Chapter 33
Towards Multidimensional Rule Visualizations

Vytautas Čyras and Friedrich Lachmayer

Abstract This paper reviews visualizations in legal informatics. We focus on the transition from traditional rule-based linear textual representation such as “if $A$ then $B$” to two- and three-dimensional ones and films. A methodology of visualization with the thought pattern of tertium comparationis can be attributed to Arthur Kaufmann. A tertium visualization aims at a mental bridge between different languages. We explore how visualizations are constructed and what types can be found here. Review criteria comprise comprehension, relations, vertical-horizontal arrangement, time-space structure, the focus of attention, education, etc. Pictures for review are selected from JURIX 2012 proceedings. We conclude that making visualizations as avant-garde as JURIX projects themselves is a tough task that requires knowledge of law, computing, media and semiotics.

Keywords Diagrammatic models · Legal education · Legal informatics · Legal visualization · Soft visualization

33.1 Introduction

This paper reviews visualizations in legal informatics by asking the question “How is multidimensionality exploited?” There are multiple criteria to review and in turn different means to achieve multidimensionality in visualizations: colours (including black-white-grey), mixed types of graphical elements, 1D-2D-2½D-3D, quantity-quality, statistics, etc.

The mainstream of the visualization in law, legal science and legal informatics can be determined with reference to JURIX, the Dutch Foundation for Legal

This author was supported by the project “Theoretical and engineering aspects of e-service technology development and application in high-performance computing platforms” (No. VP1–3.1–ŠMM–08-K–01–010) funded by the European Social Fund.

V. Čyras (✉)
Faculty of Mathematics and Informatics, Vilnius University,
Naugarduko 24, Vilnius 03225, Lithuania
e-mail: vytautas.cyras@mif.vu.lt

F. Lachmayer
Faculty of Law, University of Innsbruck,
Innrain 52, Innsbruck 6020, Austria

© Springer International Publishing Switzerland 2015
M. Araszkiewicz et al. (eds.), Problems of Normativity, Rules and Rule-Following,
Law and Philosophy Library 111, DOI 10.1007/978-3-319-09375-8_33

vytautas.cyras@mif.vu.lt
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. In the visualizations in turn two different types can be distinguished: first, the visualizations formed according to strict formal rules; second, the more intuitive pictures which can detect situations better. A very good overview of legal visualization can be found in the book of Klaus Röhl and Stefan Ulbrich (2007).

There are also quite different approaches to visualization, for instance, through semiotics (Fig. 33.1). The classical philosophy of law, however, as approximately represented by Arthur Kaufmann (see 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 visualization, which appears as a *tertium*, can form a mental bridge between different languages.

The annual JURIX conferences are among the most important in legal informatics regarding both the content and the form of scientific presentations. The leading projects in the world are presented here. In many cases visualizations make the text easier to understand, at least in terms of key points. On a meta-reflection level, however, the empirical question is how these visualizations are constructed and what types can be found therein. Such an analysis may also affect the future design of visualizations in legal informatics, especially as corresponding design principles are not yet in the canon.

![Fig. 33.1](http://www.jurix.nl/?page_id=8)
33.2 Types of Multidimensionality in Legal Visualizations

First we explain what we mean by multidimensionality in rule representations.

33.2.1 One-dimensional (1D) Visualization

Traditional norms (rules) are represented linearly: in text, both in natural languages and in artificial languages including mathematical notations, formal logic (propositional logic, predicate logic) and programming languages such as Prolog. A traditional notation is “If $A$ then $B$”, $A \rightarrow B$ or $N(A/B)$, read “when a state of affairs $A$ is given, then the legal consequence $B$ applies”. There are other notations such as Polish prefix notation that comprises a deontic modality and was used by Ilmar Tammelo (1978). An example of a Prolog-like notation is the logical legal sentence in Hajime Yoshino’s Logical Jurisprudence (2011).

33.2.2 Two-dimensional (2D) Visualization

Metaphors and symbols can also be employed to represent norms and hence pictorial two-dimensional representations emerge (Röhl and Ulbrich 2007, pp. 42–62). An ancient example is the frontispiece of the book Leviathan by Thomas Hobbes,2 where the state allegory is encapsulated in the sovereign Leviathan that is represented by a giant crowned figure. Besides pictorial visualizations, logical diagrammatical visualizations including info-graphics are widely used to represent legal content such as argumentation graphs, storytelling, legal workflow, etc. (Kahlig 2008).

33.2.3 Two and Half-dimensional (2½D) Visualization

2D diagrams can include pictures of three-dimensional real world bodies such as cubes, cylinders, people, computers, houses, etc. and their icons, producing so-called 2½ representations. The icons of three-dimensional real bodies are used to contrast 2D diagramming elements and abstract concepts.

33.2.4 Three-dimensional Visualization and Films

An example of three-dimensional visualization is the “Menzi Muck timber case—the Film!”,3 which presents situational visualization. The case concerns the liability

---

for damages suffered by a volunteer. This 4-min film takes a familiar case from 2002 (BGE 129 III 181 ff.). The Swiss Federal Court defined demarcation criteria between favour (Gefälligkeit), gratuitous contract (unentgeltlicher Auftrag), agency without specific authorisation (negotiorum gestio, Geschäftsführung ohne Auftrag) and the compensation claim of a volunteer (Schadenersatzanspruch der unentgeltlich helfenden Person).

### 33.3 Visualization Criteria

We further examine selected pictures from JURIX 2012 papers. This examination is done on the reflexive level of legal informatics. First we discuss systematically different criteria:

- **Citation.** The names of laws and article numbers can be included in diagrams (Winkels and Hoekstra 2012, p. 160).
- **Colours.** In black–white press, dark and light grey tones aid comprehension (Winkels and Hoekstra 2012, pp. 158–166).
- **Dimensions.** Multiple dimensions on the paper can be achieved with 2½D. For instance, a wire-cube representation in Pace and Schapachnik (2012, p. 11) is supplemented with transitions and represents strength diagrams.
- **Domains.** Different problem domains can be referred to (Winkels and Hoekstra 2012, p. 158).
- **Elements with text.** Abbreviations may be difficult for non-experts (Szöke et al. 2012, p. 150). Similar may be with suspension points; see e.g. (Robaldo et al. 2012, p. 137) and (Szöke et al. 2012, pp. 150, 152).
- **Focus.** This is represented by bold face and a dark background. Important elements are coloured in dark grey and less important in light grey or white (Szöke et al. 2012, p. 154). There are also different shapes (angled, rounded).
- **Mindmapping.** Visualizations in the form of mindmapping are creative. An ontology design (Poudyal and Quaresma 2012, p. 118) is shown with no cross-links.
- **Mixed types.** Different types of elements are combined (Szöke et al. 2012, p. 150). This is good for legal education, but may be not very useful for formal semantics.
- **Quantity.** Too many elements confuse the issue. Therefore layers, levels and sub-elements are used (Winkels and Hoekstra 2012, p. 158).
- **Relationships.** Various relationships are depicted with different connectors. Different types of arrows are normally used: arced, curved, down, etc. Relationships can have a predefined or a newly defined meaning and are represented with edges in graph-like diagrams. Examples of relationships can be found in argument diagrams and defeat graphs in argumentation-based inference (Prakken 2012, 

---

Towards Multidimensional Rule Visualizations

• Tables. They contain much textual information but are not always creative (Pace and Schapachnik 2012, p. 113). Transitions can be added (Ramakrishna et al. 2012, p. 132).

• Traditional formal diagrams. Examples are argument diagrams (Lynch et al. 2012, p. 84) and statistical data visualization (Poudyal and Quaresma 2012, p. 118; Winkels and Hoekstra 2012, p. 166). They are clear, look good, but are nothing special.

• Vertical and horizontal axes. Placing elements top-down can mean different orders: hierarchy, time axis, etc. Horizontal arrangement from left to right can denote ordering in time. Other meanings can also be defined (Robaldo et al. 2012, pp. 137–139), where both the left arrows and right arrows show the rule-triggering sequence.

33.4 Visualizations in JURIX 2012 Proceedings

Selected JURIX 2012 articles are reviewed below in the order of their appearance in the proceedings, where they are ordered alphabetically.

33.4.1 Refined Coherence as Constraint Satisfaction Framework for Representing Judicial Reasoning

A constraint satisfaction framework as a potent tool for representing judicial reasoning is reported by Araszkiewicz and Šavelka (2012). Figure 1 on p. 8 shows a constraint network for conversion claim in the Popov v. Hayashi case. The picture is interesting, primarily from the point of view of relations, and open. A drawback of the picture is the absence of a legend for nontrivial abbreviations (FA—factual assertion, LA—legal assertion, FLR—FA to LA rules, LLR—LA to LA rules, LA₁—‘Hayashi is liable…,’ LA₂—‘Hayashi is not liable…,’ etc.) and three types of relationships (positive constraints, negative constraints, and the positively constrained chain). The reader has to guess whether the vertical arrangement means hierarchy and the horizontal one means flow.

33.4.2 Computational Data Protection Law: Trusting Each Other Offline and Online

A collaborative project to develop a communication in infrastructure that allows information sharing while observing data protection law “by design” is reported in

vytautas.cyras@mif.vu.lt
Buchanan et al. (2012). Figure 1 on p. 36 shows an overview of the architecture; see Fig. 33.2. This 2½D space-structured picture is composed of different subsystems. Two cloud-shaped “islands” that are connected with the “bridge” look better than white rectangles. Black and white textual elements interplay. Different icons of humans depict distinguished roles. The picture is comprised of different elements but is successful didactically. The same applies to Fig. 2 on p. 38.

### 33.4.3 Supporting Transnational Judicial Procedures Between European Member States: The e-Codex Project

The e-Codex project is meant to implement building blocks for a system to support transnational procedures between EU member states so as to increase cross-border relations in a pan-European e-justice area (Francesconi 2012). Figure 1 on p. 43 is composed of mixed elements that suggest clouds or islands and look like a territory map in 2½D. This is interesting; however, much of the text and graphics is too small and barely legible. Figure 2 on p. 47 is composed of mixed elements and a vertical static dichotomy between two models. It is interesting that dynamic flow is shown above with the interchange of grey and white ellipses. Figure 3 on p. 48 is composed of screenshots and arrow flows, but the dynamics is not elaborated.
33.4.4 Argument Analysis System with Factor Annotation Tool

An argumentation support tool which is based on a Toulmin diagram is reported in Kubosawa et al. (2012). Figure 1 on p. 62 shows the architecture of the system. The flow is represented by arrows and rounded white and angled grey rectangles. The reader might be familiar with this type of flow diagram which dates from the 1970s. Figure 2 on p. 63 shows a screenshot that is composed of mixed elements (a table of textual factors and an argument graph) and contains two flows. Figure 3 on p. 65 does not define the meaning of the vertical placing: a hierarchy or a process in time? The meaning of computer symbols can only be guessed (“documents” or something else?). Do the dashed elements exist or not exist? Figure 4 on p. 66 is too abstract because contrasting white and grey circles is not intuitive, although the labels α, β, Λ, z, w, K, etc. are explained in the text of the paper. Figure 5 on p. 68 is also not intuitive. Figure 6 on p. 69 is a bad design pattern: the primary screenshots in the background are too small and illegible and the callout recalls comics.

33.4.5 An Argumentation Model of Evidential Reasoning with Variable Degrees of Justification

A gradual argumentation model of evidential reasoning is reported in Liang and Wei (2012). The research work is interesting and mature. At first glance, however, Fig. 1 on p. 74 seems too abstract. Time and space structure, different arrows and abbreviations are not clear. Likewise, Fig. 2 on p. 79 is elegant but also lacks a legend. This may be justifiable if the reader is familiar with argument graph formalisations, John Pollock’s critical link semantics and the ASPIC+ framework.

33.4.6 Comparing Argument Diagrams

Lynch et al. (2012) report the results of an empirical study into the diagnostic utility of argument diagrams in a legal writing context, namely, how law students employed the LASAD program. Figure 1 on p. 84 is a type diagram. It is drawn to read from right to left although one might expect time axis from left to right. Some texts are in an excessively small font, which may be the fault of a student.

33.4.7 Types of Rights in Two-Party Systems: A Formal Analysis

A formalisation of Kanger’s types of rights in the context of interacting two-party systems, such as contracts, is reported in Pace and Schapachnik (2012). Figure 1 on p. 111 looks elegant although very formal and the reader has to judge if semantics complies with it. This picture recalls the logical square and cube which are known

vytautas.cyras@mif.vu.lt
in modal logic (Philipps 2012, pp. 69–81). The table on p. 113 is not detailed although this may be reasonable for summarising just yes/no in each cell.

33.4.8 An Hybrid Approach for Legal Information Extraction

An approach and prototype software for legal information extraction is reported in Poudyal and Quaresma (2012). They aimed to populate an ontology automatically. The approach combined a statistically-based method (machine learning) and a rule-based method. Figure 1 on p. 116 represents the ontology design. A reader could view it as a mind map and also ask whether the square of four concepts is a logical deontic square. All elements are in grey and therefore barely distinguishable. Figure 2 on p. 118 is not very creative.

33.4.9 Formalising a Legal Opinion on a Legislative Proposal in the ASPIC\textsuperscript{+} Framework

Prakken (2012) presents a case study in which the opinion of a legal scholar on a legislative proposal is formally reconstructed in the ASPIC\textsuperscript{+} framework. Figure 1 on p. 127 demonstrates well-defined relations. This is achieved with texts in the boxes, dashed lines, labels and white vs. grey. Figures 2 and 3 on p. 128 look elegant thanks to the abbreviations, white/grey tones and arrows. Abbreviations make it hard to comprehend, however. A question arises about the patterns within the figures. The meaning of the horizontal-vertical arrangement—hierarchy or time—can be understood only after a thorough reading.

33.4.10 The FSTP Test: A Novel Approach for an Invention’s Non-obviousness Analysis

A mathematical approach called the FSTP Test for determining a non-obviousness indication in patent application during the examination stage is proposed in Ramakrishna et al. (2012). A table in Fig. 2 on p. 132 is a hybrid with process curves. This would benefit from elaboration, probably in a longer paper.

33.4.11 Compiling Regular Expressions to Extract Legal Modifications

Prototype software for automatically identifying and classifying types of modifications in Italian legal texts is reported in Robaldo et al. (2012). The work employs the
Towards Multidimensional Rule Visualizations

Italian standard NormeInRete (NIR), which was the outcome of a previous project. Figures 2–5 on pp. 137–139 attract attention with arced arrows (and a loop in Fig. 5) and two reading directions (from left to right and vice versa).

33.4.12 A Unified Change Management of Regulations and their Formal Representations Based on the FRBR Framework and the Direct Method

A unified change management of legislative documents and their representations is introduced in Szöke et al. (2012). This is based on the Functional Requirements for Bibliographic Records (FRBR) framework and the direct method of legislative change management. Although Figs. 1 and 2 on p. 150 appear side by side, they have opposing reading directions. With regard to contents, Fig. 1 is very interesting because of the intermediate forms and four steps (Item-Manifestation-Expression-Work). Abbreviations (and formulas) make Figs. 2–6 on pp. 150–154 hard to comprehend for non-experts although bold face is used. Figure 6 has an opposing reading direction, ellipsis and rectangle-shaped elements with grey background and one with “dramatic” black. Relations are well-defined but formulas make the framework hard to comprehend.

33.4.13 Automatic Extraction of Legal Concepts and Definitions

Winkels and Hoekstra (2012) present the results of an experiment in automatic concept and definition extraction from the sources of law which are expressed in a simple natural language and standard semantic web technology. The software was tested on six laws from the tax domain. Relations in Fig. 1 on p. 158 are well identified and good for learning purposes. Although composed of four layers, the figure seems too quantitative. White and grey elements are used and a dark grey in the focus, but the whole is confusing and not heuristic. Figures 2 and 3 on p. 160 are good for citations, but three schemes in two figures to save space is undesirable. The processes in Fig. 4 on p. 165 are bottom-up and right-left, and not usual. Therefore the picture is schematic and not intuitive. A line-approaching curve is shown in Fig. 6 on p. 166.

Conclusions

Producing elaborated visualizations is a work that requires the mastery of several problem domains: law, informatics, visual media and semiotics. This is a tough task.
References


