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## Chapter 18

# A Reasonable Model of Complexity for the Legal Domain

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The complexity of the universe can only be defined in terms of the complexity of the perceptual apparatus. The simpler the perceptual apparatus, the simpler the universe. The most complex perceptual apparatus must conclude that it is alone in its universe.

## 1. Introduction

The concept of complexity has been neglected in the legal domain, both as a qualitative concept that could be used to legally and politically analyze and criticize legal proceedings and as a quantitative concept that could be used to compare, rank, plan and optimize these proceedings. In science, the opposite is true. Especially in the field of Algorithmic Information Theory (AIT), the concept of complexity has been scrutinized. In this chapter, we will first have a quick look at AIT to see what it could mean in this phase of our research in the legal domain.

The conclusion is that there is a difference between (subjective) problem complexity and (objective) solution complexity. In this chapter, we therefore start to develop a model of complexity by describing problem complexity in the legal domain. We use a formal model of legal knowledge to derive and describe the parameters for the description of the problem complexity of cases represented in this formal model.

Further research will focus on refining and extending the formalization of the model of complexity, the comparison of problem and solution complexity for several legal cases using available algorithms and on the validation of the combined model against concrete cases and lawyers' and legal organizations' opinions about their complexity.

## 2. Complexity in the Legal Domain

As has been said the concept of complexity is hardly developed in the legal domain. Most of the descriptions of concepts related to complexity in legal literature refer to qualitative notions of vagueness (intension of concepts), open texture (extension of concepts), sophistication (level of detail of elements and relations) and multiplicity of norms (competing opinions) — in most cases without explicit reference to the concept of complexity.[1] Complexity arises in all these cases from the existence and competition of alternative perspectives on legal concepts and legal norms.[2] A (subjective) complex concept or norm from a legal point of view is not necessarily a(n) (objective) complex concept or norm from a scientific point of view. If all parties involved agree, i.e., have or choose the same perspective/opinion, there is no legal complexity, i.e., there is no case/the case is solved. The more the parties disagree, the more legally complex the case becomes, even if its quantified information content is not complex.

In science, more exact, quantitative definitions of complexity are common and applied.[3] Complexity is associated with *inter alia* uncertainty, improbability and quantified information content.

[1]The epistemology of complexity, specifically the number of variables and their interrelations as a measure of complexity, has been studied extensively in most subdomains of social science (e.g., Hayek, 1967), but not in the legal domain.

[2]For example, Hart (1994), who uses the concept of discretion to characterize hard (complex) cases; and Dworkin (1986), who distinguishes easy from hard cases using the concept of principled interpretation; although fundamentally differing in their opinion about the sources of the decision criteria, they both acknowledge the alternative perspectives that play a role in deciding complex cases (the judge's discretion in the light of the parties' alternative perspectives vs. the judge's principled interpretation in the context of the parties' alternative perspectives).

[3]Legal knowledge, in particular legal decision-making, has been studied applying quantitative methods. However, this research has not been directed at understanding the complexity of legal knowledge. For example, in the field of AI and Law, quantitative methods have been applied to predict new decisions (see the vast literature on legal case-based reasoning) and network analysis of the law has been applied to address the relative importance of legal precedents but not the knowledge theoretical complexity of these precedents. For example, Fowler and Jeon (2008) and Winkels *et al.* (2011).

Despite this discrepancy between the legal domain and the domain of science, in the legal domain complexity is as important as in other knowledge domains. Apart from the obvious human interest of acquiring and propagating knowledge per se, complexity has legal, economic, political and psychological importance: legal, because a coherent concept of complexity helps to analyze and criticize legal proceedings, in order to clarify them, to enable a justified choice of the level of expertise needed to solve legal cases and to reduce unnecessary complexity (an example of reducing complexity by compression is given in the next paragraph); economic, because complexity increases costs and measuring complexity is a precondition for the reduction of these costs (can help in designing effective norms, implementing them effectively, calculating and reducing the costs of legal procedures,[4] planning the settlement of disputes and other legal proceedings, etc.); political, because legal complexity can be an instrument to exert power and can increase inequality; and psychological, because complexity increases uncertainty. A validated model of complexity in the legal domain can help to promote these interests.[5]

## 3. How to Develop a Model of Complexity in the Legal Domain (Methodology)

In this chapter, I will try to bridge the gap between the intuitive definitions of complexity in the legal domain and the more exact way of defining complexity in science (see Section 4). I will do that on the basis of a formal model of legal knowledge (the Logic of Reasonable Inferences and its extensions) that we introduced before (see Section 5), that was implemented as the algorithm of the computer program Argumentator and that was empirically validated against a multitude of real-life legal cases. The "complexities" of these legal cases proved to be adequately represented in the formal model. In earlier research, I actually tested the formal model against 430 cases, of which 45 were deemed more complex and 385 less complex by lawyers. A first result was that the algorithm (Argumentator) when provided with case facts and legal knowledge was able to solve 42 of the more complex cases and 383 of the 385 less complex cases in exactly the same way as the legal experts did (including the systematic mistakes made by these experts). A second result was that the algorithm when instructed to do so improved the decisions in 30 (66%) of the 45 more complex cases

[4] For example, White (1992).
[5] For example, Schuck (1992); Ruhl (1996) and Kades (1997).

and in 104 (27%) of the 385 less complex cases. This result confirms the relative complexity of the first 45 cases (see Section 7). The selection of these 45 cases thus provides us with the material from which the criteria for the definition of complexity in this chapter could be derived. These criteria are translated to quantitative statements about the formal representation of the cases (see Section 6).

Further research will focus on the fine tuning of this quantitative model by comparing its results with new empirical data (new cases and opinions of lawyers about the (subjective) complexity of cases). Finally, the ability of the fine-tuned model to predict complexity in new cases will be tested. A positive result can be applied to reduce the aforementioned costs of processing complex legal knowledge.

## 4. Models of Complexity in Science

There are many different definitions of complexity in science. The aim of this research is to develop a quantitative measure of subjective complexity for formal representations of legal knowledge and their algorithmic implementations. In this paragraph, I will therefore refer to definitions of complexity from Algorithmic Information Theory (AIT), which studies the complexity of data structures (representations of knowledge in a computer).

In AIT, the complexity of data structures is equated with its information content. Complexity is postulated to decrease proportionate to the degree of (algorithmic) compressibility of the data structure. To assess the usefulness of AIT, for our practical purpose, i.e., the design of a quantitative model of complexity of legal knowledge, I studied some publications from the domain of AIT. I read that complexity is approached as Algorithmic Probability (e.g., Solomonoff's *a priori* probability), i.e., the higher the probability that a random computer program outputs an object, the less complex this object is considered to be. I read that complexity is approached as Algorithmic Complexity (e.g., Kolmogorov's descriptive complexity), i.e., the shorter the code needed to describe an object (string), the less complex this object is considered to be. This is an interesting approach since it seems to offer a concrete measure of the complexity of certain objects (e.g., of legal judgements) and it associates with the concept of compressibility, which can be transposed as simplification (as opposed to sophistication) to the legal domain. Finally, I read about Dual Complexity Measures in Burgin (2010), which relate AIT to more complex problem structures and distinguish the complexity of the system described (the actual problem and its solution) from the complexity of the description (the algorithm used to describe the problem and its solution). A common and essential aspect of these approaches is the compressibility of the object as a measure of its complexity. In all these cases, the computer program is considered to be an explanation of a (more or less complex) object (or data structure).

My conclusion is that these approaches will be useful when trying to prove certain characteristics of the model of complexity in the legal domain, once developed, but not primarily for the design of the model. I will have to describe the formal model and the algorithm (explanation) first. Just to get a practical insight into the concept of compressibility, I did apply the idea of compressibility to some legal cases (see the following example). However, many of the characteristics of legal cases that make them "complex" according to lawyers are not directly related to compressibility. Moreover, incidentally the most simple "palaver" in the legal domain is meant to be incomprehensible and therefore misses the (semantic and relational) patterns that are needed to be compressible. The conclusion is that this concept only partially covers the problem in the legal domain. I am eager to discuss this with my colleagues in the mathematical domain.

### An example of compression using logical equivalence in the legal domain

Objects regulation U.1. Appendix III Decree Indication Chemical Waste reads as follows:

*Waste products are* ***not*** *considered as chemical waste* [cw] *if they are objects* [o] *that have attained the waste phase* [wp] *of their lifecycle*, ***unless***:

*a. This has happened* ***before*** *they have reached the user* [ru];
*b. This has happened* ***after*** *they have reached the user* [ru] *and they are*

*1. transformers* [1];
...
*10. Mercury thermometers* [10].

The logical structure of this legal provision is as follows:

*not cw is implied by o and wp and not* ((*not ru*) *or (ru and* (*1 or .. or 10*))).

Logically equivalent with this formalization of the provision is the following formula:

*not cw is implied by o and wp and ru and not* (*1 or . . . or 10*)

which is a compression of the original provision.

Interestingly enough, the retranslation of this equivalent formula to natural language is as follows:

*Waste products are not considered as chemical waste if they are objects that have attained the waste phase of their lifecycle and they have reached the user and they are not 1. transformers .. 10. Mercury thermometers.*

Although this example illustrates that compression can be beneficial because it improves the readability of the regulation, it does not reduce its actual complexity which — in practice — is related to different opinions about the meaning of concepts like "waste products".

## 5. A Formal Model of Legal Knowledge (Reasonable Inferences)

The first step in developing a model of complexity in the legal domain is to describe the formal characteristics of legal knowledge that are related to the essence of complexity in this domain, i.e., the competition of opinions. In a previous publication (de Vey Mestdagh and Burgin, 2015), we introduced the following model that allows for reasoning about (mutually exclusive) alternative opinions and that allows for tagging the alternatives, e.g., describing their identity and context.

Our knowledge of the world is always perspective bound and therefore fundamentally inconsistent, even if we agree to a common perspective, because this agreement is necessarily local and temporal due to the human epistemic condition. The natural inconsistency of our knowledge of the world is particularly manifest in the legal domain (de Vey Mestdagh and Hoepman, 2011).

In the legal domain, on the object-level (that of case facts and opinions about legal subject behavior), alternative (often contradicting) legal positions compete. All of these positions are a result of reasoning about the facts of the case at hand and a selection of preferred behavioral norms presented as legal rules. At the meta-level, meta-positions are used to make a choice for one of the competing positions (the solution of an internal conflict of norms, a successful subject negotiation or mediation, a legal judgement). Such a decision based on positions that are inherently local and temporal is by definition also local and temporal itself. The criteria for this choice are in most cases based on legal principles. I call these legal principles meta-principles because they are used to evaluate the relations between different positions at the object-level.

To formalize this natural characteristic of (legal) knowledge, we developed the Logic of Reasonable Inferences (LRI, de Vey Mestdagh *et al.*, 1991). The LRI is a logical variety that handles inconsistency by preserving inconsistent positions and their antecedents using as many independent predicate calculi as there are inconsistent positions (Burgin and de Vey Mestdagh, 2011, 2013). The original LRI was implemented and proved to be effective as a model of and a tool for knowledge processing in the legal domain (de Vey Mestdagh, 1998). In order to be able to make inferences about the relations between different positions (e.g., make local and temporal decisions), labels were added to the LRI.

In de Vey Mestdagh and Hoepman (2011), formulas and sets of formulas are named and characterized by labeling them in the form ($A_i$, $H_i$, $P_i$, $C_i$). These labels are used to define and restrict different possible inference relations (Axioms $A_i$ and Hypotheses $H_i$, i.e., labeled signed formulas and control labels) and to define and restrict the composition of consistent sets of formulas (Positions $P_i$ and Contexts $C_i$). Formulas labeled $A_i$ must be part of any position and context and therefore are not (allowed to be) inconsistent. Formulas labeled $H_i$ can only be part of the same position or context if they are mutually consistent. A set of formulas labeled $P_i$ represents a position, i.e., a consistent set of formulas including all Axioms (a perspective on a world, without inferences about that world). A set of formulas labeled $C_i$ represents a context (a maximal set of consistent formulas within the (sub)domain and their justifications, i.e., the world under consideration). All these labels can be used as predicate variables and if individualized, to instantiate predicate variables and consequently as constants (variables as named sets).

Certain meta-characteristics of formulas and pairs of formulas were finally described by labels (e.g., meta-predicates like Valid, Excludes, Prefer) describing some of their legal source characteristics and their legal relations which could be used to rank the different positions externally. The semantics of these three Predicates (Valid, Exclude and Prefer) are described in de Vey Mestdagh and Hoepman (2011). These three predicates describe the elementary relations between legal positions that are prescribed by the most fundamental sets of legal principles (principles regarding the legal validity of positions, principles regarding the relative exclusivity of legal positions even if they do not contradict each other and principles regarding the preference of one legal position over another). It was also demonstrated that the LRI allows for reasoning about (mutually exclusive) alternatives.

In de Vey Mestdagh and Burgin (2015), we have shown that labels can be used formally to describe the ranking process of positions and contexts. With that the thus extended LRI allows for local and temporal decisions for a certain alternative, which means without discarding the non-preferred alternatives like belief revision does and without using the mean of all alternatives like probabilistic logic does. This extended the LRI from a logical variety that could be used to formalize the non-explosive inference of inconsistent contexts (opinions) and naming (the elements of) these contexts to a labeled logical variety, in which tentative decisions can be formally represented by using a labeling that allows for expressing the semantics of the aforementioned meta-predicates and prioritizing (priority labeling). In de Vey Mestdagh and Burgin (2015), we illustrated the use of these labels by examples.

In the next paragraph, the extended LRI is used to identify the quantitative parameters of complexity in the legal domain.

## 6. A Formal Model of the Complexity of Legal Knowledge (Parameters for a Reasonable Calculation of Complexity)

The processing of legal knowledge takes place in successive phases. Each phase is characterized by its own perspectives and associated parameters of complexity. Roughly, first the different parties in a legal dispute take their positions, then the positions are confronted and a decision is made and finally the decision is presented.

The complexity of the dispute differs from phase to phase: again roughly, from intermediate *initial complexity* (the separate positions), to high *problem complexity* (the confrontation and decision making), to low *solution complexity* (the decision itself). The separate positions are basically consistent and their contents can each be processed within a separate single logical variety. When the dispute starts, complexity increases, because the shared axioms of the dispute have to be calculated and the positions are by definition mutually inconsistent and several calculi within the logical variety have to be used to calculate the joint process of the dispute and to decide between different hypotheses within the dispute. Ultimately, the decision principles included in the different positions have to be used to rank the different consistent solutions. The dispute ends by presenting the highest ranking consistent (local and temporal) decision, representing a concurring opinion or a compromise. The complexity of this result is reduced again, because it can be (re)calculated within a single consistent variety. In the following, these phases are described in more detail and the related parameters of complexity in terms of the formal model introduced above.

### 6.1. *Phases and parameters of legal knowledge processing*

In a particular case, the complexity of the case can be quantified on the basis of the case elements and relations presented by all parties. The processing takes place in five phases:

(1) At the start of legal knowledge processing, the case can be described as follows: A number of sets $n$ (the number of parties involved) of labeled formulas $\mathrm{H}_{i,l}$ representing the initial positions of each of the parties in a legal discourse, i.e., hypotheses$_i$ of parties$_l$ about the (alleged) facts and applicable norms in a legal case.
(2) The next step is determining the intersection between these sets $\mathrm{H}_{i,l}$, which defines $\mathrm{A}_i$ representing the agreed case facts and norms, and determining the union of all complements, which defines $\mathrm{H}_i$. ($\mathrm{A}_i$, $\mathrm{H}_i$) represents the initial case description.
(3) The third step is calculating all possible minimal consistent positions $\mathrm{P}_i$ that can be inferred from ($\mathrm{A}_i$, $\mathrm{H}_i$) applying a logic, e.g., the LRI, a logical variety that allows each position to be established by its own calculus. If these calculi differ, this adds to the complexity of the problem. In earlier publications, we assumed all the calculi to be the same (predicate calculus).
(4) The fourth step is calculating all maximal consistent contexts (possible consistent worlds) $\mathrm{C}_i$ on the basis of ($\mathrm{A}_i$, $\mathrm{H}_i$, $\mathrm{P}_i$).
(5) The last step is making a ranking of these contexts on the basis of the application of the meta-norms (decision criteria) included in them. A formal description and an example of this process can be found in de Vey Mestdagh and Burgin (2015).

### 6.2. *Parameters for a reasonable calculation of complexity*

Each step in this process is characterized by its own parameters of complexity. In legal practice, different procedures are used to determine and handle (reduce) complexity in these different phases:

(1) In the first phase, a direct, static measure of complexity is commonly applied: the number of parties and the number of hypotheses. This is

a rough estimate of the number of different positions (interpretations, perspectives, interests).

(2) In the second phase, a direct, relative measure of complexity is commonly applied: the number of $A_i$ and its relative size to $H_i$. The larger the relative size of $A_i$, the less complex a case is considered to be, because there is supposed to be more consensus.

(3–4) In the third and fourth phases, all positions $P_i$ and contexts $C_i$ are derived:

Given the resulting set of labeled formulas ($A_i$, $H_i$, $P_i$, $C_i$) representing the legal knowledge presented in a certain case, the problem complexity of this set can be defined as follows:

(a) The subset $A_i$ (agreed case facts and norms) is by definition included in each $P_i$ and $C_i$ so its inclusion as such is not a measure of complexity as it reflects absolute consent.

(b) The elements of the subset $H_i$ are by definition not all included in each $P_i$ and $C_i$, so the relative size of the inclusion of its elements is a measure of complexity as it reflects relative consent. If there is more conformity, there is less complexity. It is even possible that certain elements of the subset $H_i$ are not included in any $P_i$ and $C_i$. The number of these "orphaned" elements can also contribute to the complexity of a case, because they represent antecedents without consequents (a justification for an absent conclusion) or consequents without antecedents (a decision is proposed without justification). Orphaned elements can be the result of incompletely presented positions or — worse — be smoke screens.

(c) The relative size of the fraction of subset $A_i$ in ($A_i$, $H_i$) — relative to the fraction of $A_i$ in other cases — is a measure of complexity as it reflects the size of shared (consented) knowledge in a legal dispute. This holds, even if the size of $A_i$ is manipulated by one or more of the parties involved (as a winning strategy or for billing reasons), because the other parties have to take the $A_i$ into consideration.

(d) The relative size of the fraction of subset $H_i$ in ($A_i$, $H_i$) — relative to the $H_i$ in other cases — is a measure of complexity as it reflects the size of the disputed knowledge in a legal dispute. This holds even if the size of $H_i$ is manipulated by one or more of the parties involved (as a winning strategy or for billing reasons), because the other parties have to take the $H_i$ into consideration.

(e) The relative size of the subset $P_i$ (relative to the $P_i$ in other cases) is a measure of complexity as it reflects the number of different minimal positions that can be taken logically in this specific case. The size of $P_i$ can only be manipulated indirectly (through the respective sizes of $A_i$ and $H_i$).

(f) The relative size of the subset $C_i$ (relative to the $C_i$ in other cases) is a measure of complexity as it reflects the number of different consistent contexts (possible decisions) that can be distinguished in this specific case.

(5) In the fifth phase, ranking of the contexts takes place. The number of rankings depends on the inclusion of ranking meta-norms in the respective contexts. For example, if $C_i$ includes a ranking meta-norm that concludes to Prefer($C_i$, $C_j$) and $C_j$ includes a ranking meta-norm that concludes to Prefer($C_j$, $C_i$), there are (at least) two rankings. Meta-norms that are agreed upon are part of $A_i$, meta-norms that are not agreed upon are part of $H_i$. The process of applying the meta-norms is fully recursive, since the objects of the meta-norms are other (meta-)norms, which are themselves also part of ($A_i$, $H_i$). This means that the determination of the complexity of the *application* of the meta-norms is included in the previous phases. In this phase, only the resulting number of rankings is established and can be considered to be an independent measure of complexity.

## 7. Validation of the Model of Complexity

The model of parameters for a reasonable calculation of complexity of legal knowledge as described in the previous paragraph is based on prior theoretical and empirical research into — among other things — the complexity of legal knowledge (de Vey Mestdagh, 1997, 1998). In this research, a theory of legal knowledge has been developed and translated into a formal model of legal knowledge. This model — the logic of reasonable inferences (LRI) — is introduced in Section 5. The LRI has been implemented as a general computer model of legal knowledge, the legal knowledge system (algorithm) Argumentator. A total of 430 environmental permit law cases and knowledge of environmental permit law, administrative and court rulings, principles, policies and practices have been formally represented in

Argumentator resulting in an expert system for environmental permit law (ESM). The relative complexity of the 430 cases has been established on the basis of legal expert judgements. The opinion of the experts was that 45 cases (concerning secondary aluminum smelters) were of a relatively complex nature and 385 cases (concerning petrol stations) of a relatively less complex (more general) nature. This has been verified by applying the expert system ESM to these cases. The ESM was enabled (provided with more complete general data and knowledge) to improve on the human judgements in the 430 cases. The test results have shown that in the complex cases, 66% of the human judgements were improved by the expert system (of which 20% were full revisions), while in the less complex, general cases only 27% of the human judgements were improved by the expert system (of which only 2% were full revisions).

The testing was conducted in two ways. First, an investigation was made of which rules the expert system applies and which conclusions it draws if it starts with the same data as the human decision makers did in the cases from legal practice (*descriptive mode*). This investigation made it possible to draw conclusions about *the expert system as a model of the actual administration of the law* by comparing the norms applied and the conclusions drawn in the decision-making process of the human experts vs. that of the ESM. Second, an investigation was made of which rules the expert system applies and which conclusions it draws if it not only considers the case data but is also enabled to apply all the known norms and independently collect additional data (*supplementary mode*). This investigation made it possible to draw conclusions about *the expert system as a* (*normative*) *model of the formal and informal rules in force within Environmental Permit Law.* The expert system and the tests were evaluated by 18 independent assessors. In de Vey Mestdagh (1997), the test research and the independent assessments are described.

In *descriptive mode*, the ESM successfully (re)constructs 425 of the 430 examined decisions. So, only 5 mismatches were encountered, 3 of them in complex cases and 2 of them in the less complex cases. In all 3 mismatching complex cases, an invalid rule was applied in practice (7% of the 45 complex cases) while a valid rule was applied by the ESM. In just 1 of the 2 mismatching less complex cases, an invalid rule was applied in practice (0.3% of the 385 cases). In the other case, an — unpublished — valid local rule was applied. The test in descriptive mode validates the theoretical basis and its formalization and implementation. The legal expert system is a valid model of the use of legal knowledge in legal practice because it applies the same knowledge in a large majority (425) of the cases. It also shows a higher occurrence of the application of invalid rules (mistakes made) in legal practice in more complex cases.

In *supplementary mode*, in the complex cases 30 (66%) of the 45 decisions were amended by the ESM: 9 (20%) of the 45 examined decisions were revised (contradicted); furthermore 11 (24%) of the 45 examined decisions turned out to be subject to competition of legitimate (contradicting) alternatives, which were not taken into consideration in these cases, and 10 (22%) of the 45 examined decisions qualified for legitimate extensions.

In the less complex cases — as a consequence of the erroneous or non-application of valid rules — according to the ESM, 104 (27%) of the 385 decisions should be amended: 7 (2%) of the 385 decisions should be revised, 34 (9%) of the decisions are certainly subject to the competition of legitimate alternative (contradicting) decisions which were not taken into consideration, 31 (8%) of the decisions are subject to the competition of legitimate alternative (contradicting) decisions depending on the content of unknown additional data and 32 (8%) of the decisions should be extended.

In both complex and less complex cases, the legitimacy of the decisions proposed by the ESM has been judged to be in accordance with Dutch law by the 18 independent assessors.

In conclusion, in supplementary mode, the ESM is enabled to apply more complete knowledge of Environmental Permit Law (formal and informal object-level and meta-level rules). As a consequence, it improves the quality of a large number of the complex and less complex legal cases from practice. The difference between complex and less complex cases is reflected in the much larger improvement in complex cases (66%) than in less complex cases (27%). The improvements consist of (1) revision of decisions by applying valid rules instead of the erroneous or non-application of valid rules or the systematic application of invalid rules (also detected in descriptive mode), (2) weighing up legitimate alternatives (rules) by applying decision rules (meta-rules) instead of only applying the routine alternatives and (3) the application of valid and legitimate additional rules. In all cases, the number of normative opinions (rules and meta-rules) considered in making the improved decision is larger than that considered in making the original decision.

The distinction between the complex and less complex cases can be quantified by the differing numbers of normative opinions taken into consideration. The test of the ESM in supplementary mode thus confirms the assessment of complexity by the independent assessors. The complex cases are characterized by higher counts of the parameters distinguished in the previous paragraph. The number of parties and the number of hypotheses (rules and meta-rules) and with that the number of elements of $H_i$ are higher in the complex cases. In an average complex case, the number of parties is 4 (3 licensing parties with diverging policies, principles and practices, 1 licensee). In an average less complex case, the number of parties is 2 (1 licensing authority, 1 licensee). The number of rules and meta-rules is relative to the number of regulations and licensing parties. The number of regulations is much larger in the complex cases (see list of regulations and description of policies, principles and practices in the original publication). The test results show that the number of (contradicting) alternatives and with that the number of elements of $P_i$ and $C_i$ are higher in the complex cases. Finally, the number of meta-rules and with that the number of rankings are higher in complex cases.

Further validation research is needed to refine the model of parameters for a reasonable calculation of complexity of legal knowledge as described in the previous paragraph. The relative weight of the counts of the parameters described will be varied against the available dataset of legal cases. The results will also be correlated with other variables that are available to gain further insight into possible parameters of complexity. Examples of these variables are number of submitted documents, length of procedure, number of appeals, spending power of the parties involved, level of expertise of the lawyers involved, etc.

## 8. Conclusion: A Reasonable Model of Complexity and Further Research

In this chapter, we have explored the concept of complexity in the legal domain. A first conclusion is that the concept has not been studied explicitly in the legal domain. Only indirectly as a qualitative concept (vagueness, open texture, etc.) and hardly ever as a quantitative concept. However, a quantitative model of complexity in the legal domain has — apart from its scientific meaning *per se* — legal, economic and political implications. It will allow us to improve the quality and efficiency of legal proceedings. Algorithmic Information Theory offers several approaches to the quantification of complexity that inspired the approach chosen in this chapter. It induced the thought that in the legal domain a distinction between subjective problem complexity and objective resolution complexity is necessary and that a quantifiable model of complexity based on the formal representation of subjective legal knowledge should be the first step in developing a model of complexity in the legal domain.

In this chapter, we have given a description of a formal representation of legal knowledge (the extended Logic of Reasonable Inferences) and we have described the quantitative parameters of complexity for this model. The result of this we would like to call *a Reasonable Model of Complexity*, because it is based on the Logic of Reasonable Inferences (LRI) and because it inherits its relative, perspective-bound character. Complexity is specifically relative to the number of perspectives combined in the knowledge under consideration.

Further research will focus on extending the model of complexity to resolution complexity, using — among others — available algorithms (e.g., Argumentator, the computer program we developed to implement the LRI). It will also use the available dataset of 430 environmental law cases that have been described and analyzed before and that have already been represented in Argumentator.

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