

MILIEU: a LKBS to support prosecution of environmental offenders

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Abstract

In the Netherlands, the prosecution of environmental offenders is hindered by poor quality of the argumentation provided by the police. The general aim of the project reported here is to determine whether knowledge technology can be applied successfully in the domain of criminal environmental Law. This paper describes the development of a LKBS-prototype to support police officers in the task of taking correct environmental samples and making correct applications for analysis at the Forensic Science Laboratory. The developmental cycle of the LKBS, i.e. knowledge acquisition, analysis and implementation, was strongly based on a model describing how police officers should behave ideally and models directly derived from this behavioral model. The use of models in the developmental process is strongly defended in this paper. In our experience, it enables a developmental process with almost no backtracking and produces a LKBS with an underlying general structure to accommodate future expansions. Moreover, we believe that a LKBS based on a firm model of ideal behaviour is better understood by users and more easily accepted by the parties concerned.

1. Introduction

In the Netherlands, prosecuting environmental offenders is often frustrated by the fact that samples of

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the environment, on which the argumentation of the crime is based, are taken incorrectly. The research reported here investigates the possibility of developing a Legal Knowledge Based System (LKBS) to support the process of taking samples and making correct and adequate requests for analysis of these samples at the Dutch Forensic Science Laboratory (FSL) of the Justice department. Developing a LKBS, including knowledge acquisition, analysis and implementation is a hard assignment which therefore should be based on a firm and clear model of what the task of the system exactly is. This paper describes the development of a LKBS named MILIEU and focuses on the role of the models used and developed during the design process.

The paper is organized as follows. Section two discusses the objective of the research and provides necessary background information. Section three presents the initial behavioral model on which the development of MILIEU is based. Sections four, five and six describe the three phases: knowledge acquisition, analysis, and implementation.

2. The research objective

During the last decades, the protection of the environment has become an important social and political topic. One way to protect the environmental is by criminal enforcement of environmental regulations which is the responsibility of both the Ministry of Justice and the police department. One of the most persuasive problems confronting the Dutch system is that it is hard to prosecute offenders successfully because of the complexity of gathering evidence. For environmental offenses, evidence

gathering often includes the taking of samples and requesting analysis of these samples at the Forensic Science Laboratory (FSL). To do this right, legal knowledge is needed as well as a lot of technical knowledge about sample taking and analysis methods [Eijkel, 1995].

Evidence gathering for environmental crimes involves several problems. First of all, samples are often not taken in accordance with prescribed procedures. This results in the situation that either the appropriate analysis cannot be carried out by the FSL or the evidence based on the analysis will not hold in court.¹ A further problem is the fact that the requests for analyses often lack the necessary background information the FSL needs to perform an effective and efficient analysis. These problems may be overcome if police officers are provided with up to date knowledge on both the legal and technical components of sample taking. *Prima facie*, this knowledge may be provided by a LKBS (see also [Markowitz, 1994]). Therefore, the FSL requested the Computer/Law Institute of the Vrije Universiteit in Amsterdam to study the possibilities of using knowledge technology to support the prosecution of environmental offenders.

As a method to investigate whether knowledge technology can be used in this particular domain, it was decided to build a LKBS related to a test domain: illegal litter burnings. Obviously, actually building a LKBS² is not the only method, and maybe not even the most suitable, to study feasibility. However, this method provides a number of advantages which made it the most suitable for this project. Firstly, it gives researchers real life insight into (unexpected) problems during development. Secondly, it is a training for building larger systems in this area. Finally, this method produces a demonstrable prototype to show and convince others of using knowledge technology. The LKBS developed is called MILIEU: *Multi Inferences for Legal Indictment of Environmental Undesirabilities*.

3. The behavioral model

One of the origins of the problems mentioned in section two is the lack of understanding what evidence the FSL can and cannot provide. Police officers seem to think that the results of the analysis can be awaited previous to deciding which provision the offender will

be charged with. However, the FSL needs to know what exactly should be proven in order to set up an examination. The provision the offender will be charged with determines to a large extent the analysis of the sample. The examination of soil, for instance to prove that it was polluted by burning asbestos as prohibited via the Environmental Protection Act (EPA), is entirely different from the examination of waste in order to prove the dangerousness for public health as stated in the Dutch Penal Code.

The FSL created a behavioral model describing how police officers should act ideally when confronted with a pollution constituting a breach of environmental regulations. This model dictates which steps a police officer should perform in order to decide what kind of environmental investigation has to be carried out. The model consists of the following steps:

1. Establish what the relevant facts of the situation are.
2. Determine the presumable offenses in this specific situation. Determine what exactly should be proven in order to draw up an indictment.
3. Determine what technical environmental investigation has to be carried out on behalf of the indictment.

Basically, this procedure requires characterizing the offense, formulating the relevant provisions of law, selecting the proper investigation and, if necessary, taking samples and making a request for analysis at the FSL containing all relevant information to set up an efficient examination. All these activities require a large amount of legal and technical knowledge.

The behavioral model served as a guideline throughout the developmental process of MILIEU. It very strongly influenced the way the knowledge acquisition and analysis phase were conducted, and how MILIEU was implemented. Knowledge acquisition, analysis results and implementation are the subjects of the following three sections.

4. Knowledge acquisition

At the start of a project like this, researchers are easily overwhelmed by the amount of relevant knowledge and how to acquire this knowledge [Evans, 1988]. It is therefore imperative to structure the knowledge

[Breuker et al. 1988, Schreiber et al.1993, Stemerding et al., 1994]. The structuring of the knowledge for MILIEU was based on the behavioral model described in section three. MILIEU's knowledge can be divided in three knowledge categories, roughly corresponding to the three steps of the behavioral model:

1. Knowledge about how cases should be described.
2. Knowledge about the legal provisions environmental offenders can be charged with.
3. Knowledge about the research methods which may be suitable to carry out.

Besides this structuring of knowledge, we found it very useful to structure the knowledge acquisition phase into two distinct phases. In the first phase, the relevant knowledge for each knowledge category was collected without paying attention to the possible relations between the knowledge in the three categories. Thus, the three categories were studied as independent knowledge categories. After collection of the relevant knowledge, it was analyzed thoroughly. In the second phase, knowledge acquisition aimed at discovering the relations between the knowledge in the three categories. Thus, here the focus was on the interdependencies between the categories.

Phase 1 of the knowledge acquisition

In the first phase, for each of the knowledge categories a different method of knowledge acquisition was used. Knowledge about the way cases should be described, was obtained in two ways. Firstly, requests for analysis at the FSL, written by police officers were studied. By means of this study, insight was obtained about how (on what level of abstraction) police officers describe crime scenes, in particular, illegal litter burnings. Secondly, a selected group of FSL employees was asked to list all terms suitable to describe the scene of an illegal litter burning, in such a way that this description facilitates an efficient analysis of the samples. It was necessary to acquire this supplement because, as explained earlier, currently, the requests for analysis often lack the appropriate information.

The primary method to obtain knowledge about the legal provisions relevant for illegal litter burnings was literature study. An advantage of building legal KBSs compared to KBSs in general is that knowledge and expertise on law is more easy available [Oskamp,

1990]. This is especially the case as long as knowledge can be studied in isolation such as was the case during the first phase. Sources that were studied, include the Law itself, literature on criminal and environmental law and acts of parliament.

Knowledge about sample taking was obtained by asking the FSL Environmental Hygiene Department to draw up a list of all possible samples a police officer might have to take when investigating an illegal litter burning.

Phase 2 of the knowledge acquisition

In the second phase, the focus shifted towards the relationship among the knowledge categories and their contents. As will become apparent in section five, seven of these relations can be distinguished. The primary method of knowledge acquisition in this phase was by means of interview sessions with experts of the Environmental Hygiene Department on sample taking and analysis methods. The interviewers themselves were considered to be experts on the relevant Laws.

This second knowledge acquisition phase consisted of three evaluation cycles. Each cycle started with an interview which took about a day. The results of the session were written down and the transcript was sent to the expert. At the next interview session, then, the transcript was evaluated, followed by a thorough interview again. The last transcript was evaluated by all employees of the Environmental Hygiene Department.

5. Analysis results

Knowledge acquisition lead to a large amount of data. During the analyzing phase, two models were developed. The first model, further referred to as the collection model, is directly derived from the behavioral model and is very similar to the categorization model made for the knowledge acquisition phase. The collection model is a declarative model, i.e. it describes what the task of MILIEU is. The second model, further referred to as the task structure, is a procedural model, i.e. it describes how the task of MILIEU is to be carried out. Both the collection model and the task structure determine how domain knowledge is used. Below, first the collection model is discussed, then the domain

knowledge is presented and finally, the task structure is set out.

5.1 Collection model

In the collection model, three collections are distinguished: C (Cases), P (Provisions), and R (Research methods). Collection C contains all possible cases a police officer may encounter in the field. P contains all provisions an environmental offender may be charged with in case of illegal litter burnings. R contains all investigation methods a police officer may have to conduct. The task of MILIEU can now be described on an abstract level as a task in which three new collections, referred to as C', P' and R', have to be created. The collections C', P' and R' are subsets of C, P and R. Their elements should meet the following conditions:

- C' contains one element only, describing the current fact situation.
- P' contains all provisions applicable to the element in C' if the research methods in R' indeed prove what they intent to prove.
- R' contains the research methods necessary to prove the provisions in P'.

The collection model was later refined by including the notion of *legal factors*. In order to adjudicate an offender of anti-pollution regulations, the evidence has to be both complete and legally valid. Typical for penal provisions is the way the proof should be delivered: a penal provision can be divided in several so-called 'legal factors' that should all be proven in order to prosecute the offender successfully with the provision [Bemmelen, 1989; Bruggink, 1993; Buiting, 1993; Enschedé, 1990; Hazewinkel-Suringa, 1991]. Therefore, requests for analyses at the FSL should always have the aim to proof a particular legal factor of a particular provision [FSL FT-norm 401.05., 1994].

With the accomplishment of the collection model, it became clear that provisions should be central in MILIEU. Although the aim of MILIEU is to establish which research methods should be carried out, MILIEU's functioning is much easier understood if the provisions are taken as the most central entities. It is therefore important to know the exact relation between

provisions and legal factors. Whether a provision can actually be used to charge an offender with, depends on whether all legal factors can be proven. The question whether a legal factor can be proven depends on details of the case at hand, and, if these details are not sufficient, the evidence the FSL might offer based on the analysis of the samples. Obviously, MILIEU is not interested in provisions of which one or more legal factors are in contradiction with the current fact situation. These provisions simply do not apply to the case. Maybe not so obvious, MILIEU is also not really interested in provisions which can be proven solely on the basis of the current fact situation, i.e. all legal factors can be proven solely on the basis of the case. That is because these provisions do not need additional evidence, for instance by sample taking, and are therefore of no interest to the task of determining which sample should be taken. Thus, MILIEU's major interest is in those provisions of which most, but not all, legal factors can be considered proven and for which an appropriate research method exists to prove the remaining legal factors.

5.2 Domain knowledge

The collection model describes the task at a high level of abstraction as three collections and the relations between these collections. Domain knowledge refers to the content of these collections and their relations and can therefore be divided in seven categories presented here (a more thorough presentation is given in [Groendijk & Tragter, 1994b]):

- 1 All facts, further referred to as basic facts, by which a case can be described. Obviously, since case descriptions contain a combination of basic facts, the number of cases is far more larger than the number of basic facts.
- 2 All the provisions environmental offenders can be charged with and the legal factors constituting these provisions. MILIEU contains a number of provisions found in the Environmental Protection Act, the Soil Protection Act and the Penal Code.
- 3 All research methods and their components. A research method consists of an instruction how in a specific situation a particular legal factor should be proven. Typically, this includes the taking of a sample such as an ash, soil or disposal sample or some combination.

- 4 The relation between the facts describing the case and the factors of the provisions (the relation C - P). For instance, a illegal litter burning out in the open excludes all provisions dealing with establishments.
- 5 The relation between the provisions and the research methods. This body of knowledge consists of rules describing which research method can be used for a particular legal factor (the relation R - P). For instance, a soil sample combined with so-called reference samples is the method to prove soil contamination as meant in section 13 of the Soil Protection Act.
- 6 A body of knowledge describing when a research method can be applied (the relation C - R). For instance, an ash sample cannot be taken if the rain has washed away the ashes.
- 7 Knowledge under what circumstances it is useful to carry out a particular research method to prove a specific legal factor. Each specific situation needs its specific method of proof. When samples are necessary, the sample taking method depends both on details of the crime scene and the question what the police officer intends to prove (the relation C - P - R).

5.3 Task structure

The task structure describes MILIEU's task in a very detailed yet abstract manner. Because of the complexity of this model, only a rough sketch is given here. By the way, the design of the task structure marked an important point during the development of the MILIEU-LKBS. During the project, it was presented to the employees of the Environmental Hygiene Department of the FSL in order to report on the progress of the project and to obtain a go-ahead signal.

In order to follow the presentation of the task structure, it should be understood that collections C, P and R are considered static and C', P' and R' are considered dynamical versions of C, P and R. Thus, at the start of a session, C', P' and R' are equal to C, P and R; during problem solving the number of elements in C', P' and R' are reduced until C', P' and R' are in agreement with the conditions of the collection model.

The task structure displays six phases:

1. Within the first phase, an initial case description of the current fact situation is obtained by questioning the user. Thus, this phase aims at narrowing down the number of cases in C'.
2. In the second phase, more information is obtained about the case at hand. However, this time the questions are guided by the provisions in P'. It's aim is to narrow down P' by asking questions which, either directly or indirectly, prove the negation of legal factors of provisions.
3. In this phase P' contains the provisions that contain no legal factors in contradiction with the current fact situation. The questions asked in this phase aim at proving the remaining unproven legal factors and thus the provision based on the current fact situation. As explained before, proven provisions can also be removed from P'.

In these three phases, the reduction of the set of relevant provisions (P') is based on the facts of current fact situation. In fact, both facts confirming and facts denying the applicability of provisions may have limited the original set. In phase four and five, a further reduction of provisions is obtained by investigating whether the FSL can offer suitable analyses to prove the factors that are still unproven.

4. In phase four, the so-called absolute unprovable provisions are removed from P' by checking whether R' contains research methods for the unproven legal factors of P'. Obviously, if no such method exists the provision cannot be proven and, hence, should be removed from P'. No questions are asked during this phase.
5. In phase five, the so-called relative unprovable provisions are removed from P'. A provision is considered relative unprovable if a research method exists for some still unproven legal factor but cannot be carried out because of some property of the current fact situation. For instance, a concrete floor obstructs the taking of a soil sample.
6. In phase six, the resulting collections C', P' and R' are in agreement with the requirements of the collection model. This phase comprises of presenting the results to the user (cf. 6.3).

6. Implementation

In the previous section, two models are presented. The collection model describing the task of MILIEU in a declarative manner and the task structure describing the procedure that should be carried out. These two models are also identifiable in the implementation of MILIEU. MILIEU is implemented in a shell, developed at the Computer/Law Institute of the Vrije Universiteit, called JPS (Judicial Problem Solver). JPS is a hybrid system containing the subsystems: PRODEON and FORM. PRODEON is a rule-based system previously reported on in (Groendijk & Herrestad, 1993). PRODEON is meant for the formalization of declarative knowledge. In principle the order in which the rules and elements of the antecedents are formalized in PRODEON does not influence the way MILIEU operates. FORM's primary function is to implement procedural knowledge. That is, in FORM, the knowledge engineer determines in what order the sub tasks are carried out. The collection model is formalized in PRODEON. The task structure is primarily implemented in FORM but some details are taken care of in PRODEON. The formalization of the domain knowledge, which is also discussed here, is done in PRODEON.

6.1 Collection model

In the collection model, three sets (Cases, Provisions, and Research methods) and their dynamic counterparts (C', P' and R') are of importance. The set of all possible cases C is not represented as such in MILIEU. This set is far too large to represent as a set within a LKBS and therefore, the current fact situation is represented as the combination of basic facts emerging as a result of the answers of the user.

The set of all relevant provisions is small. It contains 16 provisions out of the Environmental Protection Act (EPA), the Soil Protection Act and the Penal Code. These provisions are formalized in a special way. For instance provision 10.43 of the EPA is formalized as follows:³

```
(fact [ :prov_10_43_EPA is part of P])
```

```
(if
  [and
    [disposed material is dangerous]
    [disposal within an establishment]
  ]
  then
    [ :prov_10_43_EPA is applicable]
)
(if
  [or
    not [disposed material is dangerous]4
    not [disposal within an establishment]
  ]
  then
    not [ :prov_10_43_EPA is applicable]
)
(fact [ : [disposed material is dangerous] is a legal factor of
:prov_10_43_EPA])
(fact [ : [disposed material is dangerous] is a legal factor of
:prov_10_43_EPA])
```

The first statement puts the provision in set P. One of the constituents of the set model is a dynamic set P' which is a subset of P. During problem solving the subset changes. For instance, at the start of phase 2 of the task structure, MILIEU is interested in the provisions not in contradiction with the current fact situation, but also not completely in agreement with the current fact situation. To find this set, MILIEU uses the following rule in which the variable <provision> is instantiated to those provisions which contain legal factors that still need to be proven:

```
(if
  [and
    [ : <provision> is part of P]
    [naf [ : <provision> is applicable]]
    [naf not [ : <provision> is applicable]]
  ]
  then
    [ : <provision> is part of P_accent in phase_2]
)
```

Research methods (R) are formalized in a very similar manner. As explained before, a research method is used to prove specific legal factors of provisions in P. For instance, there are several ways to prove that a certain material is dangerous as meant in provision 10.43 of the EPA. One of the methods is to take a sample of the disposal and send it to the FSL. This is formalized as:

```
(fact [ :take_disposal_sample is a part of R])
```

```
(fact
  [:take_disposal_sample
   is FSL research for
   :[disposed material is dangerous]]
)
```

At the start of phase 4, as an example, R' consists of all research methods that might be used to prove legal factors of provisions in P'. R' can be found using the following rule in which the variable <research_method> is instantiated to those research methods which might be used to prove legal factors of provisions within P':

```
(if
  [and
   [:<provision> is part of P_accnt in phase_4]
   [:<legal_factor> is a legal factor of :<provision>]
   [:<research_method> is FSL research for :<legal_factor>]
  ]
  then
  [:<research_method> is part of R_accnt in phase_4]
)
```

6.2 Domain knowledge

Domain knowledge is also formalized in PRODEON rules. In order to make domain knowledge easily changeable, the formalization is kept simple, i.e. the formalization of this body of knowledge never uses variables. In section 5.2, domain knowledge was divided in seven categories. The fourth category, in which the legal factors are connected to fact situations, is definitely the largest category. The following rule is an example of the formalisation of the knowledge within this category. It explains the term establishment used in the formalisation of provision 10.43 of the EPA.

```
(if
  [and
   [industrial activity]
   [within a closed area]
  ]
  then
  [disposal within an establishment]
)
```

6.3 Task structure

Because of the procedural character, the task structure is primarily implemented in FORM. The basis implementational unit of this system is a so-called Knowledge Unit (KU). The order in which KU's are executed is determined explicitly by the knowledge

engineer, allowing him to implement procedures straightforwardly as a sequence of KUs each performing a specific sub task such as asking the user to provide some information or jump to another procedure. The implementation of the task structure often uses KUs which interact with PRODEON's rule base. Thus, at specific moments, the task structure activates the inference engine to obtain some knowledge. The results of such interactions determine the finer details of how the task structure is executed. For instance, at the start of phase two the task structure asks the rule base to supply all the provisions still relevant. If no provisions are available (any more) phase two to five are skipped. Otherwise, MILIEU chooses one of the provisions to elaborate on.

Phase one of the task structure simply consists of calling a sequence of questions to obtain an initial description of the current fact situation. By the way, these questions are also implemented in FORM. For reasons explained in section 6.4, these questions are not considered to be part of the task structure. Only the calling of these questions is.

In general terms, the structure of phases two to five is very similar. Each of these phases starts by asking PRODEON which provisions are relevant. Then, for each of the relevant provisions, PRODEON is asked to provide the relevant legal factors, that is, legal factors of which the truth or falsity has not been determined yet. After this, a phase and legal factor specific procedure is started with the objective to modify the set of provisions and research methods. The differences between the phases are, firstly, implemented by using a phase dependent definition of what a relevant provision is, and, secondly, by the nature of the phase and legal factor specific procedures. The definition of relevant provisions, that is the content of P', for each phase is formalized in PRODEON. In section 6.1 an example of such a rule is given in which P' is established for the second phase. For each of the phases the requirements for P' become more constraining.

In phase six, the results of the session are presented to the user. The main screen presents two sets of provisions. The first set contains the provisions which are, without requiring additional research, applicable to the current fact situation. The second set contains the provisions which need additional proof. The user

may select one of the provisions which leads him to the unproven legal factors. A selected legal factor leads to instructions on how to carry out the particular research method for this legal factor. The user interface thus reflects the underlying structure of provisions, legal factors and research methods.

6.4 Extendability

MILIEU is a LKBS in the field of illegal litter burnings. However, its design aims at the whole domain of criminal enforceable environmental regulations. It is therefore imperative that MILIEU is easily extendable. The implementation of MILIEU can be described as a three-layered model. This model does not represent a certain stage during the development, but offers a particular view on the implementation with regard to extendability and maintenance. The first layer consists of the shell in which legal tasks in general can be implemented. The second layer consists of the task structure and the collection model. This layer relates to the task of finding appropriate research methods in the field of penal law in general. The third level consists of domain knowledge which is specific for the domain of illegal litter burnings. To extend the domain of MILIEU to the whole domain of criminal enforceable environmental regulations, only the domain level has to be extended.

The advantages of the three-level model go even further than this. The task of formalizing the knowledge within a legal domain is complex. Often, at the start of a project, knowledge engineers are overwhelmed by the amount of domain knowledge and the many possibilities of transferring these real-life data into a manageable structure. Thus, one of the first aims is to narrow down the degrees of freedom surrounding the process of formalization in a meaningful manner. The shell, the task structure and the collection model offer such a meaningful limitation. Obviously, the way a domain can be formalized is limited by the limitations of the formalization language of the shell. The task structure and the collection model further limit how the knowledge within the domain should be formalized. For instance, the task structure demands that the legal factors of a provision and also the research methods available are formalized in a specific way. These limitations should be regarded as advantages because

they give knowledge engineers a clear framework on how to proceed when extending MILIEU.

7. Discussion

The aim of the research reported here is to establish whether knowledge technology can be used to support police officers in the task of taking correct environmental samples and making correct applications for analysis at the Forensic Science Laboratory. To answer this question, a LKBS was build for the domain of illegal litter burnings. The developmental cycle, including knowledge acquisition, analysis and implementation was conducted in a nine month period which is, in our opinion, a rather small time. Obviously, there are many ways to build such a system (cf. Kroese, *et al.*, 1994). In the current project, the development was strongly facilitated by developing abstract and general models based on a model describing ideal police officer behaviour.

This behavioral model consist of a three step procedure to accomplish the task of taking correct environmental samples and making correct applications for analysis. Based on these three steps, the knowledge relevant for the system was split in three categories and each category was approached differently during the knowledge acquisition phase. During the analysis phase, the tripartition of knowledge gave rise to the so-called collection model which describes the task at a declarative level. To describe how the task should be carried out, a procedure called the task structure was designed. Both these models highly structured the implementational phase. In fact, the collection model and the task structure are still clearly identifiable in the implementation.

The collection model reveals that a legal focus has been chosen towards the development of MILIEU (cf. [Groendijk & Tragter, 1994a]). At the start of the project it seemed that research methods should be the most important entities in the system. However, it turned out that developing the LKBS was easier accomplished by concentrating on the provisions and the legal factors derived from them. Therefore it can be said that MILIEU is indeed a *legal* KBS. Many parties are involved in the process of prosecuting environmental offenders: The major concern of the police is to catch the offender and gather necessary evidence; The task of the Districts Attorney is to draw

up a valid indictment; The task of the judge is to evaluate the evidence and decide on the unlawfulness of the behaviour. The factor binding them together is the Law. For the acceptance of MILIEU, it is thus important that MILIEU's operation is justified by the legal character of its underlying implementation (cf. [Lippolt *et al.*, 1991]).

MILIEU offers support in various ways. On a basic level, MILIEU supports the user in determining the relevant characteristics of the crime scene, which provisions are or might be applicable, when and how to take samples, what safety precautions to take, and, how to handle the administration. MILIEU's advises are of a tentative nature. Therefore, the results of the session are offered in a way to facilitate a rational decision of the police officer. The most important characteristic of the support offered, is, however, the fact that MILIEU encourages a specific line of thinking, that is, a provision driven method of finding proof. This legal character facilitates a better understanding of the requirements of the task. Therefore, using MILIEU also has educational value: the user will gain more insight in how to investigate environmental crimes properly.⁵

Notes

1. For reasons of simplicity, the term 'analysis' is used to denote the type of investigations the FSL can perform. Actually, the range of investigations performed by the FSL is much larger.
2. By using words such as building, developing and implementing, we refer to the whole process of developing a LKBS, including knowledge acquisition, analysis, formalization, and, implementation.
3. The actual rule within MILIEU's rule base is slightly more complex and in Dutch.
4. 'Not' denotes explicit not. The placement in front of the sentence is not other then to make the formalization more transparent (cf. Groendijk and Herrestad, 1993).
5. This spring, MILIEU is used in a course Environmental training for police officers on a regular basis and also in a course for Judges and District Attorneys.

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