TOWARDS REQUIREMENTS FOR A META MODELING FORMALISM TO SUPPORT VISUAL LAW REPRESENTATIONS

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***Abstract**:* *In order to enable machine based analyses of visual law representations we propose to use concepts from the area of meta modeling. Thereby the syntactic structures of visual representations can be represented formally. As a starting point we illustrate how meta modeling concepts can be applied to a visual law representation and then derive requirements for an according meta modeling formalism.*

1. Motivation

In the area of visual law many different kinds of electronically available visual representations have been created in the past[1]. In order to realize machine-based analyses and thus aid users in dealing with the contents of large amounts of such representations, the provision of an appropriate foundation in the form of a machine-readable language is necessary. Depending on the way the visual representation has been created, it may however either just consist of a raster image or may come in a format that contains more information about the composition of the elements in the image – e.g. in the case of vector graphics that specify graphical primitives and their visual properties. In some cases, the representations may have even been described in formats that abstract from the purely graphical representations and thus allow for more comprehensive analyses of the contents. Examples for such abstractions would be graph-based formats that specify nodes, edges, and their attributes and visual representations as e.g. in GraphML[2]. However, as only a small fraction of representations in visual law are graph-based, it is necessary to turn to formats that are capable of abstracting from the purely graphical descriptions and that are at the same time flexible enough to be applied to a variety of visual law representations. This can be accomplished by reverting to formats in the area of visual modeling languages. The syntax of such modeling languages is thereby typically described by meta models and the semantics by natural language statements or through the specification of according algorithms.

In the following we will therefore derive requirements for a meta modeling formalism that is able to support representations in the area of visual law. In section 2 we will briefly outline the necessary foundations from the area of meta modeling. The intended application is subsequently illustrated by an example in section 4 that is used to derive the requirements for the meta modeling formalism.

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[1] See the current version of the visual law database maintained by the University of Zurich that comprises more than 15.000 images: http://rwiweb.uzh.ch/rechtsvisualisierung/release2/ (last access 28-12-2011).

[2] See http://graphml.graphdrawing.org/ (last access 03-01-2012)

2. Foundations

According to a framework proposed by [Karagiannis and Kühn, 2002], a modeling language consists of a *syntax*, *semantics*, and a *notation*. Thereby, the syntax defines the elements and attributes of the language and the semantics assigns the meaning to these constructs. The notation specifies the visual representation of the elements and may also be dynamically adapted based on changes in attribute values. A *meta model* in this context describes the syntax of a modeling language, i.e. the so-called *abstract syntax* [Sprinkle et al., 2010], [Harel and Rumpe, 2004]. The models created with this modeling language have to correspond to the rules given by the abstract syntax and are represented using the visual notation for the elements. The resulting visual representations then correspond to what is denoted as *concrete syntax*. For the specification of the abstract syntax of a modeling language also some kind of language has to be used. We will denote this as the *meta modeling language*.

The choice of a meta modeling language thus determines which constructs are provided for the specification of modeling languages and how these constructs have to be used to create valid meta models and models. This also concerns how *inheritance*, *containment* and *associations* can be used to specify meta models. Thereby, inheritance is a powerful way to specify generalization/specialization relationships between elements of a meta model to provide means for effecting polymorphic behaviors at model execution or interpretation time [Sprinkle et al., 2010]. This is required for the design of algorithms that shall work on multiple modeling languages without the need of particular adaptations: By defining an algorithm on a set of general elements in a class hierarchy, the algorithm can be later bound automatically to elements that are inherited from the general elements. Containment refers to the inclusion of a set of elements into another element of the modeling language. This is typically used to specify *model/diagram types* or *aggregations/nestings* that group sets of specific elements. Associations define how elements and elements and attributes of a modeling language can be linked to each other.

In the context of visual law, modeling languages have been discussed in various contexts. Apart from standard process modeling and mind mapping techniques that have been used previously by several authors in visual law e.g. [Olbrich, 2007], [Sauerwald, 2007], also new modeling languages have been developed particularly for this domain [Kahlig, 2011]. However, these modeling languages have either been created before their application to visual law or have been conceived independently of visual law representations. Therefore we will illustrate in the next section how a modeling language can be derived from *existing* visual law representations. This will give us the necessary insights to derive requirements for an according meta modeling formalism.

3. Requirements for the Meta Modeling Formalism by Using an Example

To derive the requirements for a meta modeling formalism that is capable of representing concepts in visual law, we will use an example that has been presented in [Brunschwig, 2011] – see figure 1. It illustrates how a contract is concluded between two parties – shown in the right part – based on their previous mutual assent – shown in the left part. The representation is only given in an image format and can thus not be directly processed by an algorithm. To identify the elements of a possible modeling language for representing this legal episode, we use the technique of a “visualizing analysis” as described in [Fill, 2008]. Thereby we first identify possible elements and their relations to each other in both images as shown in figure 2-(1). Next, we identify elements and relations that are of the same type to derive classes of elements as shown by the different shapes in figure 2-(2). Then we identify attributes of these classes to distinguish elements that belong to the same class but have different properties – as shown by the two colors of the triangle elements. Finally we identify relations between the two images.

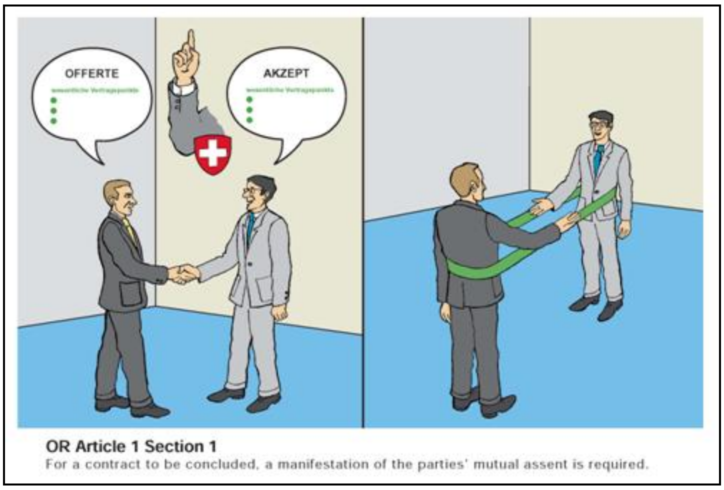
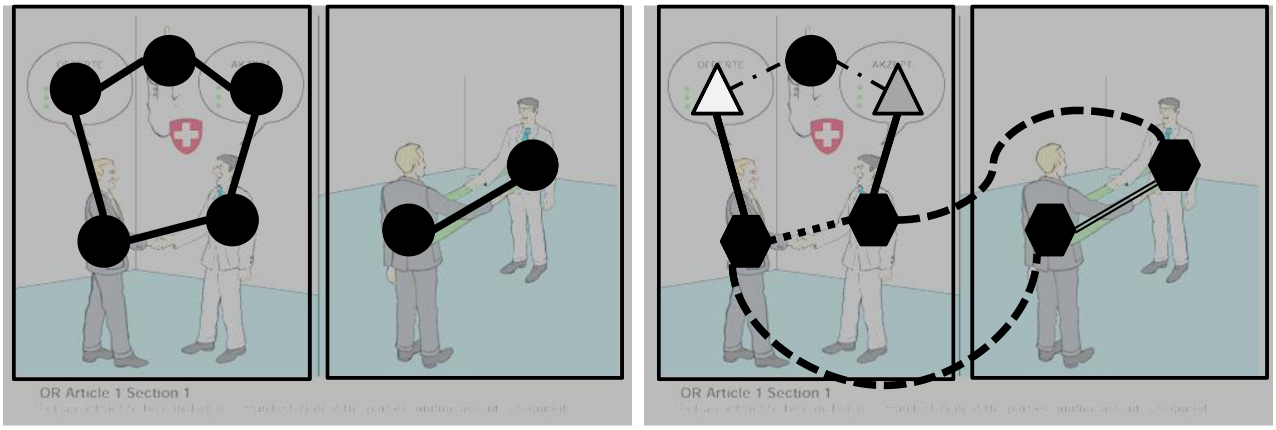


Figure 1: Example for a Visual Law Representation (Source: Brunschwig, 2011)



(1) (2)

Figure 2: Two iterations for identifying elements and their relations in the visualization (1); identifying classes of elements, classes of relations and relations between different groups of elements (2)

By applying these steps we end up with an abstracted model-based representation of the original visual law representation. The abstract symbols shown in figure 2-(2) could be easily replaced by the icons used in the original images. From these illustrations we can now investigate what requirements an according meta modeling formalism has to fulfill in order to describe the abstract syntax of such a modeling language.

- First, it has to permit the definition of *elements* and *relations* between elements.
- Elements and relations have to be *typed* to represent classes of elements and relations.
- It must be possible to *group* elements and relations in order to describe a particular visual law representation or parts thereof – e.g. two images as shown in figure 2.
- The relations can either be defined as first-class-objects or may also be defined as elements that offer ways to link to other elements if necessary. Relations should in any case also be able to *cross boundaries* between different groupings of elements.
- It must further permit the addition of *attributes* to elements and – if separately defined – relations. These attributes can then be used to characterize the properties of the elements and relations. Furthermore, attributes must also be *typed* and must permit to link to other elements in the same or a different group.
- It must permit the specification of a graphical representation for the elements and relations, in particular in the form of iconic images.

- In order to structure the classes of elements and relations and to permit the use of polymorphic behaviors when designing algorithms for the resulting modeling languages, the formalism should also provide inheritance for classes and classes of relations.
- The formalism should be easy to use and not require extensive mathematical knowledge to be practicable also for users in visual law with little or no technical background.

4. Conclusion and Outlook

In this paper we have shown a first approach towards requirements for a meta modeling formalism to support visual law representations. Based on these requirements, it can now be analyzed in detail which of the large variety of meta modeling approaches is the most suitable for the domain of visual law. However, as most of the concepts of current meta modeling approaches are not described in a mathematically formal way [Kern et al., 2011], the next step will be to develop a formalism that permits to formally describe the required meta modeling concepts and thus allow a detailed comparison.

5. References

Brunschwig, C. R., Multisensory Law and Legal Informatics - A Comparison of How these Legal Disciplines Relate to Visual Law. In: Geist, A., Brunschwig, C.R., Lachmayer, F. & Schefbeck, G (eds.), Strukturierung der Juristischen Semantik – Structuring Legal Semantics, Editions Weblaw, Bern, p. 573-668 (2011).

Fill, H.-G., A Polysyntactic View on the Encoding of Semantics in Legal Visualizations. In: Schweighofer, E., Geist, A., Heindl, G. & Szücs, C. (eds.): Komplexitätsgrenzen der Rechtsinformatik, Richard Boorberg Verlag, p. 548-556 (2008).

Harel, D., Rumpe, B., Meaningful Modeling: What's the Semantics of "Semantics"?. IEEE Computer, October 2004, p. 64-72, (2004).

Kahlig, W., Visualisierungstypologie des Deutschen Privatrechts. In: Jusletter IT 24. Februar 2011, (2011).

Karagiannis, D., Kühn, H., Metamodeling Platforms.In: Bauknecht, K., Tjoa, A.M. & Quirchmayr, G. (eds.): Third International Conference EC-Web 2002 – Dexa 2002, Springer, Aix-en-Provence, France. p. 182 (2002).

Kern, H., Hummel, A., Kühne, S., Towards a Comparative Analysis of Meta-Metamodels. 11th Workshop on Domain-Specific Modeling 2011, URL: http://www.dsmforum.org/events/DSM11/Papers/kern.pdf (last access 05-01-2012).

Olbrich, S., Visualisierung von rechtlichen Rahmenbedingungen in Geschäftsprozessmodellen. In: Schweighofer, E., Geist, A., Heindl, G. (eds.), 10 Jahre IRIS: Bilanz und Ausblick, Richard Boorberg Verlag, p. 474-479, (2007).

Sauerwald, M., Mind Mapping als Visualisierungsmethode in der juristischen Praxis. In: Schweighofer, E., Geist, A., Heindl, G. (eds.), 10 Jahre IRIS: Bilanz und Ausblick, Richard Boorberg Verlag, p. 480-485, (2007).

Sprinkle, J., Rumpe, B., Vangheluwe, H., & Karsai, G., Metamodelling - State of the Art and Research Challenges. In: Giese, H. et al.: MBEERTS, Springer. p. 57-76, (2010).