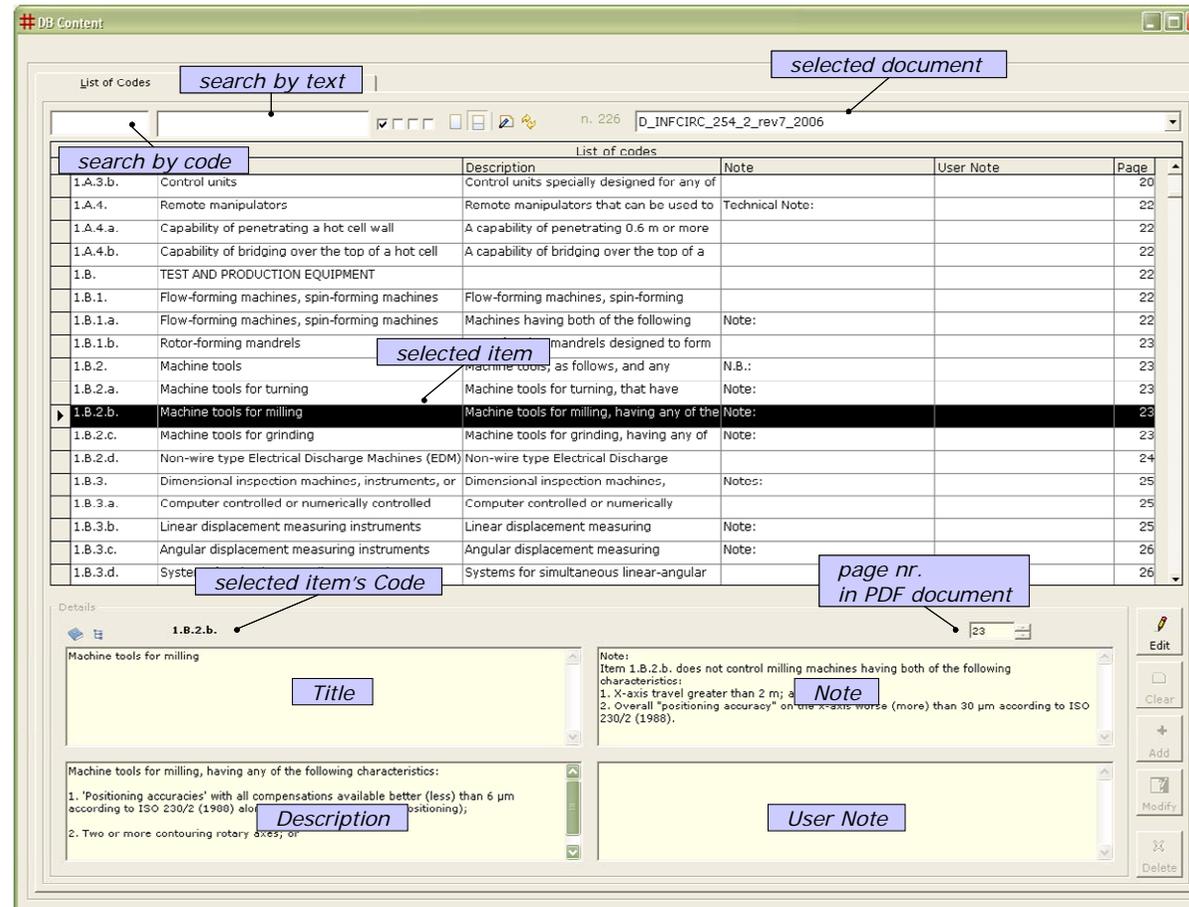


Figure 28 – DB Content window. List of Codes tab: Managing a document's table.

The **Correspondences** tab is to manage correspondence tables between pairs of documents (Figure 29). The super-user selects a correspondence table to work with by the pull-down list located top-right on the tab. The correspondence table name is composed by the names of the document pair put in correspondence. A correspondence table is a list of correspondences between pairs of items in the two documents. Each correspondence is made of three fields:

- *Code From*: code identifying an item in the first document;
- *Code To*: code identifying an item in the second document;
- *User Note*: free text annotation on the correspondence between two items.

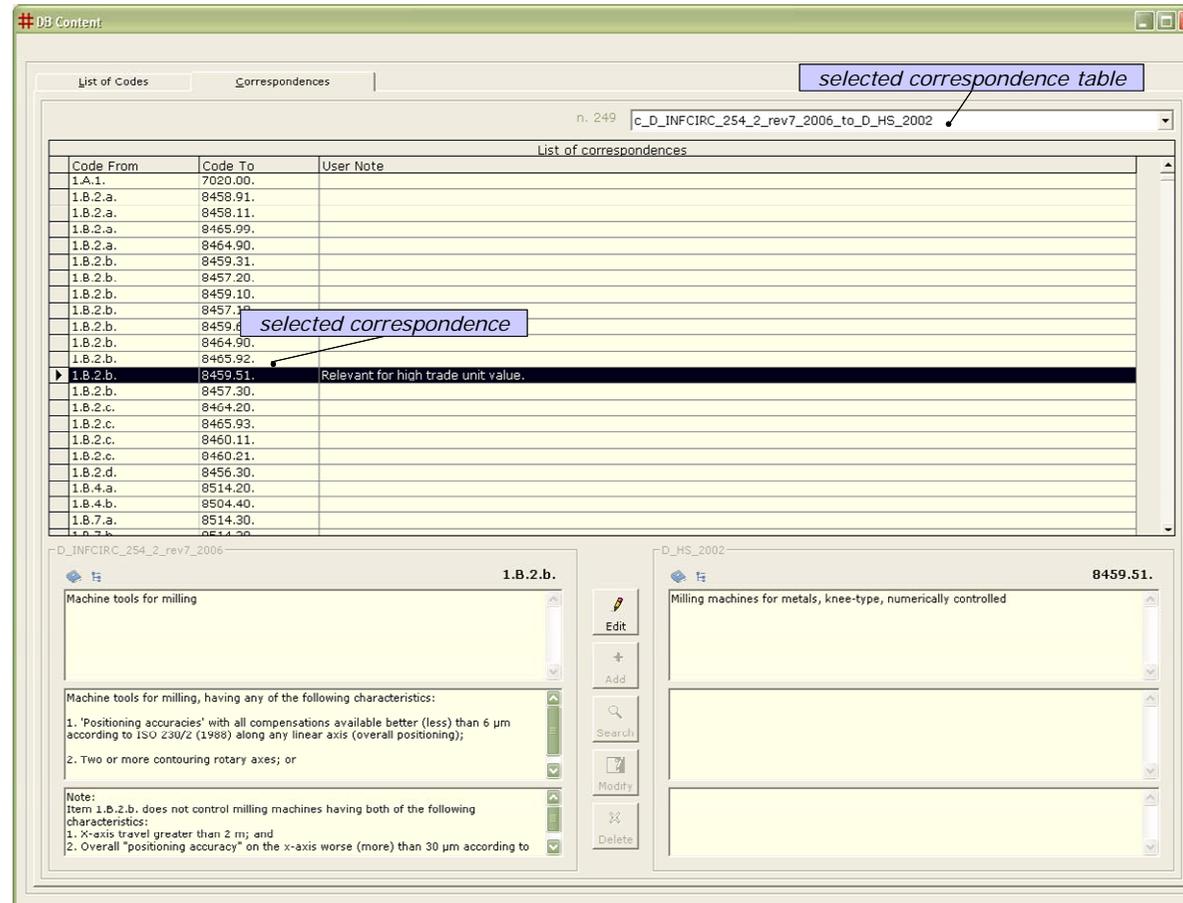


Figure 29 – DB Content window. Correspondences tab: Managing a correspondence table.

To edit the table of correspondences, click the *Edit* icon.

- For an existing, selected correspondence, *Modify* allows to edit the *User Note*.
- *Add* is to create a new correspondence pair. Clicking on *Add* modifies the *Correspondences* tab layout to allow select new *Code From* and *Code To* to be put in correspondence (Figure 30). A *User Note* can be added.
- *Delete* removes an existing, selected correspondence. Warning: this is an irreversible operation.

To exit *Edit* mode, click on the *Edit* icon again.

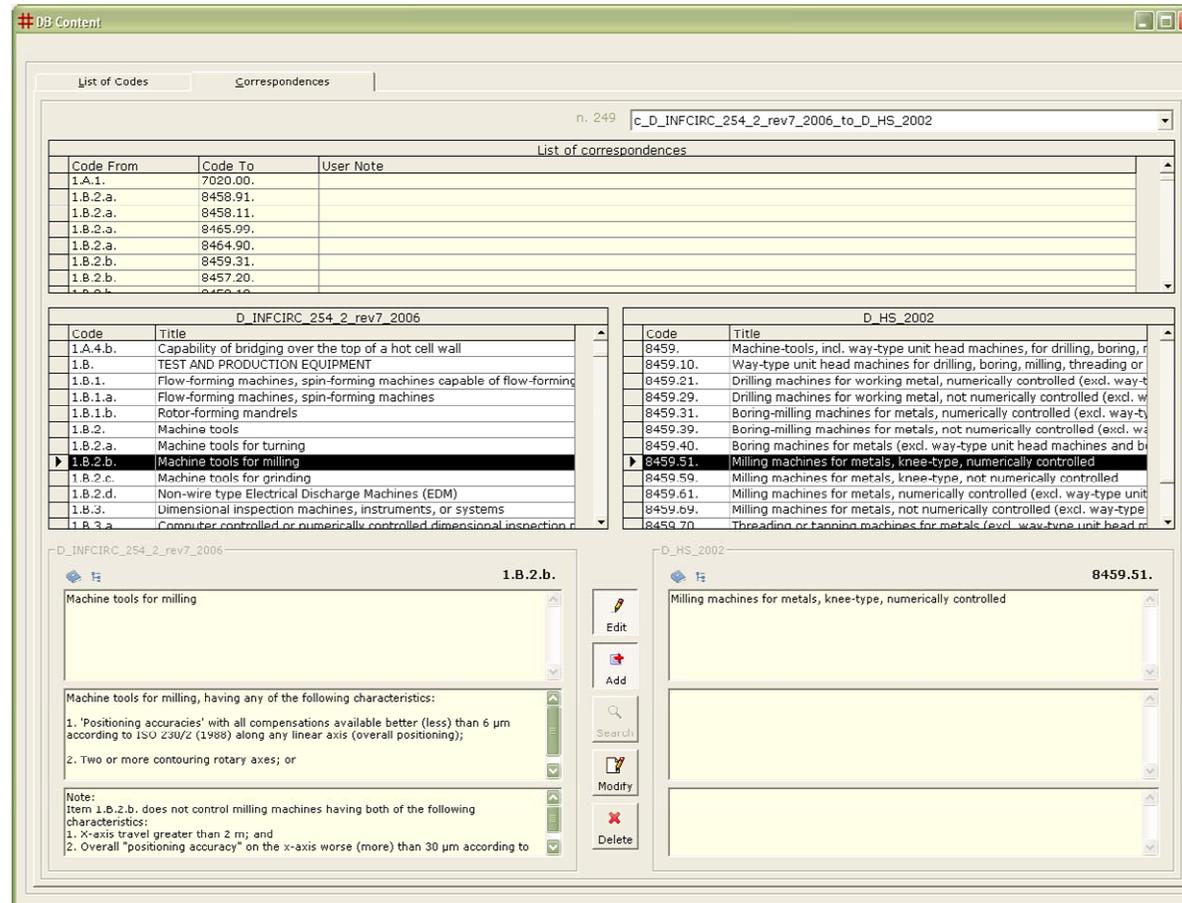


Figure 30 – DB Content window. Correspondences tab: Adding a new correspondence to the table.

3.6. Wrap-up on TBT's work-flow

This Section recaps TBT's work-flow illustrated in Figure 31.

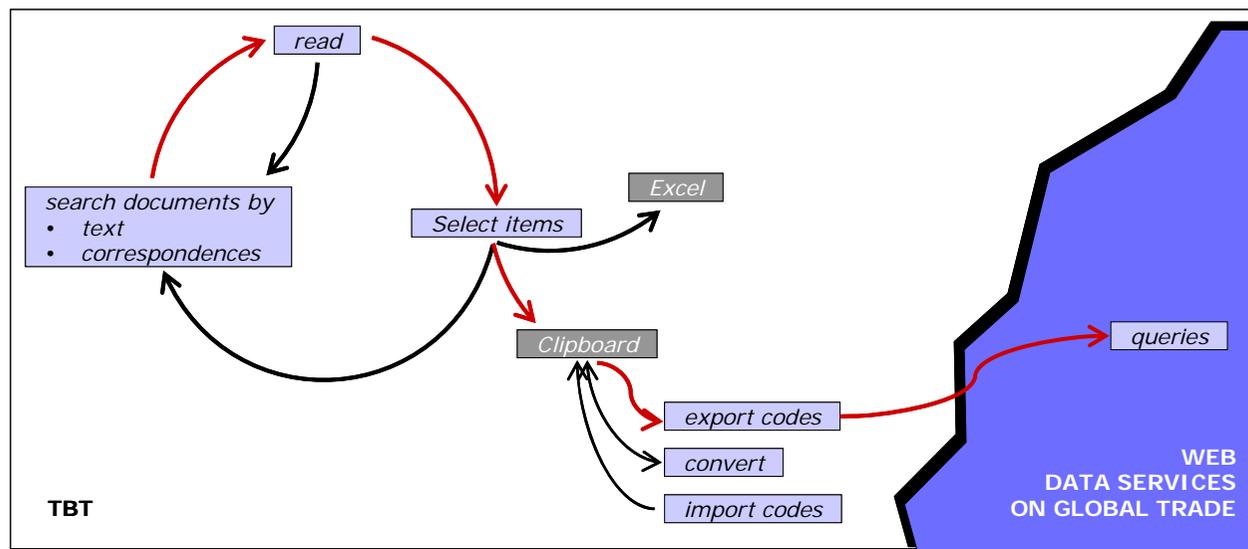


Figure 31 – TBT's work-flow.

TBT can be seen in first place as an information tool on export-controlled items. These items are defined and described in a collection of reference documents including regulatory documents, technical handbooks and the Harmonized System. Documents appear in TBT as lists of items and as PDF files.

The list of items format is stored in a database (*DB command*, § 3.5). Documents are tables in the database with fields *Code*, *Title*, *Description*, *Note*, *User Note* for each listed item.

TBT provides functionalities to search the document collection by text and by correspondence tables.

Text search can be run on a single document (*Focus Document panel*, § 3.4.1) or on multiple documents (*Information panel, Search tab*, § 3.4.2). Text search can be restricted to selected fields (*Code*, *Title*, *Description*, *Note*, *User Note*). Returned records can be read as structured text (*Information panel, Content tab*, § 3.4.2) or in the original PDF documents (*Viewer panel, Document tab*, § 3.4.3).

Correspondence tables identify related items appearing in the document collection. For example, correspondence tables connect items appearing in regulatory documents to their technical handbook equivalents –if any. Likewise they identify Harmonized System descriptors for items listed in regulatory documents. Corresponding items are visible in the *Correspondences* tab of *Information panel* (§ 3.4.2).

Items of interest (for example, to a trade-related case study) can be selected for further processing. Typically items are copied to:

- *Excel* tables (see 3.4.3) – For documentation purposes, it is useful to create tables of items that have been retained as relevant to a given case study. These may include HS descriptors.
- The Clipboard – In view of querying web data services on global trade, selected Harmonized System codes need to be formatted in a way compatible to a data service's query mask. This is done in the *Clipboard* by the *Export Codes* tab (see 3.4.4).

Web data services are queried 'outside' TBT. To this goal, the TBT web browser can be used. It stores as Favorites subscribed data services (*Viewer* panel, *Browser* tab, see 3.4.3).

Red arrows in Figure 31 depict the main TBT path starting from document search, to items selection, HS codes export and trade data queries.

4. TBT & related tools

TBT was designed and developed specifically to support work on nuclear trade analysis. To this end, the combination of tools offered by TBT is unique to the best of our knowledge. Some elements in TBT are related to other tools developed in the context of export controls. These are briefly reviewed hereafter. The majority of these are designed to inform EU exporters on legal restrictions that apply to trade. As such they support searching reference documents only in a few, selected directions. One tool (eCIT – SCORE) has been developed to support licensing and enforcement of export controls.

- **TARIC** [18] – Maintained by the European Commission (DG TAXUD) TARIC incorporates all EU legislation on trade, including EC Reg 428/2009 and EC Reg 423/2007. TARIC is a search tool published on a public web site. It can be accessed via TARIC codes, a subdivision of the HS. Given a TARIC code, the system retrieves the legislation that applies to the corresponding TARIC goods. This is the only search direction supported. TARIC does not contain technical information on items to which legislation applies.
- **Umschlüsselungsverzeichnis** [19] – The German export control authority BAFA publishes on its public web site a correspondence table between TARIC codes and items covered in EC Reg 428/2009. It is a PDF document organized by sections of the HS and intended to inform German exporters about restrictions that apply to the trade of items listed in Annex I of EC Reg 428/2009. The document does not contain technical information on the items covered and can be searched only by text. While the privileged order of consultation of the table is in the direction: TARIC → dual-use items, a full text search can be run on the set of PDF documents to derive the converse: dual-use items → TARIC for items of interest.
- **UK Goods Checker** [20] – The UK export control authority BERR publishes a web site to inform UK exporters on trade restrictions that apply to items listed in EC Reg 428/2009 and in national control lists. Access to the site requires registration. Legislation can be searched by text only. No reference is made to TARIC or HS codes. Some image data on controlled items is provided.
- **eCIT – SCORE** [21] – The U.S. Department of Energy (DOE) provides searchable online access to export controls lists as well as technical information on controlled items. Access to the site is restricted. This tool is meant for licensing and enforcement officials. Reference to the HS is made, but legislation or technical information on items covered in the system cannot be retrieved by HS codes. eCIT-SCORE appears to be the tool most related to TBT in that it connects various export control lists together and to technical information on items.

5. TBT's future developments and perspective uses of global trade data

TBT is an application designed to support nuclear trade analysis for IAEA safeguards. TBT embeds a collection of reference documents listing items subject to controls and correspondence tables between related items, including Harmonized System descriptors. Trade analysis is then based on web global trade data retrieved by Harmonized System codes from data services outside TBT.

From the use point of view, TBT is already adopted by the IAEA Safeguards Information Management division to support the collection and analysis of trade data directly or indirectly relevant to safeguards.

A further objective, yet to be achieved, is to establish a correlation between listed items and nuclear fuel cycle related activities. By doing so, TBT would help analysts integrating listed items in the Safeguards State evaluation process. As the main IAEA internal document to describe the nuclear fuel cycle, the IAEA Physical Model (PM) appears to be the most appropriate reference to use for this purpose. The PM already links activities with indicators, including material, equipment and components, but in a static way. These links would need to be reviewed, updated and completed as a prerequisite to their integration in TBT.

The IAEA also lists a number of manufacturing activities to be declared to the IAEA under the Additional Protocol (AP) [10] Annex I. TBT could link AP Annex I activities with both their input (material, equipment and components needed to carry out the activities) and their output (the nuclear related items they produce). Steps in this direction are presented in a JRC report [22]. This again would help analysts identify indicators of activities to be reported to the IAEA, fitting them in the general State evaluation process.

In both cases TBT would become an instrument to help translate references used by export controls and customs services into indicators of fuel cycle activities, well understood by the IAEA Safeguards community.

From the **software development** point of view, the main priority is to create TBT's *administrator* tool. The purpose of this tool is to manage and maintain over time document collection and the correspondence tables between these documents. Administrative tasks include: creating tables to host new documents and correspondences; deriving new correspondences by composition of existing ones (see 2.4); duplicating document tables to host document revisions; controlling documents' visibility in TBT's search interface; connecting document tables to PDF documents; creating database back-ups; and more.

A desirable further development is to create a *web-based version of TBT*. This would enable a large community of users to work with a shared documents' database (instead of locally installed databases), providing users authentication, and controlling levels of accessibility to TBT's database content.

Concerning the **document collection**, it is foreseen to complete in the short term the itemization of the whole EC Reg 428/2009 Annex I on items from internationally agreed dual-use controls. These include the Wassenaar Arrangement, the Missile Technology Control Regime (MTCR), the Nuclear Suppliers' Group (NSG), the Australia Group (AG) and the Chemical Weapons Convention (CWC). Presently TBT embeds only items listed in the NSG Guidelines Part 1 [12] and Part 2 [5]. With items from all control regimes covered, TBT could support tasks such as the rating of items for *export licensing for all regimes*; especially if connecting Annex I items of the EC Regulation on dual-use to technical handbooks available from the control regimes to which EU Member States adhere. In this respect, it is foreseen to include in TBT at least the technical handbooks by the AG and the CWC. Likewise, it is planned to extend the document collection to lists (besides [16][17]) that restrict the export of specific items to particular destinations. These will include the European Regulation implementing restrictive measures against the DPRK [23][24].

Perspective uses of global trade data of relevance to JRC work pertain to the area of export controls.

In all countries the *licensing* of export-controlled items is the responsibility of national authorities. It is based on detailed information provided by exporters in license applications. It makes use of the technical expertise of licensing officers and a history of national trade on export-controlled items. However, there is a global perspective to export controls that goes beyond data and

knowledge available at the single country level. This perspective could be provided by global trade data.

On the *enforcement* side of export controls, national customs authorities may need to consider global trade data to detect cases of deflection of trade. These are cases where nationally controlled items licensed for export to a given destination country are re-exported to a third country, thereby possibly circumventing national trade restrictions on the end-destination country. A second use in enforcement is to verify the effects of the implementation of sanctions related to embargoes.

At *policy* level, the effective implementation of export controls must facilitate low-risk trade while impeding trade connected to significant proliferation risks. In the EU one instrument to facilitate low-risk trade is the Community General Export Authorization (CGEA). CGEAs are configured as lists of controlled items and destinations for which export licences are not required. The decision about how to configure CGEAs is taken as EU level. Global trade data can help shape CGEAs on areas where facilitation of trade may be needed due to existing high-volume trade flows towards low-risk destinations.

In all cases sketched above, information derived from global trade data can play a role as presently no official data about the world trade on export-controlled items exists in formats that countries are ready to share. Yet global trade data can only give indications on trade covered by export control regulations due to approximations introduced by the use of Harmonized System descriptors.

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Appendix 1: Acronyms

- **TBT:** The Big Table.
- **HS:** Harmonized System [1].
- **WCO:** World Customs Organisation [1].
- **EU:** European Union.
- **EU CT:** EU Correlation Table [7].
- **NSG:** Nuclear Suppliers Group.
- **AP:** Additional Protocol [10].
- **GRL:** Goods Review List [14].
- **TARIC:** Integrated Tariff of the European Communities [18].
- **PM:** Physical Model.

Appendix 2: Glossary

- **Harmonized System:** Taxonomy of goods designed and maintained by the World Customs Organisation. Goods are identified by a *Code* and an *Explanatory Note*. The Harmonized System is used by exporters and importers to declare goods to customs authorities.
- **TARIC:** Database on EU trade legislation concerning tariff suspensions, quotas, import/export prohibitions, surveillance, restrictions, etc. It identifies goods by TARIC Codes, a subdivision of the Harmonized System.
- **Web data service on global trade:** Web service providing open source data on world trade. The data originate from goods' declarations made by exporters and importers to customs authorities [2].
- **Trade case study:** The use of global trade data to verify (i) information about declared or alleged trade transactions; or (ii) hypotheses about undeclared activities.
- **Reference document:** Trade regulatory document on items subject to controls; Technical handbook describing controlled items with possible uses; The Harmonized System.
- **List of items:** Items listed in a reference document. Each item is described by a Code (mandatory, unique identifier of the item in the reference document), a Title (mandatory), a Description (optional), a Note (optional). Items can be nested in a hierarchy.
- **Correspondence table:** Table identifying related items appearing in two reference documents. The table is a list of pairs. Each pair connects items in the two documents by their identifying *Codes*.
- **EU Correlation Table:** Correspondence table mapping to TARIC Codes (and hence to the Harmonized System) items listed in Annex I of COUNCIL REGULATION (EC) No 428/2009 setting up a Community regime for the control of exports, transfer, brokering and transit of dual-use items (recast) [9].

Appendix 3: TBT's main commands

Table 6 summarizes TBT's main commands. Each entry in the table indicates the effect obtained by a performing a given action in a given context.

Command name	Context	Action	Effect
<i>Start TBT</i> (↪ 3.2)	TBT's executable icon	<Double-Mouse-Left> on  .	Opens TBT's <i>Start</i> window.
<i>Settings</i> (↪ 3.3)	<i>Start</i> window	<Mouse-Left> on <i>Settings</i> button.	Opens TBT's <i>Settings</i> window.
	<i>Settings</i> window, <i>Data</i> frame.	<ul style="list-style-type: none"> Edit file name / locate database Edit directory name / locate documents folder. 	Connects to TBT's database and to PDF documents folder. Action required after TBT's installation.
<i>Search</i> (↪ 3.4)	<i>Start</i> window	<Mouse-Left> on <i>Search</i> button.	Opens <i>Search & View</i> window to search TBT's document collection.
	<i>Search & View</i> window	<Mouse-Left> on  .	Selects panel layout for <i>Search & View</i> window.
	<i>Search & View</i> window, <i>Focus Document</i> panel (↪ 3.4.1)	Select <i>Focus Document</i> from pull-down list.	Shows list of items of selected <i>Focus Document</i> .
	<i>Search & View</i> , <i>Focus Document</i> panel (↪ 3.4.1)	Type text in long entry box.	Searches <i>Focus Document</i> by text. Search can be restricted to selected fields among: <i>Title, Description, Note, User Note</i> . Matching items are returned as individual records.
	<i>Search & View</i> window, <i>Focus Document</i> panel (↪ 3.4.1)	Type text in short entry box.	Searches <i>Focus Document</i> by text only on field <i>Code</i> . Matching items are returned as individual records.
	<i>Search & View</i> window, <i>Focus Document</i> panel (↪ 3.4.1)	Select one (<Mouse-left>) or more items (CTRL-Mouse-left).	Synchronizes the content displayed in the <i>Information</i> and <i>Viewer</i> <i>panels</i> to reflect selected items.
	<i>Search & View</i> window, <i>Focus Document</i> panel (↪ 3.4.1)	Select one or more items + <Mouse-Left> on  or  or  .	Opens independent windows to show for selected items: <i>Content</i> , or PDF page, or correspondences.
Table 6 – Summary table on TBT's main commands.			

Command name	Context	Action	Effect
	<i>Search & View</i> window, <i>Focus Document</i> panel (☞ 3.4.1)	Select one or multiple items + <Mouse-Left> on  or  .	Adds selected items to <i>Excel</i> or to the <i>Clipboard</i> .
	<i>Search & View</i> window, <i>Information</i> panel, <i>Correspondences</i> tab (☞ 3.4.2)	Tick one or more items on the tree + <Mouse-Left> on  or  .	Opens independent windows to show for ticked items: <i>Content</i> or PDF page.
	<i>Search & View</i> window, <i>Information</i> panel, <i>Correspondences</i> tab (☞ 3.4.2)	Tick one or more items on the tree + <Mouse-Left> on  or  .	Adds ticked items to <i>Excel</i> or to the <i>Clipboard</i> .
	<i>Search & View</i> window, <i>Information</i> panel, <i>Correspondences</i> tab (☞ 3.4.2)	<Mouse-Right> on one item on the tree with a <i>User Note</i> attached ( .	Opens an independent window to show the <i>User Note</i> attached to a given correspondence.
	<i>Search & View</i> window, <i>Information</i> panel, <i>Correspondences</i> tab (☞ 3.4.2)	<Mouse-Right> on one item on the tree + <Mouse-Left> on  .	'Pivots' on the selected item, i.e. its document of origin is loaded as <i>Focus Document</i> and the item appear as selected. Synchronizes the content displayed in the <i>Information</i> and <i>Viewer</i> <i>panels</i> to reflect the selected item.
	<i>Search & View</i> window, <i>Information</i> panel, <i>Search</i> tab (☞ 3.4.2)	1. Compose a query by <Mouse-left>  . 2. Tick documents where the query is to be executed. 3. Execute query by <Mouse-left> on  .	Searches by text ticked documents in the collection. Search can be restricted to selected fields among: <i>Title, Description, Note, User Note</i> . Matching items are returned in a tree-like structure. The <i>Content</i> of ticked items are visualized by <Mouse-left> on  or  their correspondences by <Mouse-left> on  .
	<i>Search & View</i> window, <i>Viewer</i> panel, <i>Document</i> tab (☞ 3.4.3)		Shows the PDF file of <i>Focus Document</i> . When an item in <i>Focus Document</i> is selected, shows the PDF page where the item appears.

Table 6 – Summary table on TBT's main commands (*cont.*)

Command name	Context	Action	Effect
	<i>Search & View</i> window, <i>Viewer</i> panel, <i>Excel</i> tab (☞ 3.4.3)		Shows the Excel spreadsheet. It is used to compile tables of items of interest. Selected items are added from other panels by <Mouse-left> on  .
	<i>Search & View</i> window, <i>Viewer</i> panel, <i>Browser</i> tab (☞ 3.4.3)		Shows a web browser. Favorites sites or documents can be stored.
	<i>Search & View</i> window (☞ 3.4.4)	<Mouse-Left> on  .	Opens <i>Clipboard</i> window.
	<i>Search & View</i> window, <i>Clipboard</i> window (☞ 3.4.4)	1. Tick items in tree 2. Select <i>Export codes</i> tab 3. Mouse-Left> on  .	Formats ticked items (codes) with a chosen separator and layout. Selected formatted codes can be copied and pasted outside TBT (e.g., to query web global trade data by HS codes).
	<i>Search & View</i> window, <i>Clipboard</i> window (☞ 3.4.4)	1. Tick items in tree 2. Select <i>Convert</i> tab 3. Mouse-Left> on  .	Converts ticked items (codes) by correspondence tables towards a specific document in the collection.
<i>DB</i> (☞ 3.5)	<i>Start</i> window	<Mouse-Left> on <i>DB</i> button	Opens <i>DB Content</i> window (requires <i>super-user</i> login). Manages TBT's document collection and correspondence tables.
	<i>DB Content</i> , <i>List of Codes</i> tab	<Edit> + <Modify> a selected item. <Edit> + <Add> a new item. <Edit> + <Delete> a selected item.	For a selected document table, manages its list of items.
	<i>DB Content</i> , <i>Correspondences</i> tab	<Edit> + <Modify> a selected entry. <Edit> + <Add> a new entry. <Edit> + <Delete> a selected entry.	For a selected document table, manages its entries.
<i>Exit</i> TBT (☞ 3.2)	<i>Start</i> window	<Mouse-Left> on <i>Exit</i> button.	Quits TBT.

Table 6 – Summary table on TBT's main commands (*cont.*)

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Abstract

This report overviews functionalities provided by 'The Big Table' (TBT), a software tool designed to support nuclear trade analysis for IAEA safeguards. TBT allows analysts to perform steps preparatory to the retrieval and analysis of data records pertinent to case studies on nuclear trade. Trade data records stem from open source web data services on global trade and are retrieved by Harmonized System codes, i.e. commodity descriptors used by traders to declare imports and exports to customs authorities. The report is structured in two main Parts. The first Part presents elements of nuclear trade analysis. The second Part deals with implementation aspects and more directly with TBT. The report concludes by comparing TBT to related information tools developed in the context of export controls. Future developments on TBT are outlined pointing to new application areas.

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