Constructing concept relation maps to support building concept systems in comparative legal terminology

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Abstract. Graphical tools to organise and represent knowledge are useful in terminology work to facilitate building concept systems. Creating and maintaining hierarchically structured concept relation maps while manually gathering data for terminological databases helps to gain and maintain an overview of concept relations, supports terminology work in groups, and helps new team members catching up on the subject field. This article describes our approach to support the building of concept systems in comparative legal terminology using the concept mapping software CmapTools (IHMC): we build hierarchically structured concept relation maps where linking lines with arrowheads between concepts of the same legal system represent generic-specific relations, and combined concept relation maps where dashed lines without arrowheads connect similar concepts in different legal systems.

1. Introduction

Concept maps are a graphical means to organise and represent knowledge and are used, inter alia, in learning (cf. Novak & Gowin 1984, Novak & Cañas 2008), since they aid in understanding and memorising relationships between concepts. Such graphical representations are also very useful in terminology work to depict complex sets of concepts and concept relations. Hierarchically structured concept relation maps, then, show similarities and dissimilarities between different systems of concepts across languages, and where concept gaps and designation gaps exist; crucial information in comparative terminology. Building concept relation maps during the collection of terminological data helps to maintain an overview of concepts, designations and concept relations and to build concept systems in the first place.

Further advantages of constructing concept relation maps while collecting and restructuring data for terminological databases will be discussed throughout this article, and will be linked to our approach to structuring concept relation maps in comparative legal terminology using the free software CmapTools[1] by IHMC (Florida Institute for Human and Machine Cognition).

This article is structured as follows: In section 2, we give some definitions (based on ISO 1087-1:2000 and ISO 704:2009) for key terms in terminology we use throughout this article; in section 3, we stress the importance of building concept systems in terminology work. In section 4, we introduce the notion of "concept relation maps" and explain the differences to concept maps, and then discuss their usefulness for dealing with challenges in terminology work (5.1) and especially in legal terminology (5.2). In section 6, we explain how our concept relation maps are structured in order to cope with the challenges discussed in section 5. Section 7 gives reasons for our choosing of the software CmapTools, briefly comparing it to Xmind portable. We conclude with an outlook in section 8.

2. Definitions

In this article, we use the following terms with their meaning in terminology:

- *concept:* "Unit of knowledge created by a unique combination of characteristics" (ISO 1087-1:2000, 3.2.1);
- *designation:* "Representation of a concept by a sign which denotes it" (ISO 1087-1:2000, 3.4.1);
- *term:* "Verbal designation of a general concept in a specific subject field" (ISO 1087-1:2000, 3.4.3);

[1] http://cmap.ihmc.us

- *concept system:* "Set of concepts structured according to the relations among them" (ISO 1087-1:2000, 3.2.11);
- *hierarchical relation:* Concept relation where concepts are organised into levels, and the superordinate concept has at least one subordinate concept (ISO 704:2009, 5.5.2.1);
- *generic relation:* Hierarchical relation between two concepts where the intension of the subordinate (= *specific*) concept includes the intension of the superordinate (= *generic*) concept and at least one additional delimiting characteristic (ISO 704:2009, 5.5.2.2.1);
- *coordinate concepts:* In a hierarchical relation, "subordinate concepts at the same level and resulting form the application of the same criterion of subdivision" (ISO 704:2009, 5.5.2.1);
- *intension:* "Set of characteristics which makes up the concept" (ISO 1087-1:2000, 3.2.9);
- *extension:* "Totality of objects to which a concept corresponds" (ISO 1087-1:2000, 3.2.8);

3. Terminology work

Concepts and their relative positions in concept systems are essential elements in terminology work. Along with identifying and defining concepts, assigning designations to concepts, and comparing terminological information across languages (in comparative terminology work), identifying concepts and concept relations as well as analysing and modelling concept systems are among the main activities of terminology work (cf. ISO 704:2009).

A concept is defined by its extension and its intension, both determining its relative position in the concept system. However, there is a constant interplay between building concept systems and defining concepts. On the basis of definitions and concept characteristics, it is possible to relate concepts to each other and to construct concept systems (Schmitz 2011); on the other hand, modelling concept systems serves to facilitate the writing of definitions (ISO 704:2009), since intensional and extensional definitions are based on hierarchical relations. Intensional definitions describe the intension of a concept by stating the superordinate concept and the delimiting characteristics, and extensional definitions enumerate all of the concept's subordinate concepts under one criterion of subdivision (ISO 1087-1:2000). Accordingly, definitions should reflect the concept system in question, especially in standardising terminology.

The more complex a concept system is, the more essential it is to clarify relations among concepts by representing them graphically (ISO 704:2009). Indeed, in terminology, the results of concept analysis are traditionally presented graphically in form of concept diagrams (ISO/DIS 24156-1; Wright 2007); this means that visual repre-

sentations of concept relations are usually produced only after the concept system has been build up "entirely". However, if we use graphical means to illustrate concept relations already during terminological work - concurrently with collecting information for a terminological database -, structuring terminological data in the database, modelling concept systems, and comparing different concepts and systems is facilitated in the first place (see section 5).

4. Concept relation maps

Concept mapping is a type of knowledge visualisation, which in turn can be defined as "the use of visual representations of abstract data to amplify cognition to creative ends and/or knowledge sharing" (Tricot & Roche 2006).

Concept maps are semantic networks, which are "graphs consisting of nodes representing concepts[2] and labelled lines representing relationships among them" (Jonassen 2005). The idea is to create meaningful statements (propositions) by using linking phrases to connect two concepts (Novak & Cañas 2008).

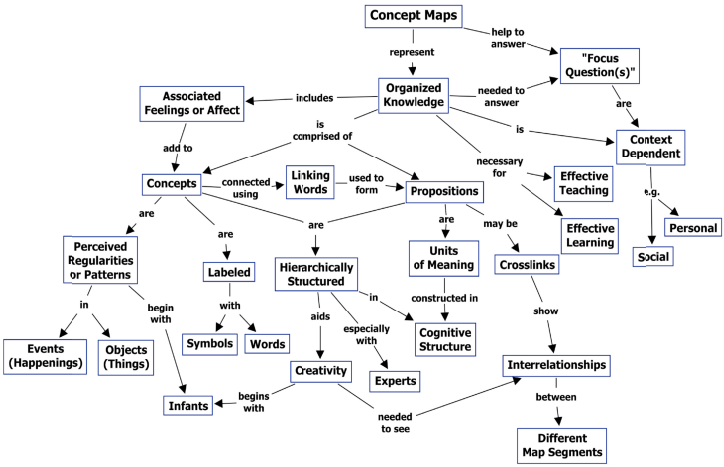

FIG. 1 - *Concept map about concept maps (Suorce: Novak & Cañas 2008)*

However, in our approach, we do not use the labels of linking lines to form meaningful statements, i.e. semantic units, and thus we do not create semantic net-

[2] *Concept* in the context of concept maps refers to "a perceived regularity or pattern in events or objects, or records of events or objects, designated by a symbol, usually a word" (Novak & Cañas 2008).

works. Instead, we follow a terminological approach using the concept mapping software CmapTools to graphically represent concepts (as defined in section 2) as nodes and the relations between them as linking lines in order to facilitate building terminological concept systems. The diagrams represent our knowledge of concept relations in a certain domain – at a certain time –, and they facilitate adding newly gained information during terminology work. We use linking lines to indicate solely two types of relationships: generic relations between concepts belonging to the same legal system, and relationships between similar concepts belonging to different legal systems. Including further types of concept relations (partitive and/or associative relations) would make the maps too complex and hard to read, therefore we focus on generic relations, which indicate superordinate and subordinate concepts and are crucial for the definition writing and organising terms in concept-oriented database entries. Furthermore, we do not use the label of the linking line to indicate the type of relationship, since it is already implied by the type of linking line itself (see sections 6.2 and 6.6) but for other information about the relationship. However, we use these graphical representations for knowledge-visualisation and knowledge-organisation purposes and to indicate how concepts are related. For this reason and in order to distinguish our diagrams from concept maps (them being semantic networks), we hereafter call ours "concept relation maps".

5. Concept relation maps in terminology work

The main use for concept relation maps in terminology work is during the phase of concept analysis; in contrast to ISO/DIS 24156-1, which emphasises the presentation of the results in concept diagrams, we emphasise the assistance for the terminologist while analysing the concepts.

In this section, we give some examples of how graphs drawn by means of concept mapping tools may facilitate terminology work: when constructed concurrently with the compiling of terminological information and the building of a terminological database.

5.1 Challenges in terminology work

5.1.1 Manual data collection

When collecting information for a terminological database, it is not always possible to use automatic extraction tools, or these tools yield erroneous and/or incomplete results. When the information on intension and extension of concepts and concept relations has to be collected manually, it becomes difficult keeping track of the usually quite extensive amount of information. While searching for terminological data on one concept or set of concepts, one will often find information about other, related concepts, and indications on how they are related. Since one cannot process

all information instantly, it is convenient to collect these terminological data on a scratchpad (e.g. by indicating designations and corresponding information sources in a list) to follow it up later on.

Collecting and concurrently structuring the information on concept relations in a concept relation map allows us to gain and maintain an overview of the relations we have found so far, and facilitates arranging the corresponding information in the terminological database; since the graph depicts which designations represent the same concept and therefore belong in the same database entry, and which entries are to be cross-linked, because the concepts they represent are related.

Example: While searching for information on *provvedimento amministrativo* (administrative measure) in Caringella (2010), we found that according to the effects the measure produces, it can be subdivided into the following subordinate concepts: *provvedimento accrescitivo* (amplifying measure), *provvedimento sanzionatorio* (punitive measure), *provvedimento ablatorio* (privative measure) and *provvedimento di secondo grado* (second-level measure). In this context, Caringella also gives a delimiting characteristic of *provvedimento accrescitivo* and some subordinate concepts. In order to facilitate following up on the subordinate concepts of *provvedimento amministrativo* later on, we augmented the corresponding concept relation map with this newly gained information.

5.1.2 Conflicting concept relations

Newly extracted information on concept relations may conflict with previous ones, as it happens quite often in legal terminology (see section 5.2.1). In maps where we have the possibility to label the linking lines (relations), we can indicate the information source according to which a certain relation has been added. This enables us to illustrate more than one interpretation or classification, indicating a source reference for each. In doing so, we can collect different interpretations on relations as a first step, and then decide which interpretation to use in the database and the (final) concept system. Thereby, we preserve the additional interpretations of relations different from the one selected for the database. Additionally, on the basis of the corresponding cross-references in the database, we immediately see which interpretation/classification (according to which law, theory, etc.) we have selected for the database. And generally, this facilitates recognising that there exist more than one interpretation or classification regarding a certain set of concepts.

We can depict conflicting concept relations in the same concept relation map or use several cross-linked maps. When shown in the same map, conflicting relations should be marked: We use the colour grey to do so (see FIG. 6 in section 6.2).

5.1.3 Multidimensionality

Subdividing a concept according to different criteria will lead to different sets of coordinate concepts. In terms of classification, where subdivision criteria correspond

to dimensions, this is called "multidimensionality" (Bowker 1997). Accordingly, in terminology, the resulting concept system is said to be multidimensional (ISO 704:2009). Working with graphical representations facilitates recognising and representing multidimensionality (Bowker 1997). Thus, if structured properly, concept relation maps built concurrently with the compilation of terminological data show for which concepts multidimensional classifications exist and which concepts are coordinate (see example in section 6.3).

To represent multidimensionality, it is convenient to use mapping tools which provide labelled and branched linking lines (as CmapTools, see section 7.2) to group coordinate concepts using a branched linking line for each set of coordinate concepts, and to indicate the subdivision criteria in the label of the linking line (see FIG. 4 in section 6.3).

5.1.4 Missing designations

In concept relation maps, we can also indicate concepts for which we have not found a designation yet, or which do not have an established designation, even though the concept exists. Unknown or non-existing designations are often a challenge in terminological databases, whereas in graphical representations, such concepts can be represented by a definition or explanation instead of a designation or even by a dummy label (see section 6.1), since they are determined by their relations to other concepts (their relative position in the concept system).

5.2 Special challenges in legal terminology

In the course of terminology work at the Institute for Specialised Communication and Multilingualism at the European Academy of Bozen/Bolzano (EURAC), we compare concepts belonging to the Italian legal system to those belonging to the legal systems of Germany, Austria and Switzerland, in order to help creating a legal terminology in German to be used in South Tyrol (Italy), i.e. assigning German designations to Italian concepts.

Building concept systems in legal terminology is a quite difficult task, amongst others, due to indeterminacy of concepts and term meanings (see 5.2.1) and constant changes in the subject field (see 5.2.2). In this section, we give some examples of how building concept relation maps may help with these challenges.

5.2.1 Indeterminacy

In law, we often find concepts with undefined intension and/or extension and, from a semantic point of view, terms with indeterminate meaning (cf. Simonnæs 2007). This is, because laws and regulations have to be applicable to a certain range of cases in real life and to be adaptable to changes in society and in the field they

regulate. Hence, in legal terminology, we regularly face differing classifications and interpretations of concepts and term meanings.

Example from the Italian administrative law: While Caringella (2010:1121) states that a *nulla-osta* (declaration of no objection) is a type of *provvedimento autorizzatorio* (authorisation), Casetta (2010:347) states that it is an *atto endoprocedimentale* (action within the administrative procedure). The extension is the same in both cases, and they assign the same characteristics to the concept except for one: they differ on whether *nulla-osta* directly affect the persons concerned or not.

Indeterminacy of concepts and different meanings of terms constitute challenges in modelling terminological concept systems often provoking a "chase for information" to force a decision at a time when this decision is still hard to make. Building concept relation maps during terminology work may help, as they enable depicting different interpretations or classifications at the same time (see FIG. 6 in section 6.4). Later, when more information on related concepts is available, a more informed decision regarding which classification to follow in the (final) concept system can be made.

5.2.2 Constant changes

Law is a very large domain and subject to constant change. Since definitions of legal concepts should leave room for interpretation of laws and the adaptation of rules to new or changed social and moral environments, concepts are constantly redefined by lawmakers, judges and legal theorists (Sandrini 1996). Hence, new laws and regulations entail not only new concepts and designations, which have to be incorporated in the concept system, but often bring about the need to redraw existing relationships between concepts, or even to restructure whole sets of concepts. For instance, terms that before have designated the same concept, now stand for two different concepts, or generic relations are created between concepts which were not related before, or the other way around, etc.

Graphic representations illustrating hierarchical concept relations show immediately which concepts are directly related to the one that has changed, and therefore indicate which entries and cross-references have to be checked in the terminological database.

5.2.3 Comparing concepts belonging to different legal systems

Concepts belonging to a national legal system form a unique system of concepts, since they reflect the social, political and historical background of the legal system. Hence, comparing intension and extension of two concepts belonging to different legal systems, we may find at the very most that they are *similar* but not *identical* even if the same designation is used. In building a terminological database containing legal terminology pertinent to different legal systems, we have to be especially careful to distinguish to which legal system a concept belongs. This distinction is

even more important if the same language is used in several countries as German in Germany, Austria and Switzerland.

Using concept relation maps to structure the terminological information (like designations and concept relations) for all legal systems in question, we are able to distinguish the concept's membership by means of assigning different colours (see section 6.6).

Furthermore, by using linking lines with special line styles, we can depict where relationships between concepts of different legal systems (similar concepts) exist, and at the same time emphasise that these relationships differ from the hierarchical relations indicated between concepts of the same legal system.

As we have seen in the previous sections, terminological systems in law are very complex and constantly changing, meanings of terms are often indefinite and interpretations and classifications of concepts may vary in jurisprudence. This is even more challenging in comparative terminology and makes it difficult to maintain an overview of similarities and differences between the concept systems. The graphical diagrams depicting designations and concept relations we have collected and structured for the individual legal systems have proved to be a great help to maintain this overview.

6. Structure concept relation maps in comparative legal terminology

In concept mapping, the choice of labels for the linking lines, pre-set shapes, link styles, labels, colours, etc. to depict concepts and the relationships between them is up to the user. However, in order to facilitate the building of concept systems, it is important that a certain structure is defined and maintained throughout the construction process, especially when working in a team, and to allow further (automatic) processing of the data.

Following a concept-based approach and in order to create consistent maps in our team, we devised the following structure for building concept relation maps in comparative legal terminology. They are network graphs drawn using the concept mapping software CmapTools[3] developed by IHMC[4].

6.1 Concepts and designations

In our maps, concepts, intended as units of knowledge according to the definition in section 2, are depicted as rectangles (nodes) (see FIG. 2). Most concepts in our

[3] Clearly, a tool tailored towards terminological work could incorporate more elements from ISO/DIS 24156-1 to support a transition towards an established standard.

[4] Florida Institute for Human and Machine Cognition

maps are represented by a single designation centred in the rectangle. Some have more designations, which are indicated in the same rectangle, since they represent the same concept (see FIG. 2). Few rectangles show no designation at all. This is, when we have no (or not yet) a designation to label the rectangle, though the concept does exist in the legal system. This may be because there is no established designation for the concept, or because we have not found it yet. In these cases, the rectangle may contain an explanation or definition, or otherwise a dummy label until a designation or explanation has been found (see FIG. 2). Designations, definitions and explanations are always followed by source references in brackets which correspond to the source identifiers we use in the terminological database. Designations representing important concepts in the domain are in boldface (e.g. "provvedimento amministrativo" in FIG. 2). Therefore, our representation differs from the one proposed in ISO/DIS 24156-1, where all designations are in boldface, only one designation per concept is depicted and no information source is added.

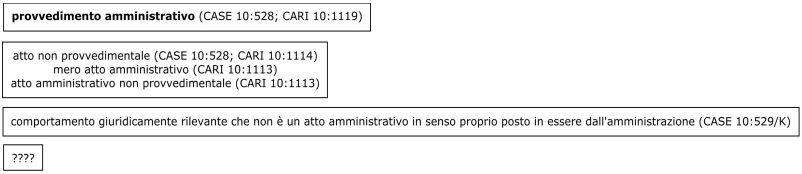

FIG. 2 – *Concepts with different labelling.*

Figure 2 depicts four concepts (rectangles). The first concept is represented by one designation, the second by three designations (one in every line), the third by a definition, and the fourth by a dummy label. The information in brackets indicates the corresponding information source.

6.2 Generic concept relations

Lines with arrowheads drawn from one concept to another represent exclusively generic concept relations. They start from the superordinate (generic) concept, with the arrowhead(s) pointing to the subordinate (specific) concept(s) (see FIG. 3). We chose this representation, different to the one recommended in ISO/DIS 24156-1, following the top-down approach in terminology work where we first define the superordinate concepts and then their subordinate concepts (cf. ISO 704:2009).

Since all links with arrowheads represent the same type of relation (generic concept relations), we omit linking words or phrases to specify the relationship as intended by CmapTools authors. However, if following a semantic approach, the linking phrases in our concept maps would be "is a hypernym of" (in the respective language), or if the line was reversed, i.e. the arrowhead pointing at the generic con-

cept, it would be “is a”. Additionally, in a strictly semantic approach, we would need to spread synonymous terms over different rectangles, linking them with “is synonym of”.

We use the label of the linking line instead to indicate, among others, the information source, according to which we draw the generic relation between the concepts, using again the same source identifiers as in the terminological database (see FIG. 3).

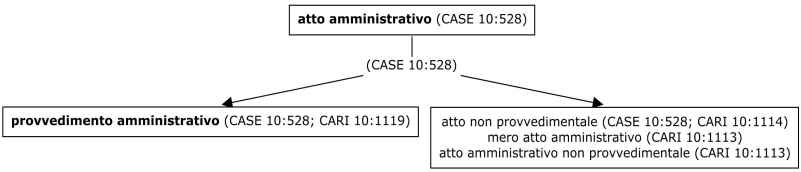

FIG. 3 – *Generic relations between three concepts*

Figure 3 depicts two generic relations between three concepts belonging to the legal system of Italy: *atto amministrativo* (administrative action) is superordinate to *provvedimento amministrativo* (administrative measure) and to *atto non provvedimentale* (administrative action which is not a “measure”), while the latter two are coordinate concepts. The information source according to which we have drawn the relationship line is indicated as label of the linking line (in brackets).

6.3 Multidimensional classification

If a concept is subdivided according to more than one criterion/dimension (see section 5.1.3), we use branched linking lines to depict the resulting sets of coordinate concepts. Additionally, we indicate the subdivision criterion as label of the linking line along with the source reference in brackets (see FIG. 4).

Often, subdivision criteria are not explicitly stated in the documentation but become apparent later on when analysing the subordinate concepts in question. However, thanks to the branched linking lines, the indication of subdivision criteria is not essential right from the start to represent multidimensionality in concept relation maps.

Figure 4 depicts the subdivision of the concept *Verwaltungsakt* (administrative act) belonging to the legal system of Germany according to the criteria *Regelungsinhalt* (content) leading to three coordinate concepts and *Rechtswirkung für den Betroffenen* (effects for the person concerned) leading to two coordinate concepts.

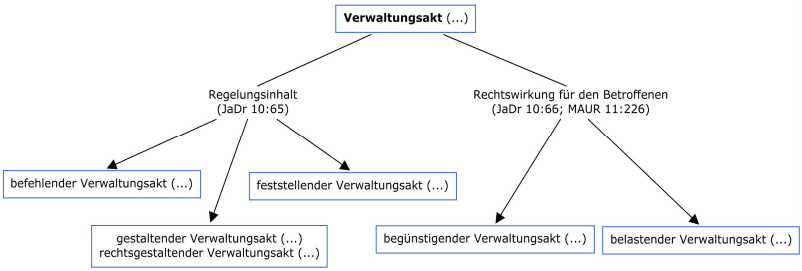

FIG. 4 – *Subdivision of the concept "Verwaltungsakt" according to two different criteria. (In this figure, we omitted the designation sources for better readability.)*

6.4 Polyhierarchy

Two or more linking lines starting form different concepts (nodes) may point to the same concept and thus form a polyhierarchy. This may be for two reasons:

a) The concept has two or more generic concepts, i.e. its intension includes the intensions of two or more superordinate concepts between which no generic-specific relation exists. An example is shown in FIG. 5: The concept *begünstigender Verwaltungsakt mit belastender Drittwirkung* (beneficial administrative act with unfavourable third-party effects) belonging to the legal system of Germany includes the intensions of *begünstigender Verwaltungsakt* (beneficial administrative act) and of *Verwaltungsakt mit Drittwirkung* (administrative act with third-party effects). Since not every beneficial administrative act has third-party effects, and not all administrative acts with third-party effects produce beneficial effects for the person concerned (addressee), there is no generic-specific relation between the two superordinate concepts.

b) The concept is classified differently in jurisprudence (see section 5.2.1). In such cases, it is essential that a source reference is indicated for each relation and that the conflicting concept relations are distinguished from "ordinary" relations. In our concept relation maps, they are represented by grey linking lines. An example taken from the Italian administrative law is shown in FIG. 6: While Caringella (2010:1121) states that a *nulla-osta* (declaration of no objection) is a type of *provvedimento autorizzatorio* (authorisation), which is a *provvedimento amministrativo* (administrative measure), Casetta (2010:347) states that it is an *atto endoprocedimentale* (administrative action within the administrative procedure), which is no *provvedimento amministrativo*. If the information source itself states that a certain classification is still discussed, we indicate the corresponding information in the label of the linking line in green colour.

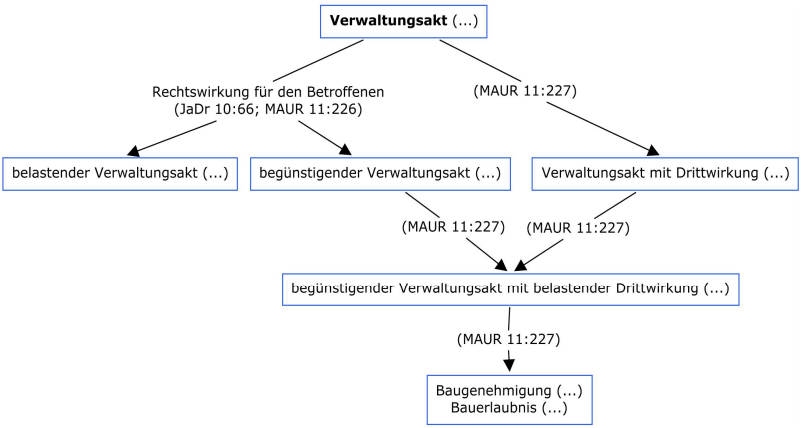

FIG. 5 – *Polyhierarchy: Specific concept having two generic concepts. (In this figure, we omitted the designation sources for better readability.)*

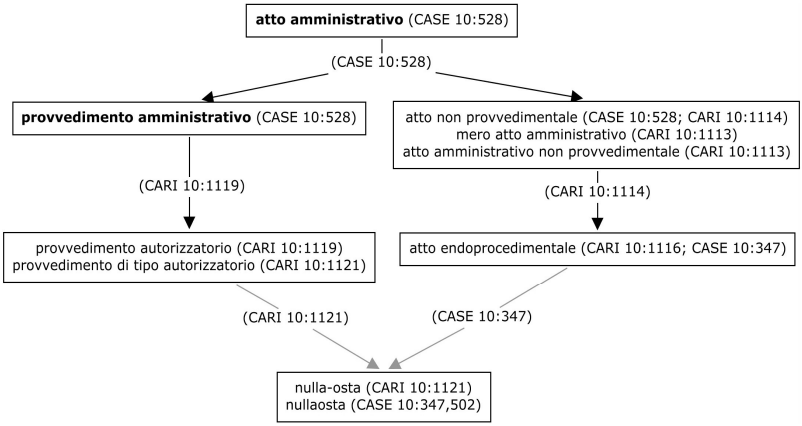

FIG. 6 – *Conflicting concept relations (grey linking lines)*

6.5 Different colours regarding generic relations

Linking lines representing generic relations are usually black, but may also be violet or brown in complex diagrams (where lines cross) to make clear where the

linking line starts and ends. These colours do not allocate different meanings to the linking line.

However, if a generic relation is represented by an orange linking line, the relation has to be rechecked, while grey linking lines indicate conflicting relations (see FIG. 6 in section 6.4).

Disregarding the source reference, which is always indicated in brackets, we use different colours for the various information labelling generic relations: subdivision criteria are indicated in black (see FIG. 4 in section 6.3), information about differing characteristics in relation to other concepts are indicated in blue and other information is indicated in green.

6.6 Comparing legal systems

In order to facilitate comparing sets of concepts of different legal systems, it may also be convenient to depict them in a combined map. For this purpose, we may take parts from other concept relation maps, which show concepts of only one legal system, and depict them together in one map.

So as to indicate to which national legal system a concept belongs, we use different line colours for the rectangles (shapes representing concepts): Black stands for Italy, dark blue for Germany, light blue for Austria and green for Switzerland (see FIG. 7). This method is applied to all concept relation maps, even if they illustrate only concepts belonging to one legal system.

In combined maps, we draw linking lines between concepts of different legal systems to indicate where similar concepts exist. These lines are dashed and don't have arrowheads, in order to distinguish them explicitly from the ones representing generic relations between concepts of the same legal system. These linking lines connect concepts belonging to the legal system of Italy with concepts belonging to the legal systems of Germany, Austria and Switzerland with their pre-assigned colours: dark blue (Germany), light blue (Austria) and green (Switzerland) as shown in FIG. 7. The label of the linking line indicates additionally which legal systems are involved by means of the following codes: IT-DE (Italy-Germany), IT-AT (Italy-Austria) and IT-CH (Italy-Switzerland).

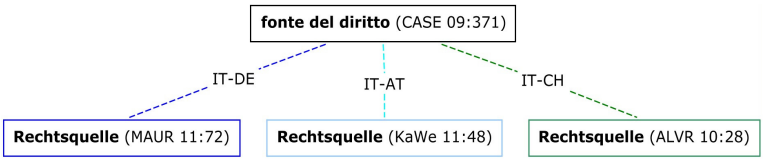

FIG. 7 – *Linked concepts belonging to different legal systems*

6.7 Further processing of the data

The main purpose of concept mapping in terminology work as described in this article is to graphically represent terminological information that has been and is being collected in order to assist the terminologist in gaining and maintaining an overview of the subject domain and to enhance the modelling of concept systems. Though, later, it should also be possible to automatically retrieve the data contained in the concept relation maps for further formal representation and processing. Using CmapTools, there are several possibilities to export information to other formats (see section 7.2).

However, problems could arise as a result of the co-existence of different types of information in the same label. The rectangle representing a concept is usually labelled by designation and designation source, and may even contain additional designations with corresponding source references (see section 6.1). In the label of a linking line, we may find different information on the relationship it represents: source reference, subdivision criterion and other information (see section 6.5). However, sources are always indicated in brackets, additional designations are indicated in new lines, and different types of information about the relationship are indicated using different colours. This facilitates later (semi-)automated extraction and processing of the data.

Of course, a specifically tailored tool could already incorporate some basic constraint checks to simplify the conversion into a format adhering to formal rules.

7. Why CmapTools?

As we searched for an apt free software tool to draw concept relation diagrams, we first chose the free version of the mind mapping software XMind[5], but later on changed to CmapTools[6]. In this section, we indicate some pros and cons of these two software tools relevant to our purpose of drawing hierarchically structured concept relation maps.

7.1 Mind mapping software XMind

"The main use of mind mapping is to create an association of ideas" (Davies 2010) starting from a central idea/topic. Although, strictly, this was not the purpose we used it for, the tool seemed auspicious.

Topics, which we used to depict concepts, could be structured hierarchically by drawing *floating topics* and *relationships*, which could even be labelled (to indicate e.g. subdivision criteria). There was also the possibility to attach *subtopics* directly

[5] http://www.xmind.net
[6] http://cmap.ihmc.us

to existing *topics*, which were then automatically arranged according to a certain structure (organisational chart, logic chart, fishbone or matrix). Additional information about a concept, like differing characteristics to other concepts, could be attached as additional text field, called *label*, to the *topic*.

Sadly, soon the first shortcomings of the software for our purposes became clear:

Using automatic structures like org charts or logic charts no additional information on the relation (as subdivision criteria or according to which source the relation was drawn) can be indicated. Furthermore, using automatic structures (org charts or logic charts), it is not possible to relate more than one superordinate concept to a concept. It would be possible to manually draw additional labelled linking lines with the according information, but the topics in the charts are arranged very close together, hence, additional linking lines would add more confusion than information to the map.

Not using automatic structures, but drawing *floating topics* and labelled linking lines and then arranging them manually, and rearranging them if new topics are added and/or relationships have to be redrawn, is very time consuming in XMind.

Additionally, the free version has severe restrictions regarding image export formats: we could only export low-resolution images.

7.2 Concept mapping software CmapTools

"CmapTools is a software environment developed at the Institute for Human and Machine Cognition (IHMC) that empowers users, individually or collaboratively, to represent their knowledge using concept maps" (Cañas et al. 2004). According to Novak and Cañas (2008), the term *concept map* is referring to "a knowledge representation form that shows individual concepts at nodes with linking words that connect two concepts and indicate the relationship between them, thereby forming a proposition." While proposition making is a semantic approach, we follow a terminological approach in constructing concept relation maps as described in section 6. However, CmapTools proved to be a valuable tool for our purposes.

Branched and labelled linking lines. As we have indicated in section 5.1.3, concepts may be subdivided according to different criteria, which leads to different sets of coordinate concepts. In CmapTools, this can be depicted by grouping these sets using branched linking lines and by indicating the subdivision criteria in the label of the linking line (see 6.3).

Knowledge models. To prevent that single *cmaps* grow too large, information may be distributed over several maps and then be linked either by drawing linking lines to concepts in other *cmaps* or by creating links to entire maps. The latter is possible, only if the *cmaps* belong to a *knowledge model*. In CmapTools a *knowledge model* is "a set of concept maps and associated resources about a particular domain of knowledge" (Cañas et al. 2003) collected in a folder which has been

set as knowledge model by activating the corresponding checkbox in the folder's properties.

Collaboration. CmapTools facilitates collaboration in terminology, since the user may search for terms instantaneously in all *cmaps*, compare *cmaps*, construct maps concurrently with other team members and even record single creation steps using the feature *Cmap Recorder*.

Merge nodes. In CmapTools, one can merge *nodes* (representing concepts) if they have the same label. All linking lines to or from the two *nodes* are maintained and are connected to the new single *node*. One can also merge *nodes* which do not show the same label, but in this case only one label is retained. This function is very useful if two concepts turn out to be only one, or the same concept has been erroneously depicted twice in one *cmap*.

Export formats. In CmapTools, several import/export formats are available, such as images, scalable vector graphics, web pages, outlines, and several xml based formats, in order to enable further (automatic) processing of the data.

List view. A further useful feature in CmapTools is *Cmap list view*, where data present in the *cmap* is displayed as a list of concepts, linking phrases or propositions (concept 1 + linking phrase + concept 2), or as *outline* (see FIG. 8). By clicking on a list item, the corresponding concept, linking phrase or proposition is highlighted and centred in the map window.

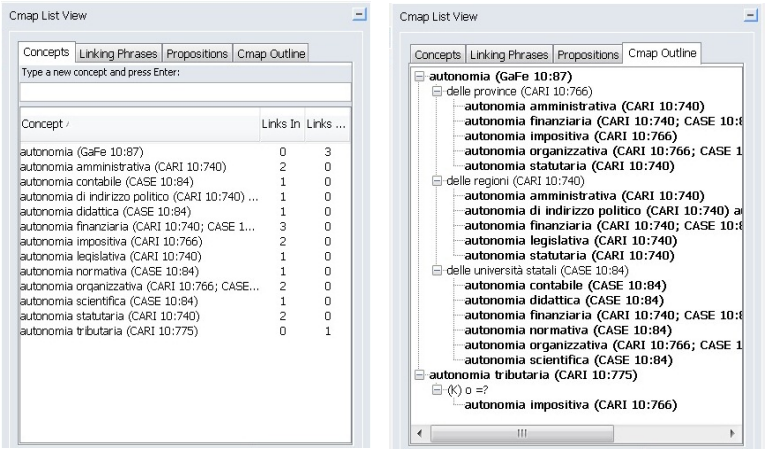

FIG. 8 – *Two Cmap list views. On the left hand: a list of all concepts present in the cmap, in alphabetical order; on the right hand: an outline list of concepts and linking phrases.*

Shortcomings. A shortcoming compared to Xmind is the missing possibility to display additional information directly attached to (below) the shape/concept. Still, mouse-over information can be indicated for the single concept. Moreover, *annotations* in the *cmaps* can be made on any position, but they are not linked/attached to a concept and therefore do not move with the concept. This additional information is represented by an *annotation* icon (), on which the user has to click to see the information. However, building concept systems could additionally be facilitated if different types of information, e.g. characteristics (following Madsen 2007), could be attached to the single concept (*node*) using different note categories. To save space, per default, only the symbol indicating the information type should be visible, while the information itself should be hidden but could be unfolded when needed.

8. Outlook

In this article, we have presented an approach to building concept relation maps in comparative legal terminology. The main purpose of our approach is to graphically represent terminological information, mainly on generic concept relations, in order to assist the terminologist in gaining and maintaining an overview of the subject field and to facilitate the modelling of concept systems. As we have seen, a valuable graphical tool for constructing concept relation maps in terminology work is the free software CmapTools by IHMC which also allows exporting the information to several, e.g. xml-based, formats. Though, to date, no export to other formats has been carried out, since the current concept relation maps are still expanding rapidly. However, further on, we want to (semi-)automatically convert the concept relation maps into more formal, ontology-like representations.

Furthermore, today, our concept relation maps deal with only one subdomain of law, namely administrative law. In the foreseeable future, we intend to expand the building of concept relation maps also to other subdomains of law; and we feel confident that our approach will also be of interest for terminology work in other subject fields besides law.

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Résumé

Parce qu'ils facilitent la compilation de systèmes de concepts, les outils graphiques permettant d'organiser et de représenter des connaissances sont très utiles pour assister le travail terminologique. Combiner la construction de cartes de relations de concepts hiérarchiquement structurées avec l'extraction manuelle des données pour une base de données terminologique permet d'avoir une vue d'ensemble des relations conceptuelles, facilite le travail en groupe et permet plus aisément aux nouveaux membres d'une équipe d'acquérir une vue d'ensemble du domaine traité.

Cet article décrit une approche utilisant le logiciel de cartographie de concepts CmapTools (IHMC) pour soutenir la construction de systèmes de concepts dans la terminologie juridique comparative. Dans notre approche, nous construisons des cartes de relations de concepts hiérarchisées où les liaisons avec flèche entre les concepts d'un même système juridique représentent exclusivement les relations conceptuelles génériques/spécifiques, ainsi que des cartes de concepts combinés où les liaisons pointillées sans flèche relient les concepts similaires dans différents systèmes juridiques.