Structural Legal Visualization

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Abstract. This paper investigates an approach which is called structural legal visualization (SLV). It is about diagrammatical views which facilitate comprehension of the meaning of legal contents. Complexity reduction is a motive. An issue is the complexity of the entire legal system and the layman's limited ability to understand legal institutions and the millions of documents. A sequence of views in SLV can be compared with a narrative. SLV differs from information visualization and knowledge visualization. SLV relates to a scenario-centered graphical narrative rather than information display or user interfaces. SLV is about the generation (synthesis) of diagrams. The sequence of images depends on the user's goals. Different pathways through the informational space are concerned. With respect to an object's change or non-change, two variations of SLV are identified: dynamic SLV and static SLV. The latter is divided into two: incremental SLV and alternate focuses SLV.

Key words: complex system, legal informatics, legal meaning, knowledge visualization, semantic network.

1. Introduction

The following work investigates an approach to visualization which we call *structural legal visualization* (SLV), also *sequential* legal visualization. SLV is about the visualization of statutory law rather than facts. It enables the user to comprehend the meaning of legal terms. SLV is diagrammatical, relation-centered, and is related to visualizing legal ontologies (Guarino *et al.*, 2009; Oberle *et al.*, 2012). The presentation of legal institutions is at stake.

SLV stems from Friedrich Lachmayer's imagination of visualizing insights, ideas and texts, primarily in the domain of law; see examples on the web.[1] Visualizing statutory law was already addressed at the beginning of legal informatics (Lachmayer, 1976). For decades, SLV was used in practice as slide presentations at numerous conferences and lectures, where each slide can serve as a separate view. Among other things, we visualized

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[1]http://jusletter-it.weblaw.ch/visualisierung.html, http://www.legalvisualization.com.

Hans Kelsen's Pure Theory of Law (Čyras *et al.*, 2011) and Hajime Yoshino's Logical Jurisprudence (Yoshino, 2011; Čyras and Lachmayer, 2012). Besides legal education, SLV is also aimed at eGovernment applications such as FinanzOnline,[2] RIS,[3] which publishes cases and supports ex-post analysis, HELP.gv.at,[4] which states the applicable law for various situations and supports ex-ante analysis, or e-Codex.[5]

Suppose an object has two options: it changes or it does not change. Thus the object of visualization (e.g., a diagram, scheme, mindmap, information space) can be either *dynamic* or *static*. Therefore, SLV can be divided into the following two major variations (i.e., build-ups of the resulting views):

1. *Dynamic SLV*. A dynamic object is viewed; the object changes. The development in time is important. The outcome is a series of images in time. This variation can also be compared with a film demonstration.
2. *Static SLV*. A static object is viewed; the object does not change in time. This variation can be divided into two sub-variations:
   (a) *Incremental SLV*. The process of adding items is important. The object's presentation grows quantitatively. Graphical items are supposed to have links to the reference area and legal effect description.
   (b) *Alternate focuses SLV*. The process of changing the viewer's focus is important. The user moves between broad overviews and detailed views.

Static SLV produces a series of views by highlighting individual items sequentially. The entire object is too complicated and visualizing it at once would be too much. This variation can be compared with navigating a map. User-centric navigation in a state space is a characteristic. Static SLV is relevant to HELP eGovernment applications, where hiding details is an essential feature.

In SLV, graphic elements commonly represent legal terms and relations. Slide tools such as PowerPoint have very limited interaction capabilities and no camera; therefore slide functions can be applied for animation. The camera concept is commonly employed in three-dimensional engines of three-dimensional virtual worlds or computer games. SLV has links to both information visualization (Spence, 2001; Card, 2008; Cockburn *et al.*, 2009) and knowledge visualization (Eppler and Burkhard, 2006), but stresses different issues.

Section 2 explains the motivation for exploring SLV. Section 3 introduces visualization in the legal area. Sections 4 and 5 present SLV. Section 6 reviews relevant works. Section 7 concludes.

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[2]FinanzOnline provides a one-click link to the Austrian tax administration; see https://finanzonline.bmf. gv.at/.

[3]The Legal Information System of the Republic of Austria; http://www.ris.bka.gv.at/.

[4]HELP.gv.at – a government agency help site on the Internet, which offers necessary information for living and working in Austria.

[5]The e-Codex project "e-Justice Communication via Online Data Exchange" (http://www.e-codex.eu) supports transnational procedures between EU member states. For example, suppose Small Claim Procedure online forms, to input data such as plaintiff, defendant, claim, etc. (Francesconi, 2012).
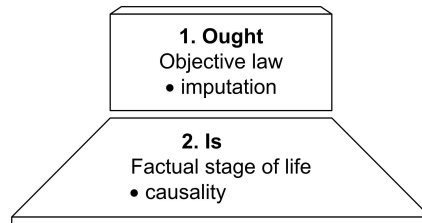
Fig. 1. The vertical and horizontal stages correspond to the Ought world and the Is world.

2. Motivation

Interpreting (legal) requirements may require comprehension of the law. This is important in engineering compliant software (Oberle *et al.*, 2012). Another trend is transferring legal texts and law enforcement to the web. There are terms such as 'service', 'contract', 'policy', etc., which are also used in computing, for instance, 'web service', 'service-oriented architecture' (SOA), 'SOA contract' (Lupeikiene and Caplinskas, 2014). Software engineers are typically laymen in legal matters although they are required to have awareness of the law.

Complexity reduction. Mastering the law as a whole and also in detail is difficult even for a professional jurist. An issue is the complexity of the legal system, which includes separate legal institutions. A layman has a limited ability to understand the entire legal system, which comprises millions of documents and gigabytes of data. Therefore, complexity is a topical issue for both professionals and laymen.

SLV communicates a complex legal content sequentially (see Fig. 4). Deep structures are comprehended step by step. An overview can be shown first, then the details. Visuals can be more suitable than reading a text, because various relationships (primarily implicit) can be shown. For instance, a categorical distinction between the legal concepts of Ought and Is (Kelsen, 1967, § 3 et seq.) can be depicted with two metaphorical stages (Fig. 1). The Is realm is associated with causality and Ought with imputation. The irreducible Is-Ought duality corresponds to a very old mythical and religious duality between the Earth and Heaven, in other words, nature and spirit.

Roles, not rules. Ordinary people think in terms of roles. People do not know the rules and paragraphs of the law. A situation can be depicted with icons that represent the roles of players. This is used in situational visualization; cf. (Butler, 2010). For example, Holzer (2010) is concerned with German penal law and distinguishes two kinds of visualization: schematic (logical) legal visualization and situational (scenery) legal visualization. Schematic legal visualization structures concepts, and situational legal visualization represents situations, their elements, and relationships. The pictures thus obtained are more suitable than texts that are one-dimensional strings of words.

Generation of images. SLV is about the generation (synthesis) of diagrams. Images can be represented by data and algorithms. The degree of automation – fully or semi-automatic generation – is another issue. The sequence of images depends on the user's goals. Pictures are merely reproduced in a simple slide preparation tool; however, pictures are generated in advanced tools such as computer aided design (CAD) systems or geographic information systems (GIS). There are interactive systems which allow the user

to navigate and to choose a visualization sequence according to her needs. For instance, in GoogleMaps, the user can first overview a broad region and then zoom in and move to details, where images are generated from a GIS database.

Scenarios. We think that scenario-centered visualized narratives can be used in the development not only of technical systems, but also of socio-technical ones. "Scenarios are a powerful antidote to the complexity of systems and analysis" (Alexander, 2014, p. 3). A scenario is a narrative of foreseeable interactions of user roles (actors) and the technical system. A narrative is a time-threaded sequence of actions. "[S]cenarios are basically holistic… [T]he scenario is in essence, a single thing that conveys a human meaning" (Alexander, 2014, pp. 4, 9).

3. Legal Visualization

In (semi)formal representations of legal norms, on the one hand, there are formal notations, which go beyond the textual ones; on the other hand, there are visual representations that also occur in competition with the text. Two different types of visualization can be distinguished: first, the visualizations formed according to strict formal rules; second, the more intuitive pictures which can detect situations better.

As noted in Brunschwig (2014, p. 900), the concept of visual law (*vox iurisprudentiae picturae*) emerged in the 17th and 18th centuries. A study of multisensory law is provided in Brunschwig (2011). Visual law explores visual legal communication practices. Commenting on a variety of these practices would extend beyond our abilities and the scope of this paper. We address the diagrammatical visualization of statutory law and leave aside other important practices such as image-driven advocacy (Murray, 2014; Porter, 2014).

Boehme-Neßler (2011) writes about the 'visualizification of the law' and its multiple facets, including the medium of television. He notes the complementarity of text and image and different characteristics and functions (Boehme-Neßler, 2011, p. 86 et seq.). Techno-images such as "structures, relationships or dynamic processes are often understood more readily when presented as maps, diagrams, models, building plans or computer simulations". A reason is that they "are created by causal mechanisms" (Boehme-Neßler, 2011, pp. 56–57).

We would also mention a study by Röhl and Ulbrich (2007) of visualization in the legal area and the motivations behind using it. They are more separated from what they write about, whereas we are emotionally tied to the diagrams we create. The lack of pictures in jurisprudence becomes a learning obstacle (Röhl and Ulbrich, 2007, pp. 15–17). A starting position is "Law is text" and therefore law is always textual for jurists. Hence there are reasons for jurists' reluctance to use visualizations. Pictures bring a risk of drawbacks, such as redundancy, a low level of abstraction, trivialization, and emotions (Röhl and Ulbrich, 2007, pp. 18–25, 100–102). However, the use of logical pictures[6] can bring ad-

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[6]*Logische Bilder* according to the sense of Klaus Röhl. The analysis of the term *logische Bilder* in the sense of Ludwig Wittgenstein and his *Tractatus logico-philosophicus* would extend beyond the scope of this paper. However, note that we hold that no indicative statement logically follows from a modal ought-statement. In other words, *Obligatory p* does not imply *p*.

vantages. Metaphors and symbols can be employed to represent norms and hence pictorial two-dimensional representations emerge (Röhl and Ulbrich, 2007, pp. 42–62). A historic example is the frontispiece of the book *Leviathan* by Thomas Hobbes,[7] where the state is represented by a giant crowned figure. To summarize, the combination of the words "law and visualizations" contains a kind of a paradoxical contradiction.

Besides pictorial visualizations, logical diagrammatical visualizations including infographics are widely used to represent legal content such as argumentation graphs, legal workflow, etc. There are also quite different approaches to visualization, for instance, through semiotics (see Fig. 4). The classical philosophy of law, however, as approximately represented by Arthur Kaufmann (Lachmayer, 2005), has provided a methodological introduction to visualization with the thought pattern of *tertium comparationis*. Especially in the European Union, with its many official languages, a visual, which appears as a *tertium*, can form a mental bridge between different languages.

A slide set is not a rich information space. SLV is intended for navigation in a state space, where visualizing concepts lead first to scenarios and next to processes. The users may have different capabilities (laymen and professionals). A problem here is presenting explicitly a huge structure of legal terms. A specific example is the variety of relationships, such as weak/strong, direct/indirect, presumed/legally established, etc.

Further, we observe two variations of SLV: first dynamic SLV, then static SLV. They differ in that the structure changes (in time) in dynamic SLV but does not change in static SLV. Although in static SLV the structure does not change, the visualizations do change: elements can be added to or deleted from different views. We treat the information space as a system.

4. Dynamic SLV

Dynamic SLV considers that the structure of information space changes. In different phases of the process, the whole structure looks different. Here we talk about different pathways through the informational space. This is not about adding or deleting items to views as in the case of static SLV. An example is as follows. Visualize the different roles of a person in the different phases of criminal proceedings (Fig. 2):

1. Suspect in the pretrial stage.
2. Defendant (accused) in the judicial stage.
3. Convict in the punishment stage.

Views in dynamic SLV can be compared with film frames. The above is an example whose object is a changing diagram. In addition to this, there is also dynamic SLV with moving pictures that are implemented in films.

The change of a structure (system) is a challenge for legal informatics. Consider the European law and decision making between the European Parliament, the European Commission and the Council of the European Union. The processes are complex and difficult

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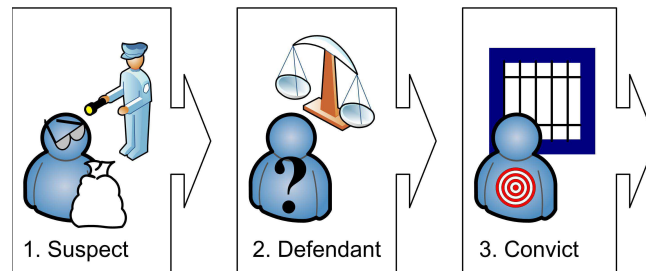[7]http://en.wikipedia.org/wiki/Leviathan_(book).

Fig. 2. A sample dynamic sequential legal visualization. Each of 3 views shows different roles of a person in the different stages of criminal proceedings.

to comprehend. However, they can be explained step by step. A novice can start from an overview.[8] Each phase is viewed differently and comprises branches. Modeling these procedures involves processes and their traces.

Different pathways through the informational space have to be considered in HELP.gov applications, in which ordinary citizens seek advice depending on a situation and a phase. A user navigates the system according to her needs and obtains a sequence of information chunks. Modeling the user's degree of interest and information layers is a requirement.

In SLV, the trace of a navigation process is a series of displayed views. Here the event recording symbols are graphical ones. A trace of the behavior of a process is defined as a finite sequence of symbols recording the events in which the process has engaged up to some moment in time (Hoare, 1985, p. 19). Communicating sequential processes is a mathematical abstraction of the interactions between a system and its environment. The basic building elements of a process are choice, sequential application and recursion (loop).

Film visualization. Films serve well for situational visualization; see, e.g., the Tele-Jura project.[9] Another example is "Menzi-Muck Timber Case – the Film!".[10] In this film, the type of situation is visualized with a Playmobil excavator–calf set (Fig. 3, left). The film shows and explains the decision tree (Fig. 3, right), which is employed by the visualized judge to make the judgment. The film represents a generalization of the judgment in a concrete case. The use of plastic characters and not real ones is important because a kind of relaxed mood is produced in this way, which is important from a semiotic point of view. Cognition is easier in an abstract situation.

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[8]See e.g. http://www.plan-eu.org/content//uploads/2013/05/How-laws-are-made.jpg.

[9]Tele-Jura is a project by R. Czupryniak, M. Frohn, P. Reineke, and S. Trebeß. Films run parallel to a course by Matthias Frohn at the Institute of International Private Law of the Free University of Berlin (http://www.telejura.de/).

[10]http://www.youtube.com/watch?v=KI7zeuayum4. This four-minute film takes a familiar case (BGE 129 III 181 ff.) In this 2002 decision, the Swiss Federal Court defined criteria to distinguish between favor, gratuitous contract, *negotiorum gestio*, and the claim to compensation by a person who gave voluntary help to another. See also the comment by lawyer Arnold Rusch (http://www.arnoldrusch.ch/pdf/130311_menzimuck.pdf). The case concerns a claim for damages suffered by a person who voluntarily helps another. A farmer helps a neighboring farmer to attach large logs to a Menzi Muck excavator for transport. The former falls from the ladder without any third party being at fault and is gravely injured. Is this a question of gratuitous contract, favor, or *negotiorum gestio*? The distinction is relevant because only *negotiorum gestio* entitles him to compensation.
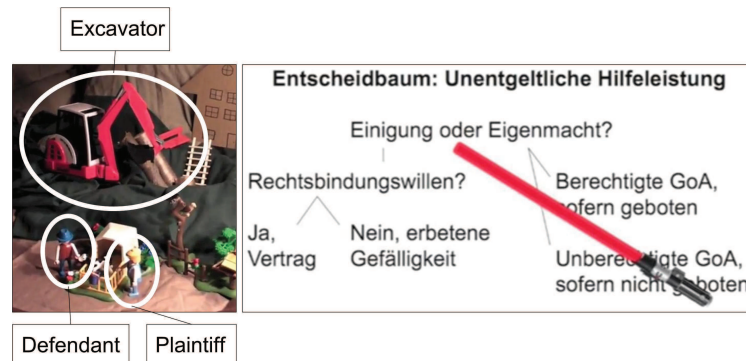
Fig. 3. A film visualization of the "Menzi-Muck Timber" case of the Swiss Federal Court. On the right a decision tree shows criteria to distinguish between favor, gratuitous contract, *negotiorum gestio* (*Geschäftsführung ohne Auftrag, GoA*) and the claim to compensation by a person who gave voluntary help to another.

5. Static SLV)

Static SLV is divided into two sub-variations: (a) incremental SLV and (b) alternate focuses SLV.

5.1. *Incremental SLV*

Diagram items are added sequentially and in the end the view becomes enriched quantitatively and complex. An example is shown in Fig. 4. Sequential SLV relates to focus + context views in information visualization.[11] The following is a simple reference model for visualization (Card, 2008, p. 519), originally in Card (1999):

Raw Data → Data Tables → Visual Structures → Views.

Another example demonstrates that each incremented view may be graphically simple, e.g., a rectangular box, but semantically difficult to understand, because it represents a complex (legal) concept. Figure 5 illustrates the idea, which has been presented in a conference (Tinnefeld and Lachmayer, 2014). A conflict between an official context and a suppressed (taboo) context is displayed incrementally. The narrative sequentially introduces five notions:

1. Everyday life.
2. The official context.

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[11] "[C]onsider visualizations in which the machine is no longer passive, but its mappings from Visual Structure to View are altered by the computer according to its model of the user's *degree of interest*... Focus + context views are based on several premises: First, the user needs both overview (context) and detail information (focus) during information access, and providing these in separate screens or separate displays is likely to cost more in user time. Second, information needed in the overview may be different from that needed in the detail... Third, these two types of information can be combined within a single dynamic display, much as human vision uses a two-level focus and context strategy" (Card, 2008, p. 536).
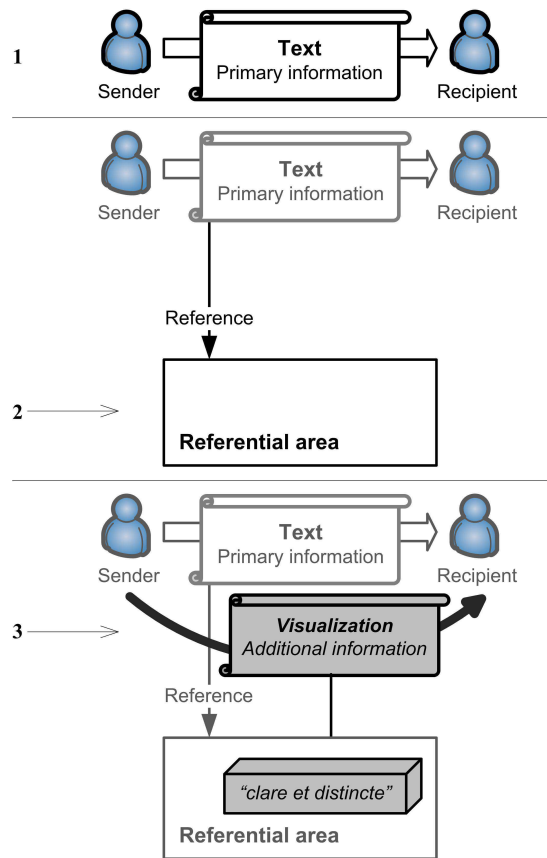
Fig. 4. A sample incremental SLV. *"Clare et distincte"*, "clear and distinct", is René Descartes's criterion of truth.

3. The suppressed (taboo) context.
4. The media's role.
5. The truth-teller's role.

The picture format is not rich enough to show an incremental animation, because printed text provides fewer visual effects than a conference presentation, which is typically dominated by voice explanation. Examples of complicated artifacts in engineering are design drawings, such as the design of a machine. A CAD system visualizes the machine. Its drawing set can be printed, but on many sheets.

5.2. *Alternate Focuses SLV*

In this sub-variation, single items are added and others are taken away, so the number of picture items per view remains manageable. Figure 6 shows a picture which can be analyzed in depth using three different focuses.
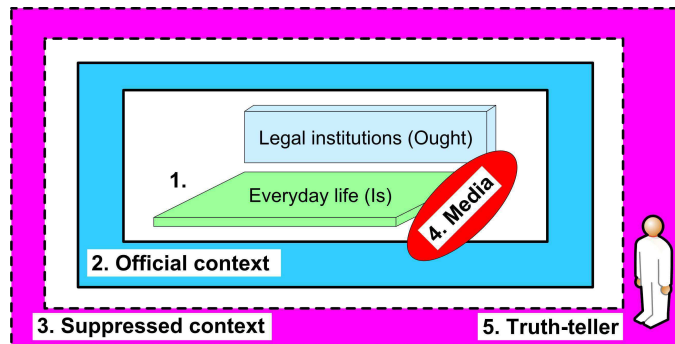
Fig. 5. A complex context is illustrated with a static SLV with a numbered sequence of accumulated elements.
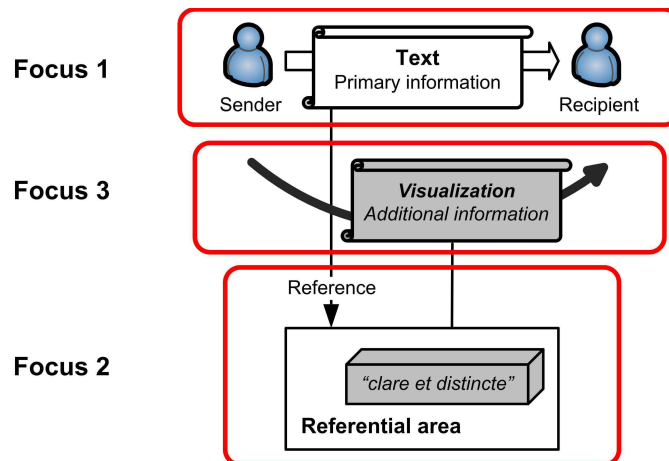

Fig. 6. A sample of three focuses in an alternate focuses SLV.

The visualization consists of a series of views each showing a perspective from a different focus. Here various methods of information visualization can be applied. They emerge in the presentation problem, where different methods of scrolling, context map, and image magnification (zooming) are used. This is exactly the problem that is explored in Spence (2001, p. 116): "the problem created by the need to have context information beneficially co-existing with detail of the focus of attention".

Other variations of SLV. Besides dynamic SLV and static SLV, other manners of visualization are possible. Consider, for example, a big picture, which can be barely comprehended with a single view (e.g., a map). Experiments to view it can be made with the focus.

In three-dimensional virtual worlds, a virtual camera commonly moves with an avatar and machinima can depict the motion. Machinima is the use of real-time computer graphics engines to create a cinematic production. Butler (2010) examines legal education with

the virtual world Second Life. He notes that machinima can contribute to a narrative-centered learning environment and "also offers a broad canvas for storytelling". Butler's machinima scenarios contain fact situations in legal ethics.

5.3. *Legal Narratives*

Visualization brings narrative vividness (*Anschauung*, *Anschaulichkeit*, Latin *imaginatio*). The sequence of images within SLV goes hand in hand with a legal narrative. A point of SLV is that the legal narrative is about the law (Ought) rather than the facts (Is). We agree that the facts and cases are also important, especially in legal practice and therefore scientific literature, particularly in the common law tradition, pays much attention to the legal narrative of facts; cf. (Murray, 2014). Visual narrativity and visual rhetoric are commonly used in advocacy. Porter (2014) provides a comprehensive scholarly treatment of images in written legal argument and offers suggestions for the fair regulation of multimedia persuasion.

Law and norms are normative whereas science is descriptive. Text is descriptive; however, legal text is normative. A narrative space is not descriptive, because the players may tell different stories (Bex *et al.*, 2010). The narrative space of the text, e.g., the sales law, can also refer to normative elements, e.g., the United Nations Convention on Contracts for the International Sale of Goods. General legal norms have the potential of a narrative space and its visualization. This concerns, for instance, legal institutions that can be made more vivid.

Legal text can be processed with computers. However, text has no vividness. The text does not coincide with the narrative space; however, the text can constitute the narrative space. Visualization forms the vividness space of the text's reference range. Hence visualization does not compete with the text, but forms a narrative stage for it.

For instance, Wolfgang Kahlig demonstrates that the German tenancy law is difficult to understand even for jurists. Different cost components are legal institutions from Ought. Kahlig develops software that explains the law and serves property management accounting (Kahlig and Stingl, 2011; Kahlig and Kahlig, 2015). His diagrams are formally correct, but need even more vividness. Therefore we see a future for legal visualization in software.

The software system's front-office that is seen by the user is required to be simple and may comprise visuals such as icons. However, the back-office is complex, because it has to represent correctly formalised legal structures.

Metaphors. The language of law is of a metaphorical nature; cf. (Lakoff and Johnson, 2003). Metaphors also serve to represent the meaning (*Deutung*). The act and its legal meaning (*rechtliche Bedeutung*) are differentiated (Kelsen, 1967, p. 2). Legal terms used by the language of law are not the same as those used in everyday discourse. Two kinds of interpretation in law are distinguished: the interpretation of norms and the interpretation of facts. The subsumption "the fact a is the legal concept A" also involves the metaphor of "is". Formalization in informatics might be the *instance-of* relation between a and A.

Metaphorical legal terms can be visualized accordingly. Kleinhietpaß (2005, p. 44) devotes a separate section to logical pictures in her dissertation on metaphors in the legal

language and their visualization. She lists 19 metaphorical means of style, such as allegory, analogy, comparison, hyperbole, parabola, symbol, etc. (Kleinhietpaß, 2005, p. 82). Metaphorical styles employ entities and relationships between them. With SLV we aim to represent relationships explicitly. An example is a comparison which involves *tertium comparationis* (Lachmayer, 2005). Consider four apples being brought into relation with four pears. This is about the number, in this case about the number four, which occurs as *tertium comparationis*.

No formal semantics for diagrams. We hold that diagrams may have formal syntax, but do not need to have uniform formal semantics. Diagrams can be composed of metaphorical graphical elements. The Unified Modeling Language, UML (Booch *et al.*, 2005), for instance, has formal syntax, but no uniform semantics. UML diagrams are declarative, their interpretation depends on the user, and software can be generated automatically up to a certain level. Source code for procedural knowledge has to be written by programmers.

5.4. *Legal Visualization as Middle-Level Abstraction*

We provide one more argument for legal visualization in general and SLV specifically. We hold that middle-level abstraction contains more potential for creativity. We thus introduce three layers of abstraction in the legal area:

- Formal abstraction (in other words, high-level abstraction).
- Middle-level abstraction (in other words, interpretative abstraction). We focus on it in this article as we hold that it contains more potential for legal informatics.
- Substantive abstraction (low-level abstraction).

Each abstraction layer is discussed further separately.

Formal abstraction. This is not as dynamic as middle-level and substantive abstraction. Once found, it stays that way. As examples, the following works can be mentioned: Ilmar Tammelo's notation for the legal domain (1978), Jerzy Wróblewski's analytical theory of law (1992), Ota Weinberger's legal logic (1989), etc. Different sorts of formal logic, such as propositional logic, predicate logic, deontic logic, etc., are used here. These include, to mention just a few, studies in legal logic by Hage (2005), modeling legal argument by Prakken and Sergot (1996), Prakken (1997), input/output logics by Makinson and van der Torre (2000), legal reasoning by Sartor (2007), and visualizing normative systems by Tosatto *et al.* (2012).

Middle-level abstraction. Within the layer of medium abstraction, Hans Kelsen's Pure Theory of Law is a relevant example. Here we find a mixture of formal structuring and material closeness. This is the area of scientific progress. This level is more elastic than other two. We find this level more creative, at least for legal informatics and our investigation. On the one hand, there is enough potential for abstraction in this layer; on the other, the substantive matters are not forgotten. It should be noted that the content of concrete norms is not examined in this layer.

An example of formalization on this level of abstraction, though in chemistry, is a chemical formula notation such as H_2O. Practice shows that reasoning with such for-

mulas and their graphical models is very effective. The following are examples of structural notation in the legal area: relationships such as causality $A \rightarrow^{causa} B$ and teleology $A \rightarrow^{telos} B$, and a model of legal norms such as $Norm(A \rightarrow B)$. Here a rule of the general form *If state of affairs then legal consequence* serves as a simple model of norms. Such representation of norms is used in computer science and legal expert systems; see, e.g., Jones and Sergot (1993), Oberle *et al.* (2012) etc.

Creativity with ontologies in the legal domain can also be assigned to this layer. For example, the formalization of the norm graph concept is the starting phase in the approach of Oberle *et al.* (2012) to engineering compliant software. Here a norm graph consists of legal concepts (nodes) and links between them. Creativity is required to build the norm graph. Norm graph formalization is conducted by a legal expert and starts from extracting the required legal vocabulary. The vocabulary forms the basis of a legal lexicon which complements extracted terms by additional information. In turn, the lexicon serves as a basis for creating the computational model, which consists of classes and relations.

In the development above we see a transformation of a vocabulary (or ontology) into a computational model. We hold that there is a difference between a computational model (a database schema) and an ontology. A computational model follows the closed world assumption. This means that what is not currently known to be true, is assumed false. In other words, what is not in the model is not in the world. An ontology follows the open world assumption, which means that what is not currently known to be true is simply unknown.

Substantive abstraction. Substantive disciplines, such as legal theory and legal dogmatics (*Rechtsdogmatik*, no exact translation in the terminology of common law; legal science) describe the object in principle with words. However, these disciplines are not really of interest here, because abstraction is too concrete and it is difficult to raise it to an upper layer. The content of concrete norms is examined in this layer and hence contrasts with the two upper layers.

It is difficult to invent on the top, i.e., on the formal abstraction layer. For the same reason, we also do not focus on substantive abstraction. For instance, once an article in a law consists of a complete list of variations one can barely add more. However, we hold that creativity can be demonstrated on the middle abstraction layer. Formalizing the interpretations of facts can be assigned to the middle abstraction. An example is ontologies; see above. We aim at structuring the legal domain; namely, the big picture of the structure. In this layer, new formal notations could still be introduced, and they are not too far away from the substantive contents. This is in contrast to certain people who work on a low level and can interpret legal texts, but find it difficult to grasp the whole structure correctly.

6. Related Works

Erich Schweighofer's 8 views + 4 methods = synthesis. Informational processes in the legal domain changed essentially with the use of computers and the Web. Schweighofer (2015), concerned with the entire legal system, writes about the developments since the

1970s, and also emphasizes visualization. The law can be defined as a normative order which is conceived as a system of norms that regulates the behavior of men (Kelsen, 1967, p. 193). Since that time the informational processes have multiplied. Legal informatics has to develop a theory on what analytical tools and methods are available in the legal domain. A new approach by Schweighofer (2015) describes the 8 different representations of the legal system and the 4 computer-supported methods of analysis, leading to a synthesis, a consolidated and structured analysis of the legal domain, called an electronic legal handbook or commentary (Schweighofer, 2011). The 8 views are: text (multimedia) corpus, logical representation, ontological representation, visualization, argumentation view, annotation view, citation network view, and user view. The 4 methods are: documentation, interpretation (searching, reading and understanding), structural (logical and conceptual) analysis, and visualization. The synthesis consists in consolidating all representations and analytical methods in a common representation.

6.1. *Specifics of SLV: Visualizing Legal Meanings*

In visualizations in the legal domain our attention is attracted by the following two specific features. Firstly, legal visualization is characterized by specific raw data. It cannot be limited to a specific norm or law and covers legal sources, legal doctrine, legal science, and other elements.

Secondly, the object of visualization is a legal meaning. This differentiates legal visualization from information visualization. In the latter, computer-supported interactive visual representations are important. However, this is not the case in legal visualization. In the comprehension of law, communicating the meaning of law to the human user is of primary importance. In this sense legal visualization is related to knowledge visualization. The visual structure is a diagram that represents the meaning. Here diagrams serve well as legal norm visualizations (*Rechtsnormbilder*, Röhl and Ulbrich, 2007, pp. 109–111).

Hence, the visualization of legal meanings is distinct from information visualizations, such as the presentation of goods and services to potential customers who wish to search for a particular item.

Three functions of instructive pictures can be distinguished (Röhl and Ulbrich, 2007, p. 91):

1. Pointing function (e.g., an anatomy atlas).
2. Situational function ("A picture is worth a thousand words").
3. Construction (structure, design) function (the picture helps a viewer to build a mental model in her mind).

Our personal experience shows the importance of the latter two functions in the visualization of legal meaning.

The semantics conveyed by a visual, i.e., the meaning of the representation, is addressed by Fill (2009) in a chapter which is devoted to the analysis of visualizations.[12]

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[12]Visualisation semantics are therefore related to questions such as *What may a user associate with the resulting graphical representation?* or *Is the intended meaning of the visualization correctly transferred to the user or would another type of representation better fit?* (Fill, 2009, p. 163).

Knowledge explication is a primary aim of legal visualization in our approach. Here we refer to Fill (2009, p. 172), who holds that "the goal of *knowledge explication* ... is to explicate knowledge that resides in the heads and minds of people and express it by a visualization" and lists four basic aims of visualizations: knowledge explication, knowledge transfer, knowledge creation, and knowledge application. A subsequent aim, knowledge transfer, can be achieved by the following tasks: Diverge, Converge, Organize, Elaborate, Abstract, Evaluate, and Build Consensus (Fill, 2009, pp. 173–174).

To summarize, the goal of comprehending the meaning of law is distinguished from searching for items or information.

6.2. *Relevance of Legal Visualization to Computing*

Computer usage changes legal tasks. A new task which is addressed by legal informatics is the development of legal machines. An example of non-compliant software design is provided in Oberle *et al.* (2012). Their example demonstrates legal reasoning that leads to a violation of data privacy law. It is about a user's consent, given by clicking 'yes' on his mobile phone, but not treated as an effective consent in the legal sense.

Software requirements are formulated in the early phases of the software development life cycle. Legal requirements are at a high level and are also a concern of requirements engineering. A flowdown of the requirements leads to lower level specifications. Software is designed to comply with the initial legal requirements. However, the story above is in practice rarely so simple. There may be a wide span between the legal requirements and the technical specifications. Failure to understand the law is one of the reasons why the program may be non-compliant. On the one hand, legal texts constitute only a part of the entire legal system. The meaning of the law – the Ought realm – can scarcely be understood from a single legal text. Therefore it is difficult for a beginner to understand the spirit of law while reading a statute in isolation. For this reason only well-defined compliance problems can be implemented by ticking boxes in an audit document.

The concept of legal machines. There are simple legal machines, such as traffic lights, barriers and vending machines, and complex ones, such as the electronic forms that are used in tax and finance. A legal machine can be defined as a machine in a system whose actions have legal importance and legal consequences (Čyras and Lachmayer, 2013). Legal machines shift raw facts into institutional facts. The raw facts come from the Is world, whereas the institutional facts come from the Ought. Moreover, a raw fact may have different legal interpretations. Legal machines contribute to law enforcement, and their software implements legal rules.

Causality and imputation. Hans Kelsen, one of the most prominent and influential legal philosophers explains in detail the distinction between causality and imputation (Kelsen, 1991, Ch. 7). Imputation links a condition and a sanction brought about by a general moral or legal norm. System developers are accustomed to causality and mathematicians are accustomed to the axiomatic method. Therefore they may need special efforts to comprehend when they "encounter a principle which is different from the principle of causality expressed in the natural laws formulated by the natural sciences". These

are two "different, but analogous" functional connections.[13] SLV aims at a qualitatively more complex phenomenon than problem domains in natural sciences and software engineering, where the complexity can be mastered by quantitative methods, e.g., hierarchical decomposition, "divide and conquer".

Difficulties of understanding the meaning of law by software developers. Engineers who design legal machines might wish to make the following simplifications while modeling the law. First, representing legal norms as rules, and, second, automatic interpretation of a fact, *a*, and subsuming it under the legal term *A*, which is present in a norm. However, these simplifications and the plain interpretation are not always possible. The subsumption of *a* under *A* may be established through a complex relationship rather than a binary relation *a instance-of A*, which is preferred by software engineers. Legal professionals are familiar with different methods of interpretation such as grammatical interpretation, systemic interpretation and teleological interpretation. The interpretation of facts can lead to deep conclusions through multiple steps of different relationships. The plaintiff can argue that *a* is subsumed under *A*, but the defendant can argue for the opposite. Therefore a legal machine could make a balanced decision in routine cases and cannot in hard cases. Knowledge can be represented in a machine, but not wisdom.

A legal norm is usually not formulated in one sentence and can expand through several places. For example, a norm's element, such as a condition, a subject, an obligatory action, or a provision, can be structured differently. The thesis that a universal model for reconstructing norms from legal text is possible can be rejected.

Legal texts are not structured in the units of norms. In other words, a legal norm is not a structural element either of a legal text or of a legal document. A norm is a product of interpretation. This is conducted by legal sciences, courts and the judicature. However, norms are linguistically formulated and jurists are linguistically oriented. For example, this can be observed in a speech by a judge. A legal provision may be collected from several places.

Electronic procedures as in eGovernment applications are likely to prevail in the middle areas of all kinds of proceedings. More and more situations are standardized and can be handled abstractly. However, things are different in the two peripheral areas. The hard cases will be handled as before with manual legal work.

For trivial matters of life, machines will continue to catch on. But these tasks, although legally performed, will still not be perceived by people as law. It is likely that a new type of situational personalization will occur, such as intelligent traffic lights, a kind of animistic norm-setter.

6.3. *Information Visualization*

In SLV, the primary user's concern in approach is *what*, the content. We assume that the user chooses his path to navigate in the information space. *How* information is displayed is

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[13]The difference between the two is this: imputation (i.e. the relation between a certain behavior as condition and a sanction as consequence, described by a moral or legal law) is produced by an act of will whose meaning is a norm, while causality (i.e. the relation between cause and effects described by a natural law) is independent of any such intervention (Kelsen, 1991, Ch. 7, p. 24).

a secondary concern. In contrast, information visualization addresses primarily *how* and secondarily *what*. The how can be maintained by different user interface mechanisms. These mechanisms have different features of separation. Overview + detail is character-ized by spatial separation, lenses – Z-separation, zooming – temporal separation, focus + context – seamless focus in context, and cue-based techniques – selective highlighting or suppressing of items within the information space. Focus + context integrates focus and context into a single display (Cockburn *et al.*, 2009).

SLV increases the ability to comprehend the information space, which is the law. The purpose of cognition in SLV outweighs perception. Cognitive skills are more important in SLV than perceptual ones as in the case of information visualization. SLV focuses on cognitive tasks and not on search and target acquisition tasks as information visualization.

While investigating SLV, the purpose of visualization has to be agreed. Here we can refer to information visualization that can be defined as "the use of computer-supported, interactive, visual representations of abstract data in order to amplify cognition" (Card, 1999). Hence, amplifying cognition is the purpose of information visualization. Speaking about terminology, information visualization is distinguished from *scientific visualization*, which is applied to scientific data and is typically physically based. Both belong to the broader field of *data graphics*, "which is the use of abstract, nonrepresentational visual representation to amplify cognition. Data graphics, in turn, is part of *information design*, which concerns itself with external representations for amplifying cognition" (Card, 2008, p. 515).

Focus + context presentation techniques enable the user to discern information of in-terest. For example, multiple layers can be viewed from different focuses and with different transparencies of each layer. Suppression of data is used in situations where the display of too much information can be confusing. In this case, techniques for intelligently sup-pressing data are valuable. To summarize, the motivation is to provide balance between local detail and global context (Spence, 2001, Ch. 7). SLV has a commonality with the riffling technique Rapid Serial Visual Presentation and zooming and panning. "Panning is the smooth movement of a viewing frame over a two-dimensional image of a greater size" (Spence, 2001, pp. 127, 130). They produce a series of images in time.

Incremental SLV has a commonality with the information visualization notion of se-mantic zoom (Spence, 2001, pp. 132–133). Both concern parts and the whole, but in oppo-site directions. Incremental SLV goes from a part to the whole diagram, whereas semantic zoom from the whole to a detail. Semantic zoom can be observed in air traffic control sys-tems. In an overview an aircraft is shown on a display as a small circle. Semantic zoom-in allows the aircraft to be shown with flight information such as aircraft type, cruise level, destination, etc.

6.4. *Knowledge Visualization*

Studies in visual cognition lead to the conclusion that visualization dramatically increases our ability to think and communicate. Eppler and Burkhard (2006) link knowledge visual-ization with knowledge management and list numerous benefits of visual representations.

Hence, a longstanding objective is knowledge management. Knowledge visualization is defined as a field that "examines the use of visual representations to improve the *creation* and *transfer* of knowledge between at least two people. Knowledge visualization thus designates all graphic means that can be used to construct and convey complex insights" (Eppler and Burkhard, 2006, p. 551). Knowledge visualization is differentiated from other approaches, such as information visualization or visual communication.[14]

Information visualization typically helps in human-computer interaction while knowledge visualization is primarily used in communication among individuals. A knowledge visualization framework comprises three perspectives which answer three key questions with regard to visualizing knowledge (Eppler and Burkhard, 2006, pp. 552–553):

1. Knowledge type (What? What type of knowledge is visualized (object)?).
2. Visualization goal (Why? Why should that knowledge be visualized (purpose)?).
3. Visualization format (How? How can the knowledge be represented (method)?).

The visualization format perspective structures the visualization formats into six main groups: (1) heuristic sketches, (2) conceptual diagrams, (3) visual metaphors, (4) knowledge animations, (5) knowledge maps, and (6) domain structures. The conceptual diagrams are important from the view of knowledge representation. Eppler and Burkhard (2006, p. 554) list 18 types of frequently used conceptual diagrams, such as process, flowchart, etc.

Visualization in business informatics. We find diagrammatical representations in the legal domain relevant with Hans-Georg Fill's work (2009). He positions his work in the area of fundamental research of business informatics, observes the fields which are related to the term "visualization," and surveys existing visualization approaches. In the context of business informatics, Fill (2009, pp. 25–26) classifies the related fields into three categories:

1. Application level (knowledge visualization, enterprise modeling).
2. Conceptual level (visual languages, graph theory and graph drawing, descriptive statistics, information visualization.
3. Implementation level (computer graphics).

Visualizations in business informatics concern primarily business frameworks and business processes. The variety of their elements is very big (Fill, 2009, Ch. 3). A shared goal is to communicate business information.

Fill's survey of visualizations in business informatics may serve as a template to perform a survey of visualization methods in the legal domain. However, such a survey is out of the scope of this paper and is barely feasible for a small research group because law comprises different branches and employs different methods.

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[14]Information visualization aims to explore large amounts of abstract (often numeric) data to derive new insights or simply make the stored data more accessible. Knowledge visualization, in contrast, facilitates the transfer and creation of knowledge among people by giving them *richer means of expressing what they know* (Eppler and Burkhard, 2006, p. 551).

7. Conclusions

We explored an approach to visualization in the legal domain, which we call structural legal visualization (SLV). It is divided into dynamic SLV and static SLV. The latter is divided into incremental SLV and alternate focuses SLV.

An overall function of visualization is to reduce complexity. Depicting legal meanings is a problem. In SLV, the law (Ought, legal institutions) is in the forefront rather than facts (Is). SLV stresses a scenario rather than information display. Legal narratives with SLV are visual ones. Another point of SLV is the dynamic aspect, namely, user-centric navigation in the information space. For instance, laymen and professionals use different wordings and play different roles in informational processes. SLV can serve to show a bright-line distinction between legal terms, for instance, in eGovernment applications explaining the law to citizens.

SLV can be characterized as a top-down approach rather than a bottom-up one, which is a feature of visualizing facts in storytelling. SLV calls the user to become a "master of the law". The user is supposed to perform high-level cognitive tasks such as comprehending the information space rather than low-level mechanical tasks such as target acquisition. Each contents creator would depict an object differently. Skills in art can also be important. Thus SLV calls for imagination.

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Struktūrinis teisinis vizualizavimas

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Pristatomas vizualizavimo teisės dalykinėje srityje metodas, vadinamas *struktūriniu teisiniu vizualizavimu* (STV). Čia struktūrizuotos diagramos perteikia prasmę, kuri glūdi teisiniame turinyje (pvz., tekste, geste ar teisiniame institute). STV tikslas skiriasi nuo informacijos vizualizavimo tikslų, tokių kaip informacijos elementų paieška, o taip pat žinių vizualizavimo, skirto komunikavimui tarp individų. STV skirtas teisės, o ne faktų vizualizavimui, ir tuo skiriasi nuo situacijų vizualizavimo, kaip yra advokatų pasisakymuose teismuose.

Mūsų tyrimai motyvuojami teisinio turinio sudėtingumu. Kuriama programinė įranga turi būti suderinama su teise. Perprasti visą teisinę sistemą ar atskirus teisinius institutus gali būti sudėtinga net juristams profesionalams. Literatūroje pateikiami pavyzdžiai apie giluminį programinės įrangos neatitikimą teisiniams reikalavimams. Tai svarbu darbų sekose, kurių padariniai turi teisinę galią, pvz., mokesčių administravimo ir kitose e. valdžios sistemose.

Diagramos paprastai vaizduoja ryšius tarp teisės elementų. Teisėje svarbūs ne tik išreikštiniai ryšiai, bet ir neišreikštiniai. Ryšių įvairovė didelė: priežastiniai ir prisiejimo (normatyviniai); teisiškai įtvirtinti ir numanomi; stiprūs ir silpni ir pan. Vaizdų seką STV galima palyginti su nuosekliu pasakojimu. STV kalbama apie tokį diagramų generavimo procesą, kurio seka priklauso nuo vartotojo tikslų. Taigi turime scenarijumi grindžiamą navigavimą informacinėje erdvėje.

Priklausomai nuo to, ar vizualizavimo objektas (informacinė erdvė) kinta ar nekinta, išskiriame du STV variantus: dinaminį STV ir statinį STV. Pastarajame išskiriami dar du variantai: (a) inkrementinis STV, kai yra pridedami nauji diagramos elementai, ir (b) keičiamo dėmesio centro STV, kai pereinama prie detalių.