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A generic model for the interpretation of vague norms
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A GENERIC MODEL FOR THE INTERPRETATION OF VAGUE NORMS

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Abstract

When developing legal-knowledge-based systems, the knowledge-acquisition problem is magnified by the occurrence of vague norms. In the AI literature the model-driven approach has been proposed as a solution to the knowledge-acquisition problem. This paper presents a generic model constructed with the objective of contributing to the model-driven approach to building legal-knowledge-based systems. We demonstrate that the generic model serves the purpose of developing legal-knowledge-based systems along model-driven lines.

1 Introduction

In this paper we give an overview of a research project completed at the beginning of 1996. For details on the project we refer to Quast (1996). The motivation for our research has been derived from the observation that the implementation of statutory regulations often leaves much to be desired. In The Netherlands this is illustrated, *inter alia*, by parliamentary reports on the implementation of the Penal Code and of the Social Security Regulations (Enquêtecommissie Opsporingsmethoden, 1996; Enquêtecommissie Uitvoeringsorganen Sociale Verzekeringen, 1993), respectively. Some of the problems with the implementation of statutory regulations can be solved with the use of knowledge-based systems (e.g., Van den Herik, 1991). But with the development of such systems, one encounters the knowledge-acquisition problem. Building knowledge-based systems involves eliciting, analyzing, and interpreting the knowledge that a human expert uses when solving problems. Experience has shown that this process of knowledge acquisition is difficult, laborious and time consuming. Knowledge acquisition is often a major bottleneck in the construction of knowledge-based systems (Kidd, 1987). In our opinion, the occurrence of vague norms in the legal domain magnifies this problem. *Vague norms* are legal rules in which reference is made to indeterminate or *vague concepts*. In the Dutch legal system, the courts are responsible for the specific interpretation of vague concepts. Case law thus results in guidelines for the interpretation of vague concepts and vague norms.

In the AI literature the *model-driven approach* has been proposed as a solution to the problem of knowledge acquisition (Wielinga & Breuker, 1984). In this approach the knowledge to be incorporated is first analyzed as extensively as possible using a generic model, before proceeding with its incorporation into a computer program. A *generic model* is an abstract representation of collective knowledge concerning the performance of a class of cognitive tasks.

This paper deals with the task of treating legal cases that require the interpretation of case law on vague norms. We refer to this problem-solving task as the *qualification task*. To develop knowledge-based systems for various legal domains along model-driven lines, it is desirable to have a generic model of the qualification task. The aim of our research is to construct such a generic model (henceforth referred to as the *qualification model*) that can be used to develop legal-knowledge-based systems along model-driven lines.

In section 2 we set out our method of working and the methodological framework we used. The analysis of legal knowledge is the subject of section 3. Next we describe the qualification model (section 4) and in section 5 the results of the model evaluation are given. Finally we present our conclusions (section 6).

2 Method

In at least one important respect, our work differs from other research undertaken with a comparable aim: our model is based on the (generic) legal knowledge implemented in an existing knowledge-based system. Valente (1995) and Van Kralingen (1995), among others, constructed generic models, based on analysis of traditional sources of legal knowledge. They do not deal with implementation aspects. Since our ultimate goal is to build legal-knowledge-based systems, a drawback of their otherwise valuable approach is that, without implementation of the proposed models, it is difficult to assess whether the model can actually be used to build legal-knowledge-based systems. By contrast our approach has the advantage that the practicability has already been assessed, since the qualification model is derived from implemented legal knowledge.

In choosing a methodological framework we have taken the position that the development of knowledge-based systems is a cognitive task that requires an ergonomically sound tool. The nature of the tool must match the way in which people perform this cognitive task. After comparing five model-driven methods for analyzing knowledge¹, we decided to use KADS (Schreiber, Wielinga & Breuker, 1993) as a methodological framework. In comparison with the other methods, KADS appeared most usable since the method utilizes the ergonomic advantage of model-driven knowledge acquisition and KADS covers the greater part of the development process of knowledge-based systems.

When using KADS seven models are produced. Each model reflects just one or, sometimes, a few properties of the empirical system being modelled. The *model of expertise* in particular is important to our research; this model specifies the problem-solving knowledge. In KADS the principle that the results of earlier analysis (in the form of models) are used to produce models of expertise, has been embodied among other things in the form of a library of models: the *CommonKADS* library (Breuker & Van de Velde, 1994). The library can accommodate models of expertise and model elements that have been created by means of KADS and other model-driven methods.

3 Analysis

As stated earlier, the starting point for our research was the (generic) legal knowledge implemented in an existing legal-knowledge-based system. The implemented knowledge concerns the concept of *commensurate employment* as used in the Dutch Unemployment Insurance Act. The knowledge-based system is called LEIDRAAD. It is a first-generation knowledge-based system.²

The Dutch Unemployment Insurance Act is a social insurance scheme covering the risk of loss of income as a result of unemployment. One of the obligations under the act is to apply for commensurate employment, and to accept such a job when offered. The concept of commensurate employment is a vague concept (see section 1). The act gives a rather vague description of commensurate employment: "*Commensurate employment is considered to be all employment in accordance with the capacities and abilities of the*

¹ We compared the methods described by Clancey ((985), Chandrasekaran (1987), McDermott 1988), Steels (1990) and Schreiber, Wielinga & Breuker (1993).

² The system, constructed in cooperation with De Wildt (1993), is described extensively in Quast (1996).

*employee, unless acceptance of such employment cannot be demanded on physical, mental or social grounds*³. Criteria for deciding whether a particular job is suitable for a job seeker are developed in legal practice. Important factors are differences in nature, level, and wage between the offered job and former jobs. Other vocational characteristics, such as education, current unemployment duration, unemployment record, frequency of job changes, and frequency of job applications, may be relevant too. Finally, the unemployed person may have particular objections, *e.g.*, of a medical or social nature, to a job offer.

For the purpose of building LEIDRAAD, we made a ‘computational statement’ of the qualification task, performed in the domain of commensurate employment. To this end, we analyzed case law on the concept mentioned. According to our computational statement, judges distinguish two types of criteria: *clear-cut criteria* and *weigh factors*. Some criteria determining suitability are clear-cut. For instance, a job offer with a wage below the statutory minimum wage, can never be considered suitable. Other criteria, such as those pertaining to job level or unemployment duration, do not in themselves determine suitability. Such factors give an indication of the degree of suitability. They all have a certain weight. Some will make a job offer more suitable, others will have the opposite effect. A judgement on job-offer suitability can be given after weighing these factors against each other.

Some 235 court decisions have been published on commensurate employment. From 104 published cases decided by the Central Court of Appeal⁴, we induced a large set of conditional rules and weigh factors. Examples of induced rules are:

- *A job is not suitable if the offered wage is below the statutory minimum wage.*
- *Where the comparison between the last-earned wage and the offered wage yields a weight equal to Q and the balance of weights of other relevant characteristics equals R , then the degree of suitability of the offered wage (S) equals the sum of Q and R .*

The weights were assigned initial values, based on the initial impression of their importance. Next, the rules were implemented in LEIDRAAD. The rules and weights were tuned by comparing unpublished judgments from Courts of Appeal and the Central Court of Appeal, with system decisions on the same cases. Data on these ‘learning’ cases were collected at one of the largest Industrial Associations, namely that for construction workers.

4 The qualification model

For the purpose of constructing the qualification model, LEIDRAAD (written in PROLOG) has been redefined in terms of KADS: we have constructed the task model (partially completed), the cooperation model and the model of expertise⁵.

The above-mentioned computational statement has been used as the starting point for constructing the model of expertise. This model represents four types of knowledge concerning commensurate employment: domain knowledge, inference knowledge, task knowledge and strategic knowledge. In the model of expertise, domain knowledge is represented on the basis of a domain schema. The schema we used (figure 1) distinguishes four types of primitive: concept, attribute, relation and structure. *Concepts* are elements of domain knowledge. *Attributes* have values to be assigned to concepts. Relations between (assigned) domain attributes are represented by *relations*. We use the primitive type *structure* in a way that differs from Wielinga, Schreiber en Breuker (1993). They use it for organizations of related concepts; we use it to represent compound relations.

³ Section 24, paragraph 3, of the Dutch Unemployment Insurance Act (in Dutch: Werkloosheidswet).

⁴ The highest court in the field of Dutch social security.

⁵ For a full description of all three models see Quast (1996).

After completing the KADS definition, we constructed the qualification model by making a conceptual specification of the generic elements of the knowledge represented in LEIDRAAD. In doing so, the domain knowledge was omitted, since in terms of KADS, a generic model is an expertise model frame. A generic model is complete in form but not in contents (Van de Velde, 1994); it is a model of expertise without domain-specific knowledge. The domain schema, however, represents generic knowledge and is thus part of the generic model.

PRIMITIVE TYPE	PRIMITIVES	
Concept	domain attribute	concept
	fact	value
	weigh factor	weight
	weigh-factor balance	threshold value
Attribute	domain attribute := value	weigh factor := weight
Relation	concept IS_A domain attribute	
	fact IS_A domain attribute	
	weigh factor IS_A domain attribute := value	
	domain attribute IS_SUBCONCEPT_OF domain attribute	
	domain attribute := value IS_TRUE_IF domain attribute = value	
	domain attribute = value AND domain attribute = value	
	NOT domain attribute = value	
	weigh factor := weight WEIGHT_IF domain attribute = value	
value OPERATOR value		
Structure	compound relations	

Figure 1: The domain schema.⁶

We observe that the domain schema (the structure of the domain-specific knowledge) contains primitives that are significant in combination. For instance, conjunctions of attributed concepts and/or facts can be the decisive factor in the assignment of a value to a domain attribute. The schema also contains mutually redundant primitives. For instance, the primitive 'domain attribute' is a collective noun for the primitives 'concept' and 'fact'. These two characteristics of the domain schema constitute reasons for translating the domain schema into a *declaration schema* (figure 2) that includes significant combinations of domain primitives and in which no mutually redundant primitives occur.

Since the qualification model is intended for multiple re-use, we then compared it to models in a library of generic knowledge models: the *CommonKADS* library. The inference structure (part of the inference knowledge) of the qualification model is a variant of the four inference structures of the *assessment model* described by Valente and Löckenhoff (1994). As a result, we concluded that the *qualification model* can be conceived as a sub-type of the assessment model present in the *CommonKADS* library.

PRIMITIVE	EXPLANATION
problem statement	A question concerning the value of a concept.
Decision	The requested value.
decisive circumstance	An attributed concept (or conjunction of attributed concepts or combination of weigh-factor balance and threshold value) that is decisive for the problem statement.
not-decisive circumstance	An attributed concept (or conjunction of attributed concepts or combination of weigh-factor balance and threshold value) that is not decisive for the problem statement.

⁶ The expression 'domain attribute := value' should be read as: 'a value will be assigned to domain attribute'. The expression 'domain attribute = value' should be read as: 'domain attribute has a certain value'.

	The result of comparing the weigh-factor balance with the threshold value is decisive for the problem statement.
legal source	The location of the legal source of the declared knowledge.
weigh factor	An attributed concept (or conjunction of concepts) to which a certain weight is assigned.
Weight	A number assigned to a weigh factor.
weigh-factor balance	The sum of assigned weights.
Threshold value	Criterion value to which the weigh-factor balance is compared and that is decisive for a decision.

Figure 2: The declaration schema.

5 Evaluation

After the construction of the qualification model, we investigated to what extent the generic model was a success in that it could be used for developing legal-knowledge-based systems along model-driven lines. In particular we examined whether the qualification model is suitable for this purpose. This model is examined from two perspectives: from the perspective of the knowledge engineer and from the perspective of the domain expert. Evaluating the qualification model from the perspective of the knowledge engineer, we investigated whether the model is compatible with the method used by the knowledge engineer in developing a knowledge-based system. Since the model constructed is compatible in two respects (global structure of KADS models and inference structure of the assessment model) with an acknowledged method of knowledge-based-system development, we conclude that the qualification model is usable from the perspective of a knowledge engineer.

To answer the question whether the qualification model is also usable from the perspective of a legal-domain expert, we examined whether, in addition to modelling the domain of commensurate employment, it is also possible to model other legal domains with the qualification model. To this end we investigated whether the empty domain level of the qualification model can be filled with knowledge derived from empirical descriptions of the application of vague norms in five legal domains: *the establishment of entitlement to unemployment benefit* (Riphagen, 1991), *unemployment-act sanction decisions* (Lenos, 1993), *compensation on termination of contract of employment* (Groen, 1989; Bakels, 1994), *extension of confinement to a state mental hospital by a judicial order* (Drost, 1991), and *damages (pretio doloris) in the case of an accident* (Ferwerda, 1987; Teeuwissen, 1994; Van Wassenae van Catwijck *et al.*, 1994). Like commensurate work, the first two domains are also part of the Dutch social security system. The other three domains have nothing to do with social security. Moreover, they are quite different from each other.

The declaration schema is useful as a means for ‘fitting’ legal-knowledge-based systems relatively quickly (*i.e.*, without implementation). We evaluated the qualification model by searching in the five test domains for examples of the nine domain primitives in the declaration schema. After entering each set of examples we posed two questions:

- c are there unused primitives?
- c are there missing primitives?

If both questions were always answered in the negative, we should conclude that the qualification model would fit perfectly: it is not too small and it is not too large.

However, in all five test domains, each question was answered once in the positive. In the domain of *the establishment of entitlement to unemployment benefit* we did not use the primitives concerning weigh factors. In the domain of *unemployment-act sanction decisions* primitives for the representation of knowledge on calculating time periods

were missing. We contend that these two cases do not detract from the supposed generic character of the qualification. By definition, generic models do not fit perfectly in the real world. A generic model always has to be adapted to the modelled domain. What kind of adaptations are acceptable? We think that adaptations that leave the inference structure of a generic model intact are acceptable. In the cases mentioned above, the inference structure is not affected. Since the desired adaptations are acceptable, we conclude that we have demonstrated that the qualification model has a generic juridical character and that the model is usable for building legal-knowledge-based systems in various legal domains.

6 Conclusions

With regard to the problem examined in our research, we conclude that the manner in which the qualification model describes the qualification task (in the domain of commensurate employment) can also be applied to other legal domains. With regard to the objective of our research, we conclude that we have succeeded in constructing a generic model that is demonstrably capable of use for developing legal-knowledge-based systems along model-driven lines. This probably takes us a small step further in the direction of justice-dispensing computers.

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