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THE DECISION TABLE TECHNIQUE AS PART OF A COMPUTER SUPPORTED PROCEDURE OF LEGAL DRAFTING

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Summary

The quality of legislation is determined not only by external elements which define its content, but also by a set of intrinsic criteria that concern the content as well as the particular form and shape of the legal rules, which are fixed during the phase of legal drafting.

In order to guarantee or to increase the intrinsic quality of legal rules, a method of legal drafting can be used that is based upon the decision table technique. The purpose of the present paper is to describe and evaluate this specific method.

Within this method, the intentions of the Legislator are translated into one or more decision tables, so that the decision process can be validated in a formal way. In a next phase, those decision tables can be transformed into a decision rule and even into a legal rule written in natural language.

The use of the decision table technique opens many perspectives for computer support of the legal drafting process. That computer support is especially interesting for the evaluation of those features dealing with the content of the shaped legal rules.

1. Situation of the method in the process of legal drafting

Legal drafting can be defined as the process of creating legal rules, by the promulgation of a legal text, in which those rules are described.

It may be assumed that anyone is able to produce a natural text in which rules are stipulated. Legal rules, however, can only be promulgated by an authority that has the legal competence to establish legal rules. In a narrow sense, legal drafting is the exclusive domain of an institution called the Legislator. In this narrow sense, the term deals only with the process of promulgation of laws and decrees, which contain legal texts.

The process of legal drafting concerns not only the creation of new legal rules. A relatively important part of the legal drafting process concerns the modification, the abolishment and the coordination of legal texts. This paper only deals with the use of the decision table method for the creation of new legal rules, although the method is probably useful for the other aspects of the legal drafting process.

A legal drafting process contains some sequential acts [Hotz 1984] concerning (a) the shape of the legal text, (b) the procedures that must be followed and (c) the content of the stipulations of the legal text. The method presented here deals only with the last of the three features: the content of the stipulations.

Each legal text contains several stipulations with a different finality. Social security laws for instance, contain stipulations that can be classified into one of the following groups:

- stipulations concerning the purposes of the promulgated legal text
- stipulations containing measures concerning the field of application to the beneficiary, the character and the size of the right granted
- stipulations concerning procedure and organisation
- stipulations concerning financing

In every legal text, the second group of stipulations forms the core of the regulations i.e. the most important part for the beneficiary. In this part the law determines which rights are granted and which obligations are imposed. It is also within this group of legal rules that most of the decision points will be situated, so this is where the decision table method is most useful.

Granting rights and imposing obligations is often realised by the use of a so-called decision rule. A decision rule establishes one or more legal consequences, depending on the realisation of a certain condition or a set of conditions.

Decision rules occur frequently in some branches of law (such as tax law or social law), due to the need for a precise distinction of the various circumstances and their legal consequences. Most of the legal texts in those branches of law are large enumerations of mutually related decision rules. Such enumerations easily produces complications in the interpretation of legal rules. In order to avoid multiple legal interpretations, it is very important for a Legislator to produce legal texts that can be easily understood.

2. Finality of the decision table method

The finality of the method presented in this paper exists in the improvement of the intrinsic quality of the legal rules that are promulgated by the Legislator.

The intrinsic quality of legal rules depends on several criteria. The soundness of the logical-syntactical structure of a legal rule phrase is clearly an important criterion. But equally important is the role of a legal rule within a legal system or within human society. These criteria are not necessarily related to each other, because a technically well constructed law can have a negative effect on the legal system or on society.

In this paper, we only focus on those criteria that deal with the logical and syntactical structure of the phrase that expresses the legal rule. The most important reason for this restriction is the fact that those logical-syntactical criteria are most fit for a formal and automated support. It is not likely that computers can ever evaluate or anticipate the legal and social meaning of a legal rule in legal practice.

Some intrinsic qualities of a legal rule such as completeness, consistency and concision can be guaranteed or increased when that rule is transformed into a formal representation. Formal representation techniques make it possible to represent mental structures (such as legal rules) in such a way that particular characteristics of the structure can be shown. This can be realised by various techniques: the decision table technique is only one of them.

There are a lot of other formal representation techniques, such as logical sentences, semantic networks, flow charts, structural diagrams, decision trees or petri-networks [Reisinger and Peklo 1984; Overhoff and Molenaar 1991]. Natural language too can be considered as a formal representation technique, but this extension of the term will not be made here.

3. The representation of legal rules as decision tables

In order to set up a clear survey of all factual circumstances legal rules deal with, one needs a specific formal representation technique that enables an evaluation of the intrinsic criteria mentioned above [Cammelli 1989]. To realise this, the method presented here requires a survey of all factual cases in which the legal rules stipulate legal consequences.

The decision table technique seems to offer the best opportunities for a formal survey of all factual circumstances the legal rule deals with [Reisinger and Pelko 1984; Verhelst 1980]. Indeed, a legal rule represented as a decision table shows a logical and syntactical structure that can be defined as an enumeration of factual circumstances which are connected by basic logical operators. In this method the decision table technique is therefore considered as an adequate technique for the evaluation of the intrinsic criteria of legal rules [Overhoff and Molenaar 1991].

An important advantage of a decision table is its clarifying survey of the factual elements that play a role in the decision process. The clarity of the survey is granted by the two-dimensional representation of the elements of the decision process. These elements are formulated as conditions, of which the state is indicated as a simple "yes" or "no" (at least in the example below). The different 'Categories', in the example, refer to different amounts of allowance a person can get.

1. Married	Yes						No					
2. Concubinage	Yes	No						Yes	-			
3. Living alone	-	Yes			No			-	Yes		No	
4. Separated	-	Yes		No	Yes		No	-	-		-	
5. Child at charge	-	Yes	No	-	Yes	No	-	-	Yes	No	Yes	No
1. Category I	x	x	-	x	x	-	x	x	x	-	x	-
2. Category II	-	-	x	-	-	-	-	-	-	x	-	-
3. Category III	-	-	-	-	-	x	-	-	-	-	-	x

Figure 1: Representation of a decision table

Other formal representation techniques do not offer this clarifying survey to the same extent. Some offer no survey whatsoever. A linear legal rule for instance is much less surveyable, although the simplicity of some of those legal rules sometimes permits one to create a mental representation with the same clarity as a decision table. In more complicated cases however, a purely mental representation is no longer reliable, and a formal representation technique will be required.

The choice of the decision table technique as formal representation technique implies the underlying idea that many legal rules can be considered as decision rules. Surely, there are other kinds of legal rules in legal texts. But the frequency of decision rules in some legal branches (such as tax law or social law) permits one to conclude that a method for legal drafting based on decision tables can be developed to support the process of legal drafting in these branches.

4. Description of the method for a formal support of the legal drafting process

The method presented in this paper is based on the conviction that a supplementary step must be inserted in the "manual" legal drafting procedure in order to realize a strict control on some intrinsic qualities of the legal texts that are produced. In this supplementary step, the embryonic legal rule will be formulated as a decision table or as a set of related decision tables, so that a formal control of the intrinsic qualities becomes possible. In a next step, the decision table will be transformed into a linear decision rule. A final step transforms this linear decision rule into a legal rule in natural language.

As mentioned above, this supplementary step must guarantee and increase the quality of the legal rule that is to be produced. The underlying hypothesis of this method is that decision tables offer the best guarantees for formal control of the intrinsic qualities of legal rules, if these legal rules are decision rules. At the same time, the use of decision tables may open perspectives for an automation of the formal procedure, so that computer support of the legal drafting process would be possible in the near future.

The starting point of the method has already been studied by several authors. This paper will focus on three features of the method:

- a. How to make a formal representation by decision tables?
- b. Which are the intrinsic criteria for evaluation of legal rules and how does the decision table technique enable a formal evaluation according to these criteria ?
- c. What are the possibilities for a transformation procedure from decision tables into one or more natural legal rules?

4.1. The realization of a decision table representation

The designer of a new legal rule usually has a preliminary mental projection of the rule he/she wants to design, before he/she starts his creative work. That preliminary projection concerns for instance the objectives he/she wants to realize or some official instructions about the form or content of the legal rule.

The method for the creation of a decision table has been thoroughly described in literature [Verhelst 1980]. In general, a distinction is made between a method based on the presence of a text and a method based on the absence of such a text. In the remainder of this paper, only the method based on the absence of a text will be discussed. Nevertheless, the method based on the presence of a text may be relevant for the legal drafting process, for instance in those situations where a basic text in natural language is formally evaluated with the aid of the decision table technique, before its official promulgation.

The method based on the absence of a starting text again offers two possibilities.

Firstly, it is possible that the designer has no clear view on the legal conditions and consequences, and the relations between them. In that case, decision tables can support the search for relevant legal consequences and conditions in order to build up the decision structure. This method is called "search-method" and is sufficiently described in literature. This method starts from a completely empty decision table: through the constant addition of knowledge, legal conditions and consequences are filled in and the decision structure becomes more clear and more precise.

Secondly, it is possible that the designer has a relatively clear view on the various legal conditions and consequences, and their mutual relations. In that case, the decision table can be filled completely. The decision structure will gradually be formed by systematically filling out the values of the actions of the action part of the decision table. Manually constructing a decision table can be a cumbersome process. Therefore a tool with the name Prologa (*PRO*cedural *LOG*ic Analyzer) has been developed to automate this process, as will be illustrated later [Vanthienen 1986].

The following steps can be discerned:

- Firstly, the designer determines the legal consequences he/she wants to treat. These legal consequences are filled in in the decision table as actions.
- Next, the designer looks for all the conditions that may play a role in the decision structure concerning the legal consequences. These conditions become the conditions of the decision table. Every condition contains two or more condition states (varying from a simple yes/no-pair to a multiple choice-set). It is important to note that in this phase of the developing process, no absolute knowledge about the precise mutual relations between consequences and conditions is required.
- When the list of conditions and possible consequences (actions) is fixed, an empty expanded decision table can be used to examine each possible case one by one. Combinatorial completeness is guaranteed by the decision table technique (e.g. an expanded decision table consisting of three conditions, each with two states, has eight columns).

- In a following step, all columns that are impossible according to logical or juridical considerations, must be deleted. Such considerations are based on a systematical comparison of all condition-states: when the designer finds out that a particular combination of conditions is not permitted, this combination will be left out of the decision table.
 - Finally, the action part of the decision table is filled out. For every column that remains open after the previous step, the designer indicates the action that applies.
- Designing a decision table cannot be described by strict methodological rules, since the quality of the table also depends on the character of the formalized domain (objective elements) and on the expertise of the designer (subjective elements). The method we just presented for the realization of a decision table must therefore be considered as a logical enumeration of actions and not as a strict method of necessary steps one may not deviate from.

4.2. *The intrinsic quality criteria of a legal rule and how those criteria can be formally checked using decision tables.*

Decision tables can visualise some features of the set of rules that are drafted. This visualisation is an easy and efficient way to check the features of the decision process. In most other formalisms this cannot be done so easily.

Decision tables have traditionally been used to verify and validate the decision process [Cargun and Steudel 1987; Vanthienen 1991].

The validation of the decision process (building the right table) means that one has to check the soundness of every part of the decision process. Using a decision table to validate the decision process means that for every column one has to check the action elements that are entered in the action part of the decision table.

The verification of the decision process (building the table correctly) refers to the two properties of the decision process that are the most important intrinsic features of legal rules: completeness and consistency of the decision process or the decision rule. Completeness of a legal rule means that the rule provides a solution for every factually possible case. The notion consistency is used in a specific sense, namely *the lack of internal contradictions*.

The decision rule must also be concise, and may not contain redundant elements. Redundancy usually does not lead to errors in the decision process. The main problem with redundancy, however, is maintenance and the risk of creating inconsistencies.

Decision tables make it easy to check those features of a decision rule (i.e. completeness, consistency and concision).

- The decision process is *complete* when all possible combinations of condition states are linked to one or more action values. When this is not the case, the decision rule contains a gap: a column without actions, a missing column or an action that is not referred to.
- The decision process is *inconsistent*, when for any possible combination of condition states two or more actions are active that are conflicting or incompatible. When this is the case, there is a contradiction.
- A decision process is *concise* if there are no redundancies, i.e. redundant premises (partly complementary rules with equal conclusions, which can be combined) or subsumption (specifications with the same conclusions but with one of them containing additional premises and therefore being less general). Subsumption will not occur in the decision table, since columns do not overlap. In a contracted decision table, redundancy is solved by combining two or more complementary columns with equal action configurations leading to irrelevant conditions. This way, the number of distinct columns can be minimized.

4.3. *Transforming the decision table into one or more legal rules in natural language*

The most difficult subpart of the formal legal drafting procedure is the conversion of a decision table into natural language.

The problem consists of two sub-problems:

- First the two-dimensional decision structure of a decision table must be "translated" in the one-dimensional decision structure of a linear logical

expression. In fact the decision table can often be converted into more than one decision rule.

This subproblem is purely logical-syntactical, since it makes abstraction of the semantical aspects of the variables used: the only relevant semantics is the one of the elementary logical operators, i.e. the symbols that are used in a decision rule. The implementation of the decision logic can be realized in two ways [Vanthienen and Wets 1994]:

1. When the reasoning process is constant, the table can be transformed into a nested if-then-else structure. The outcome of the decision will then be obtained by choosing the relevant branch in the selection tree.
2. Sometimes conversion to an if-then-else structure is not flexible enough. In that case the decision table can be transformed into a set of rules. Different strategies can be used:
 - * Column based translation generates a rule for each column of the decision table;
 - * Row based translation generates a rule for each relevant action;

Next to these straightforward translations, different optimizations can be performed (e.g. minimization of expressions governing the same action).

- The second problem is that the logical expression must be converted into a rule in natural language. This transformation consists of two things: a semantical binding of the variables, as well as a conversion of basic logical operators into natural language operators with the same logical value.

This sub-problem is of a semantic-linguistic kind, but still contains a logical component: natural language operators must have the same logical meaning as the logical operators in the logical expression.

At the moment a solution for the second problem is not available, it is the object of ongoing research. Converting a decision rule into a natural language expression is still done manually. One might describe the formal rules for this conversion procedure, but these rules are situated in logic and linguistics, and they exceed the limits of purely legal AI research.

4.4. Automation of the described method

A major drawback of the use of decision tables is the complexity of the manual building process. A lot of redrawing work results from small changes such as adding or deleting conditions, condition states and actions. Some manipulations (e.g. the reordering of conditions) are quite impossible to perform manually. A major contribution of the tool Prologa (cfr. supra) is to free the developer from this cumbersome drawing job.

In addition Prologa was designed to offer some fundamental modeling functions [Vanthienen and Dries 1993]:

- Designing the representation (cf. section 4a): a powerful specification language (with provisions for expressing general rules, exceptions, preliminary results, restrictive causes and consequences, ...).
- Validation and verification (cf. section 4b): interactive possibilities such as automatic checking for consistency, correctness and completeness.
- Transformation and optimization (cf. section 4c): optimal contraction, decomposition into subtables, conversion into efficient program code, generation of (minimal) rules, ...

In figure 2 an example of these modeling issues is presented, using a Prologa incompleteness message, illustrating part of the verification and validation process.

Figure 2: Incompleteness detection in Prologa

5. Conditions for the efficient use of decision tables as part of the formal legal drafting procedure.

Using decision tables when drafting legislation is not an overall solution. It is submitted to the conditions and limitations mentioned below.

5.1. The legal rules must be decision rules

Using decision tables as a formal representation technique is only useful if the legal rules are decision rules. A decision rule is defined as a rule that gives rise to some legal consequences if one or more explicit conditions are fulfilled.

The method can be efficiently used to develop legislation in which many decision rules are used. Next to decision rules, other types of rules can be found in a law, but they cannot be represented as decision rules. Since some branches of law (fiscal and social law) mainly consist of decision rules, the use of a formal drafting procedure is most useful in these branches.

5.2. The legal rules to be drafted have to be sufficiently complex

Simple decision tables (those representing a simple decision rule) can easily be converted into natural language. A decision rule is simple if it is a conjunction or a disjunction of purely positive or negative conditions.

A lot of decision rules in law are simple. This may be an indication that decision tables can only be used for a limited number of legal rules [Franzen 1974]. That does not mean that such simple decision rules can not be represented in decision tables, but it means that the simplicity of the structure of a rule requires a more efficient representation technique.

5.3. The quality of legal rules is determined by the quality of the decision tables

An indispensable condition for using the formal drafting method in an effective way is expertise and skill in building decision tables.

The rigidity of the method requires the developer to be alert from the moment he/she is making decision tables: some aspects will be reflected in the natural language law texts. The order of the conditions in a decision table can determine the order of the semantic equivalents in the natural language representation of the rule. An example of such a change is represented in figure 3:

1. Married	Yes				No				
2. Concubinage	Yes	No			Yes	No			
3. Seperated	-	Yes		No	-	-			
4. Child at charge	-	Yes	No		-	-	Yes	No	
5. Living alone	-	-	Yes	No	-	-	-	Yes	No
1. Category I	x	x	-	-	x	x	x	-	-
2. Category II	-	-	x	-	-	-	-	x	-
3. Category III	-	-	-	x	-	-	-	-	x

Figure 3: Same example as figure 1, but with changes in the condition order

Decision tables may be big but surveyable, but at the same time correspond to unsurveyable decision rules. To avoid such unsurveyable decision rules, the structure of the decision table should not be overloaded.

In order to improve the surveyability of the decision structure, the designer can use the subtable technique. With this technique, one can split off a subtable from the main decision table, so that the main table becomes simpler. At the same time, this technique can be useful to build up a large and complicated decision process: in this way, it will be possible to represent a law as a structure of mutually related decision tables.

The next example shows the same decision table as used above (see figure 3), but now with the isolation of condition 5 as a subtable of the main table:

Main decision table

1. Married	Yes				No			
2. Concubinage	Yes	No			Yes	No		
3. Seperated	-	Yes		No	-	-		
4. Child at charge	-	Yes	No		-	-	Yes	No
1. Category I	x	x	-	x	x	x	-	-
2. SUBTABLE	-	-	x	-	-	-	-	x

subtable

1. Living alone	Yes	No
1. Category II	x	-
2. Category III	-	x

Figure 4: Main decision table and subtable

5.4. The quality of the legal rules is not only determined by the quality of the decision table

Making good decision tables is beneficial for the quality of the legal rules, but it is insufficient to guarantee an overall good quality.

The global quality of legal rules is determined by many elements; completeness, consistency and concision are only three of them. Other criteria of quality are semantic, i.e. the fact that a rule has to use an adequate set of notions or words, and 'pragmatic', i.e. the fact that a legal rule has a political or social impact [Hotz 1984]. Such criteria have no connection with the preceding criteria.

It should be mentioned that some people argue that legal rules will never be clear, because they are written in natural language. Because natural language is often ambiguous, citizens will often interpret legal rules differently. The question can be raised whether the vagueness of legal rules and their multiple "backdoors" are left there on purpose.

6. Conclusion

The decision table technique can be considered as a useful formal representation technique for representing legal rules. The choice of decision tables for the purposes of the method presented in this paper is justified by the surveyability of the decision process and the ease with which a quality evaluation can be performed by a potential designer of legal rules.

At the same time, one should mention that a sensible use of decision tables within a legal drafting method is restricted by the nature of the legal rules the designer wants to create. The decision table technique is a useful tool for drafting those legal rules that are based on a decision rule but it is not relevant for other kinds of legal rules.

The decision table technique permits the developer of legal rules to evaluate some intrinsic criteria of those rules, such as completeness and consistency. These criteria are only part of the total number of criteria for the evaluation of a legal rule. So even with the latter kind of legal rules the use of the decision table technique has its limits.

Most interesting about the use of decision tables as a formal representation technique, is that they make automation of the legal drafting process possible. Nowadays, software for automatic production of decision tables already exists: it may be expected that there will soon be a system for the conversion of decision tables into linear decision rules or even into legal rules in natural language.

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