Visualisation functionalities
for IT-based management

Hans-Georg Fill

Institute of Knowledge and Business Engineering, University of Vienna
Brünner Straße 72, 1210 Vienna
hans-georg.fill@dke.univie.ac.at

Abstract: In the area of IT-based management the use of visualisations plays an essential role for depicting complex relationships and dependencies. To generate visualisations an approach from the area of meta-modelling can be used to represent material or abstract entities and their relationships. It is estimated that a similar approach could be used in legal informatics for representing legal affairs and thus also easing the analyses in this area.

1. Introduction

The following article shall serve as a contribution to the discussion for visualisations in the area of legal informatics. By shortly describing a procedure for the generation of visual models, respectively visualisations of qualitative relationships, in the area of IT-based management it is intended to highlight key aspects for a first step towards a modelling method for visualisations of legal information.

Today several types of visualisations are used in IT-based management. Among many benefits that arise by using visualisations three important functions shall be pointed out: At first visualisations can offer representations of complex relationships for the purpose of explication and analysis of information. This view of visualisation can for example be found in areas such as business process management[1] or business performance management as well as in software engineering[2]. Another function of visualisation is the facilitation of the transfer of information between individuals that plays a role in many areas where

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[1] Cf *Karagiannis, D./Junginger, S./Strobl, R.,* Introduction to Business Process Management Systems Concepts, in: *Scholz-Reiter, B., Stickel, E. (Eds),* Business Process Modelling, Springer (1996), 81-106, Berlin et al.

[2] Cf *Hitz, M./Kappel, G.,* UML@Work – Von der Analyse zur Realisierung (2003), dpunkt.Verlag, Heidelberg.

fast communication of data and information is needed (eg for reporting)[3]. A third function can be seen in the view that is taken by the research field of information visualisation that aims to investigate structures and features of large data sets by visualisation methods[4]. In the following the first function shall be further elaborated as it is estimated that also legal information consists of complex interdependencies that need to be explicated and analysed. Therefore a short overview of the field IT-based management is given to illustrate the underlying concepts.

2. IT-based Management

When using the term 'IT-based management' several methods, techniques and probably even tools might be associated. Information technology spans many domains in the field of management: From simple office applications to highly specialised production systems computer hard- and software has been successfully deployed in the past. To clarify the understanding of the term 'management approach' and 'IT-based management' a brief definition is presented.

2.1. Definition of Terms

When attempting to determine a meta-concept for describing various types of management approaches and thus allowing for a widely applicable definition two elements can be identified that are contained in all approaches: a paradigm and a corresponding procedure. The paradigm sets the boundaries of the respective approach and defines what is investigated and explained and how this shall be done in principle. The procedure translates the theoretical definitions of the paradigm into concrete, operational steps that have to be undertaken to achieve the goals set by the paradigm. The combination of these elements then yields possible solutions and insights for the successful steering of a company.

The involvement of information technology can now come into place in two ways: It can either influence respectively support the paradigm or/and influence the corresponding procedure. When an in-

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[3] *Zelazny, G.,* Wie aus Daten Bilder werden - Wirtschaftsdaten überzeugend präsentiert (1992), Gabler, Wiesbaden.

[4] Cf *Ward, M./Munzner, T. (Eds),* Proceedings of the IEEE Symposium on Information Visualization (2004), IEEE, Austin, Texas.

volvement of IT in any or both of the two elements is found the management approach is denoted as an IT-based management approach. Another term that has to be detailed is the term 'modelling method': A modelling method is defined by a modelling technique and mechanisms and algorithms that work on the models. The modelling technique consists of a modelling language with a specific syntax, semantic and notation (eg a graph-based notation) for describing the model elements and a modelling procedure that describes how the modelling language has to be employed to generate models[5].

2.2. Example

An example for an IT-based management approach and the corresponding modelling method is the Business Process Management Systems (BPMS)[1] paradigm in conjunction with the modelling method of the ADONIS[6] business process management toolkit[7]. The BPMS paradigm describes a view on the management of enterprises that is defined through a recursive process-oriented model (see figure 1). In the ADONIS software the corresponding procedure for applying the propositions of the paradigm is realised by several types of graphical models.

One of these models is depicted in figure 2. It shows a sequence of activities (rectangles) and decisions (rhombs) as well as objects for the definition of the start (triangle) and end (circle) of a process and parallel sections (rotated triangles)[8]. This model is partly related to the Re-Engineering process of the BPMS paradigm and allows for the representation of business processes. As these procedures are highly complex when being deployed in real-world scenarios an IT support is essential for a successful action. Therefore this approach can be classified as an IT-based management approach according to the above described definition.

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[5] Cf *Karagiannis, D./Kühn, H.,* Metamodelling platforms (2002), in: *Bauknecht, K./ Min Tjoa, A./Quirchmayer, G. (Eds):* Proceedings of the 3rd International Conference ec-web - dexa 2002, Aix-en-Provence, France, Springer, Berlin, Heidelberg, 182.

[6] ADONIS is a registered trademark of BOC GmbH (http://www.boc-eu.com).

[7] *Junginger, S. et al,* Ein Geschäftsprozessmanagement Werkzeug der nächsten Generation - ADONIS: Konzeption und Anwendungen (2000), Wirtschaftsinformatik 42, 392–401.

[8] The original representations in ADONIS are coloured which allows for a better differentiation of the objects.
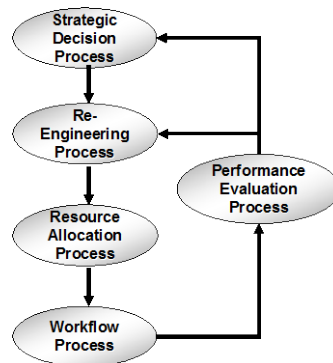
Figure 1: Business process management systems paradigm,
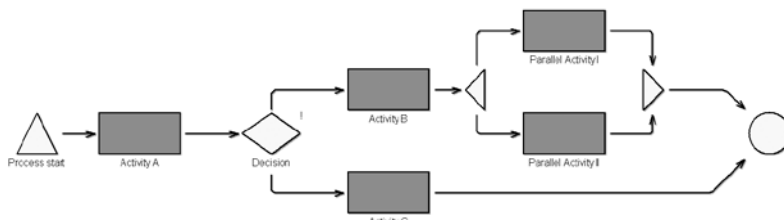(following the concepts of Karagiannis et al.[1])

Figure 2: ADONIS Business process model

3. Generation of visual models

For the generation of new visual models a method that is based on concepts of meta-modelling shall be illustrated. A meta-model is a model that defines the elements and relationships of elements that can be used in a model. For the business process model shown above the corresponding meta-model defines the modelling elements (eg start, activity, end) and the relations between these elements (eg the arrows between the graphical symbols). The concept of a meta-model can be regarded as equivalent to a modelling language as explained in the definition of terms, whereas the meta-model has the advantage of being directly representable graphically (eg using the Unified Modelling Language[9]).

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[9] *Object Management Group (OMG),* UML 2.0 Superstructure FTF convenience document, http://www.omg.org/cgi-bin/doc?ptc/2004-10-02 (access: 13-04-2005).

To develop a meta-model for a specific domain an analysis of the entities that are to be investigated has to be conducted. The entities depend on the paradigm that is used and are not restricted to material matters but can also be of an abstract nature, such as for example the entitiy 'activity' of a process in the previous example. The resulting models therefore reflect a subjective view on a real-world situation for the purpose of a specific user or a group of users[10].

When the relevant entities have been identified they can be translated to concrete model elements with a defined semantics and notation. From the perspective of visualisation the notation is the most relevant part: For every model element a visual (graphical) representation has to be found. In the case of models for IT-based management the symbols used for this purpose are often selected either based on their separability from other symbols or on specific user requirements (eg in the case of already existing symbols)[11]. To further define the model elements attributes are added, in the case of an 'acitivity' element of a business process this could be time or cost attributes.

Depending on the goal of the modelling venture the attributes of the model elements can be linked to the graphical representation. This permits to extend the visual representations and to allow for a dynamic representation of changes of attribute values[12]. An example would be to link the colour of an activity element to the cost attribute of that activity. By defining a translation function between the cost level and the intensity of the colour (eg from light to dark red) it could be easily detected visually in which parts of a process the most expensive activities are to be found (see the example for a process modified in this way[13]).

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[10] For a detailed discussion of model theory see *Stachowiak, H.,* Allgemeine Modelltheorie (1973), Springer, Wien.

[11] For more examples see: the models of the Unified Modelling Language[9]; the models of the Business Process Modelling Notation at http://www.bpmn.org or the models of IDEF eg for the representation of business processes and ontologies at http://www.idef.com.

[12] For a more detailed discussion of the graphical representation of model elements in ADONIS see *Fill, H.-G.*, UML Statechart Diagrams on the ADONIS Metamodeling Platform (2004), accepted for publication in: Electronic Notes in Theoretical Computer Science, Elsevier.

[13] Due to the black and white representation in this publication only the luminance information is visible in the example.
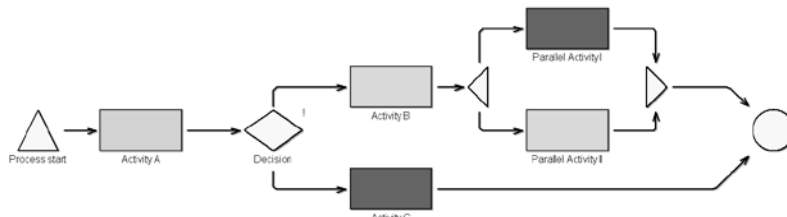
Figure 3: Modified ADONIS Business process model
(a darker activity rectangle corresponds to higher cost)

Besides the model elements also the relationships between the elements have to be defined (eg by arrows or based on the location of elements).

4. Related work and conclusion

Similar approaches for using visualisations to represent models (with different degrees of abstraction) can be found in many areas of science: The scientific field that provides general theoretical foundations for many of these areas is Visual Language Theory[14]. A comprehensive overview of existing visualisations in the area of law and legal informatics is given by Klaus Röhl and his team for a project in the visual communication of law[15].

In this article it has been elaborated what is understood by IT-based management and how visual models for this field can be generated. It is estimated that a similar approach could be used in the area of legal informatics for the creation of visualisations of legal affairs. The prerequisite for this undertaking would be to identify a set of basic (primitive) entities that can serve as a basis for legal models as well as basic relations between these entities. The approaches described by Röhl and the evolvement of legal ontologies as a way to formally describe legal contexts[16] could serve as a suitable foundation.

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[14] Cf *Marriot, K., Meyer, B. (Eds),* Visual language theory (1998), Springer; *nA,* Proceedings of the IEEE Symposium on Visual Languages - Human Centric Computing (VLHCC'04), Rome - Italy, IEEE.

[15] *Röhl, K.,* Visuelle Rechtskommunikation, http://www.ruhr-uni-bochum.de/rsozlog/ Projekte/Visuelle%20Rechtskommunikation/visuelle%20rechtskommunikation.html (access: 17-04-2005).

[16] Cf the talk by *Giovanni Sartor* at IRIS 2005: Legal reasoning: A Cognitive Approach to the Law.