First Approaches on Knowledge Representation of Elementary (Patent) Pragmatics

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Abstract. The focus of this article is to provide first approachs to a possible key solution representation and construction of legal norms, especially the national patent law norms. A semantic-system based on these approaches, complementary to the FSTP/IES-Expert system, would aim at (semi)-automatically translating the parts of the notion legal certainty from its natural language non procedural presentation to a declarative logical presentation by formal modeling through interpreting the pragmatics facts based within a National Legal Systems. This paper covers the initial abstract solutions and possible outcomes as gathered during the first year of PhD research[3].

Keywords: Facts Screening and Transformation Processor (FSTP), Innovation Test, 35 U.S.C (§§ 112, 102/103, and 101)

1 Motivation

Current emerging technologies are mostly 'Model' based inventions i.e. intangible subject matter based. In general, an innovation claimed through its patent application, can be seen as a pair <**claim, its claimed invention**>, wherein the specification (including drawings) forms the second part of the pair. An inventive property/statement of an invention, disaggregated on levels of abstraction or on grains of mental resolution into elementarily properties henceforth referred as binary inventive concept. It provides the required degrees of separation of concerns for evaluating such properties independently in the light of its subject matter. Next to trivial elementary inventive concepts are logically error resistant as they represent a single/separated concern. The same holds for a non-inventive concept of a claimed inventions element, describing one of its non-inventive properties.

(Semi)-/Automatic evaluation by means of applying elementary pragmatics, 'EP' and National Patent Laws on such binary (non-)inventive concepts requires a semanticsystem for reasoning against the considered concepts, capable of the acquisition and processing of enormous amounts of background knowledge in a machine understandable format, keeping in mind its interdependence to

[3] This Ph.D thesis is being supervised by Prof. Adrian Paschke, Freie Universität Berlin, Germany.

each other. Such a (sub)-system working in conjunction with the existing Facts Screening and Transformation Processor, FSTP [1]/Innovation Expert System, IES [2], enables a person of pertinent skill, who is needed for recognizing non-elementary pragmatics, to recognize automatically and/or guided interactively by the FSTP/-IES to consider whether such elementary properties of an innovation at issue (after its disaggregation) can be considered as Anticipate (A), Not-Anticipate (N) to its prior arts/considered reference set (RS).

2 Background - The Fact Screening and Transformation

As described in [1], [2] an innovation/creation over existing knowledge, provided as a reference set RS of prior art documents, is representable by a technique teaching, TT.0 which goes beyond the knowledge of the RS - just as in a patent/application. This compound of knowledge, representing an innovation, is called "PTR", standing for a "pair of TT.0 and RS".

The Innovation Expert System (IES) thus is the PTR Expert System, defined by the epistemological and practical requirements it meets: For any PTR to which it is applied, it is supporting its user in

1. deriving from it all technical and legal facts alias relations between TT.0 and a given RS respectively a given context, such as a given legal system (in the U.S e.g. to 35 U.S.C §§ 112, 102/103, and 101) and then
2. leveraging on this analysis instantly recognizing and answering any reasonable query for any such relation

The PTR Expert System (ES) is built around the PTRs "FSTP Test" [3], hence is also called FSTP ES. The FSTP Test of a PTR supports structuring of its PTR. This PTR-DS is disaggregated into three levels of knowledge representations (KR), "**o/AD/BID**"-KR. Wherein, **o** refers to "original", **AD** to "Aggregated $\wedge$ Disclosed", and **BID** to "Binary $\wedge$ Independent $\wedge$ Disclosed". IES supports, initially screening its documents/technical teachings for elementary building blocks of its creativity/inventivity, i.e. for its inventive and non-inventive concepts. Technical informal inventive and non inventive concepts/ properties are then transformed into technical formal inventive concepts/facts, then transforming those into the technical primary facts, and finally transforming them into the technical secondary facts, called **basic** resp. **semantic** (alias **creative**) resp. textbfpragmatic (alias **innovative**) facts. These technical secondary facts use metrics induced by the Highest Courts precedents on creativity/innovation by their numbers of BID-inventive concepts embodied by TT.0. From these BID-inventive concepts, the classical yes/no answer to the question, whether TT.0 is indicated obvious over RS, can be derived by this metric. The semantic/creative and pragmatic/innovative facts extend this metric much further by first defining a PTR plcs specific (plcs = patent law carrying semantic) innovation geometry, which depicts the plcs-height/-creativity of its TT.0 over its RS. Based on plcs-height/-creativity, TT.0s pragmat-ic/innovative height over RS additionally takes into account the PTRs pmgp (pmgp= patent monopoly granting pragmatics) in any National Patent System (NPS) which represents the national/socio/economic principles underlying the idea of rewarding an innovation by granting a 20 years monopoly to its TT.0.

3 Goals/Aim

The object of our concern in this thesis is to create a semantic-system, capable of (semi-) automatically translating the parts of the notion "legal certainty" such as patent laws (e.g. in U.S, 35 U.S.C §§ 112, 102/103, and 101) from its natural language non procedural presentation to a declarative logical presentation by formal modeling through interpreting pmgp based on NLS/ (NNI = National Normative judicial Interpretation of facts).

Figure 1, shows few (10+) basic tests as proposed in [4] enabled by its inventive concepts, automatically prompting their user through exploratively checking its meeting the requirements as stated by few NPS'es (e.g.: 35 USC 112, 102/103, and 101). Applying these tests to inventive concepts requires the requirements of the NPS'es to be modeled into declarative rules, due to their modular feature and their capability to use the same knowledge in many different ways. Modeled rules are used in deductive (non-monotonic) reasoning for legal interpretations. NPS'es, like complex computer systems, constantly face questions that aim to ascertain the state of things or the correctness of a certain contention, like these modeled rules/tests. Hence, the legal questions regarding which of a number of modeled/competing legal rules could apply in a given situation amount to some error and inconsistencies, thereby leading to inconsistent reasoned output/legal interpretations. One such non-trivial approach would be that such modeled rulebases are updated manually/guided by the system using inductive learning techniques (applying rules on case laws). Such an approach would be a long term goal and is not considered for the current use-cases shown in this thesis. The list below re- expresses the intended aim, providing possible approaches/solutions to the research question stated in Section 4 of this thesis in detail:

1. To manually(and/guided-by-system) analyze and extract the rules and ontological concepts described in the natural language descriptions of NPS'es.
2. To identify the required semantics and inference rules needed for legal reasoning with NPS'es and for the legal interpretation enabling the separating of novel innovations from obvious steps.
3. Logic-based declarative representation of these chains of complex rules for legal reasoning on top of structured formal ontology domains representing the conceptualization of the NPS'es and the underlying domains of skill and elementary pragmatics.
4. Developing a legal reasoning sub-system to the FSTP ES which allows pmgp dependent information to be derived from the NPS knowledge bases and to be used in the FSTP for semi-automated legal decision support and compliance checks with the applicable NPS for a PTR. This includes
   (a) Address the trade-off between required expressiveness of the knowledge representation and its computational complexity of the legal reasoning in FSTP.

(b) Provide support for the different roles involved, such as inventor, person of pertinent skill, examiner, patent agent etc. This requires different representation languages from natural language format for expressing questions, answers, proofs and explanations to platform-independent serializations in XML and Semantic Web formats to platform-specific executable formats on the logical reasoning layer.
(c) Provide support for life cycle management of knowledge. This addresses e.g., collaborative knowledge engineering and management (versioning, different roles such as author, maintenance), updates in the NPSes by new decisions which lead to corresponding isomorphic updates in the NPSes knowledge bases, integration of internal and external (semantic) background knowledge e.g. about skill, elementary pragmatics, usage data (annotations, proofs, etc.).

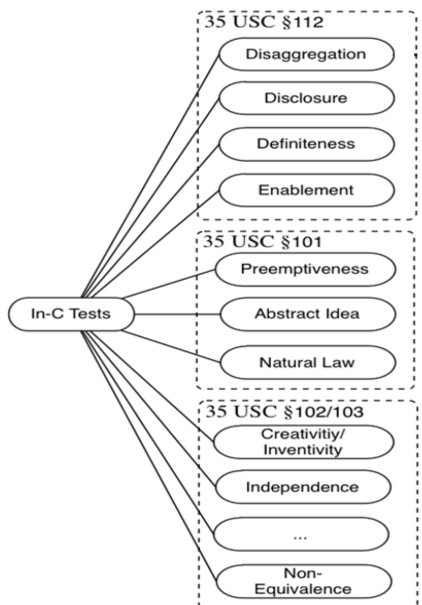


Fig. 1. 10+ In-C tests to be applied on an inventive concept for patent eligibility, in accordance to US patent law

4 Research Questions

The research question will be refined and detailed after the literature review and baseline study, from the following general problem domains of a knowledge representation.

1. Syntax:
   (a) Which representation and interchange format for the representation of the knowledge on different representation layers? (human-oriented computational independent, platform-independent supporting integration and interchange, platform-specific logical reasoning).
2. Semantics:
   (a) Which inference and interpretation semantics (non-monotonic vs. monotonic, expressiveness vs. computational complexity, closed-world vs. open world, "ontologies vs./and rules",)
3. Association problem:
   (a) How to connect the formal representation with the real-world resources and norms?

Requirements derived from these knowledge representation problem domains can be distinguished according to functional requirements for the concrete knowledge representation and non-functional requirements during design time (development / engineering of the knowledge) and run time (use of the knowledge).

1. Functional Requirements:
   (a) e.g., expressiveness, ...
2. Non functional requirements at design time:
   (a) e.g., composability and extensibility, interoperability, declarative implementability, modifiability and evolvability, reusability and interchangeability,...
3. Non functional properties at runtime:
   (a) e.g., usability, understandability and explanation, correctness and quality, scalability and efficiency, safety and information hiding (need-to-know principle),...

5 Proposed Approach

An abstract model of the system envisioned as a solution to the problem can be seen in Figure 2. An existing state-of-the-art prior art search module, using a semantic search engines like, Cognition [5], DeepDyve, etc retrieves patents through large databases which forms the required RS (if previously not specified by the jury) for the TT.0. Thus formed PTR-DS will be transformed from their natural language texts into some standard representation formats like XML, using text-mining, semantic recognition and annotation techniques supporting human knowledge engineers in the fact screening and transformation process. Similar to the PTR-DS, the existing patent rules from NPS have to be transformed from their natural language format to more standardized rule representation formats. We propose to use LegalRuleML [6], an XML standard for legal knowledge representation based on RuleML [7] which supports the modeling of norms.

Parallely, we map patent norms as used in landmark case law decisions to a workflow using some configurable workflow model. Where, each node on the

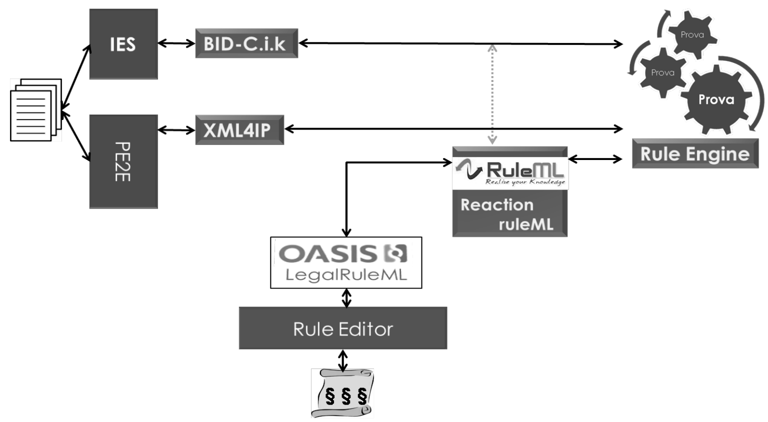


Fig. 2. Cognitive system (abstract model)

workflow (B-tree) represents a complex legal rule represented using the ReactionRuleML [8] representation format. This resolves complex legal questions and automates the analysis of a large number of patent norms with respect to their logical coherence in a given NPS. The workflow itself is represented using LegalRuleML, which provides the functionalities likes reusability, lifecycle management of nodes or the entire workflow to capture the changes over time of the rules when the legal binding text changes.

LegalRuleML is also be used to point out logical inconsistencies in current case law decisions and can also be used to evaluate the compliance of semantic facts with case law and positive law. Thereby, providing a powerful and declarative way to control and reuse such semantically linked meanings with the help of independent micro-ontologies about the NPSs and domain specific pragmatic contexts (skill ontologies, elementary pragmatics, standards etc.) for flexible processing and legal reasoning. The required (patent) rules/constraints are built by the rule creator module, which uses a distributed rule inference services network like Prova [9], a java based open source rule language for reactive agents and event processing.

Figure 3 shows the process of generating a generic workflow pertaining legal rule from landmark decisions' specific workflow. This allows capturing the different interpretations of the same law on different use cases and, thereby, arriving at a generalized workflow.

6 Elementary Pragmatics

Elementary Pragmatics are disclosures (explicit/implicit) of certain art which can be easily understood by a person of pertinent skill. According to certain National Patent Systems, an EP must not be just claimed to exist, but must be documented in an enabling way.

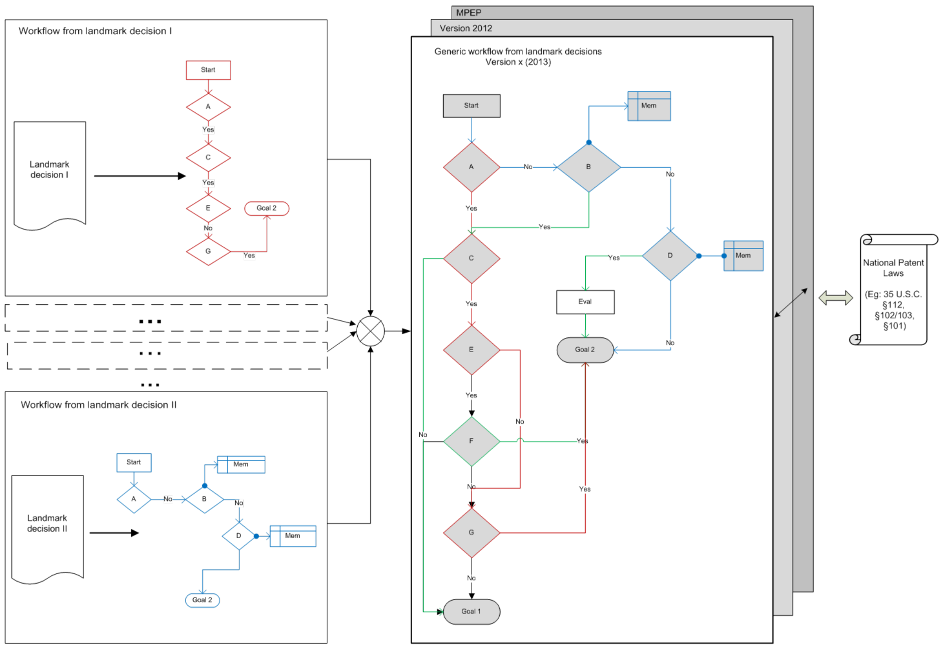


Fig. 3. specific workflow to generic workflow

EP can be divided into 4 types as shown in Figure 4 :

1. EP from Formal Rules for Filing, EP-PFP
2. EP from Patentability Conditions, EP-P
3. EP from Post Grant Procedures, EP-PGP
4. EP from Litigation, EP-L

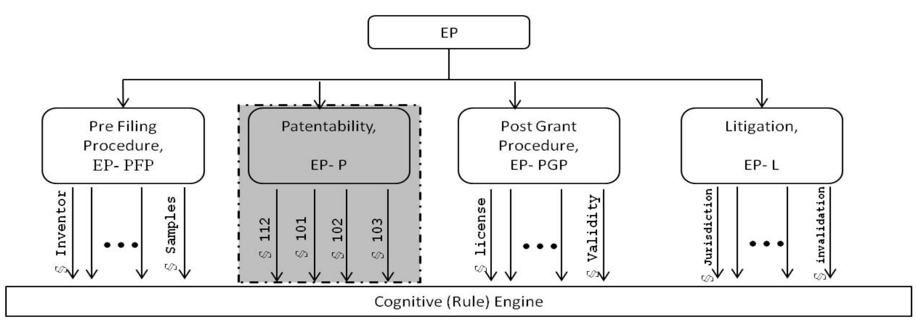


Fig. 4. Classification of EP in a National Patent System.

We narrow down our focus on Elementary Pragmatics from Patentability Conditions, EP-P. Specifically on four paragraphs (35 USC §§ 112, 102/103, and 101) of the U.S patent system [10]. Figure 5 shows the general evaluation procedure for an inventive concept under patentability. A set of inventive concepts is patent eligible, 'pe' if and only if it satisfies all the patentability criterias or EP- P's.

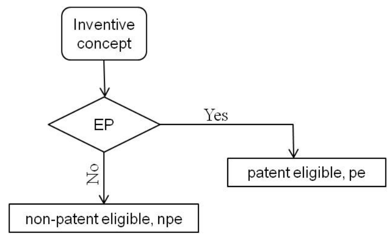


Fig. 5. Evaluation procedure.

7 Proposed Framework

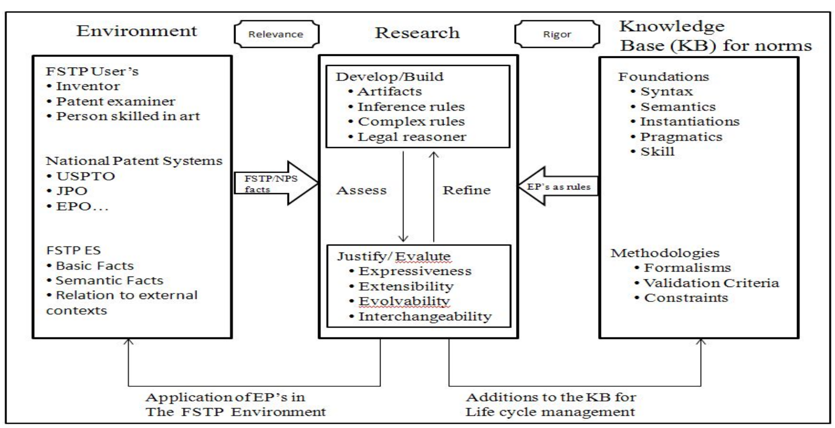


Fig. 6. Proposed Framework.

We propose a legal information system framework [11] as shown in Figure 6. The proposed framework is based on a general information system research framework [12]. The central 'Research' module is fed with information from both 'Environment' and 'Knowledge Base (KB)' modules. Information/raw material such as FSTP facts, which include the norms from various NPS'es, are fed by the 'Environment' module and the syntax, semantics, pragmatics and instantiations encompassing a norm are fed by the 'Knowledge Base' module. The central research module works towards building the inference rules required for the legal reasoner. The 'develop/build' sub-module including legal reasoner is evaluated for the norms expressiveness, extensibility and interoperability criteria's. Based on the results, the rules and the reasoner are refined again. This iterative process of (re-)assessing and refining is completed when all criteria are effectively evaluated. Processed information is fed back to the environment module for its actual usage within the FSTP ES. Additional information for the lifecycle management of a norm and its contexts is sent back to KB module.

7.1 Methodologies

Elaborating on the process of mapping patent norms to workflow models we start with the representation of all landmark case-law decisions concerning a specific norm onto a workflow. Wherein, LegalRuleML is used for such representation. We reiterate the formal template of LegalRuleML showing the most general representation syntax as defined in [13].

```
/<lrml:LegalRuleML>

  <!-- Referencing the textual provisions-->
  <lrml:LegalSource> ... </lrml:LegalSource>

  <!-- Capturing the ex-ternal temporal dimensions of the rules are represented -->
  <lrml:TimeInstants> ...</lrml:TimeInstants>
  <lrml:TemporalCharacteristics> ...</lrml:TemporalCharacteristics>

  <!-- Agent and the authority of the rules for provenance-->
  <lrml:Agents> ... </lrml:Agents>
  <lrml:Authorities> ... </lrml:Authorities>

  <!-- Associates property values to rules and also adds metadata such as jurisdiction, role, and strength--
      >
  <lrml:Context>
    <lrml:appliesRole>
      <lrml:appliesStrength>
      <lrml:appliesAuthority>...</lrml:appliesAuthority>
      <lrml:appliesJurisdiction>..</lrml:appliesJurisdiction>
      </lrml:appliesStrength>
    </lrml:appliesRole>
  </lrml:Context>

  <!-- Rules (constitutive and prescriptive) are modelled-->
  <lrml:Statements>
    <Rule>
      ..
      <!-- ReactionRuleML-->
      ..
    </Rule>
  </lrml:Statements>

</lrml:LegalRuleML>
```

Listing 1.1. General LegalRuleML syntax

Each node on the workflow represents a disaggregated rule/norm. Such rule or set of rules are embedded inside < **lrml: Statements** > using ReactionRuleML. Listing 1.2 shows a formal template of ReactionRuleML, showing the most general representation syntax as defined in [8].

```
/<Rule>

<!--rule info and life cycle management, modularization-->
  <!--(semantic) metadata of the rule-->
  <meta> ... </meta>
  <!--scope of the rule e.g. a rule module-->
  <scope> ...</scope>
```

```
<!--rule interface description-->
  <!--intended semantic profiles-->
  <evaluation> ... </evaluation>
  <!--rule interface signature and modes-->
  <signature> ... </signature>

<!--rule implementation-->
  <!--qualifying declarations, e.g. priorities, validity-->
    <qualification> ... </qualification>
  <!--quantifying declarations, e.g. variable bindings -->
    <quantification> ... </quantification>
  <!--event part-->
    <on> ... </on>
  <!--condition part-->
    <if> ... </if>
  <!--(logical) conclusion part-->
    <then> ... </then>
  <!--  action part -->
    <do> ... </do>
  <!--postcondition e.g. to check effects of execution-->
    <after> ... </after>
  <!--(logical) else conclusion-->
    <else> ... </else>
  <!--alternative action, e.g. exception handling-->
    <elsedo> ... </elsedo>

</Rule>
```

Listing 1.2. General ReactionRuleML syntax

7.2 Develop/Build (Legal Reasoner)

Disaggregated patent rules are wrapped to form a reactive agent as shown in Figure 7. A generic module "semantic- interface" here is used to depict the need for hybrid reasoning due to the fuzzy nature of patent rules. ReactionRuleML messaging is used for distributed reasoning. Listing 1.3 shows general message syntax.

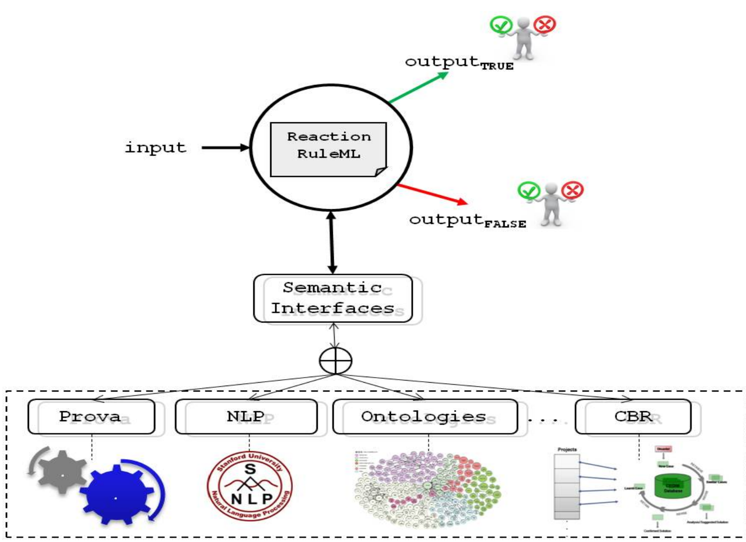


Fig. 7. Reactive agent with hybrid reasoning.

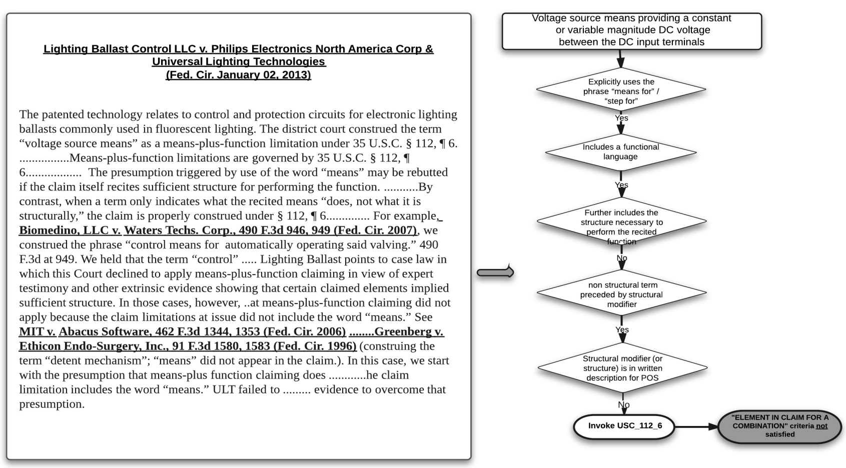
```
/<Message directive="PRAGMATIC␣CONTEXT" >
  <oid> <!-- conversation ID--> </oid>
  <protocol> <!-- transport protocol --> </protocol>
  <sender> <!-- sender agent/service --> </sender>
  <receiver> <!-- receiver agent/service --> </receiver>
  <content> <!-- message payload --> </content>
</Message>
```

Listing 1.3. ReactionRuleML Messaging syntax

8 Examples

8.1 35 U.S.C § 112 6th paragraph

Consider the latest Court of Appeals of Federal Circuit (CAFC) decision on § 112 6th paragraph in Lighting Ballast Control LLC v. Philips Electronics and Universal Lighting Technologies, Inc' [14]. Under this decision the court re-explained the norms within the 6th paragraph of § 112 (35. U.S.C Patent law). For our analysis, we map the decision and its citations into workflow. Figure 8[a] shows some excerpts from the decision itself. Figure 8[b] shows the workflow mapped from the decision for the analysis of "Means-Plus-Functions-Claiming" In its decision, the CAFC with the help of citations explains how other factors influencing this decision have to be handled.



Lighting Ballast Control LLC v. Philips Electronics North America Corp & Universal Lighting Technologies (Fed. Cir. January 02, 2013)

The patented technology relates to control and protection circuits for electronic lighting ballasts commonly used in fluorescent lighting. The district court construed the term "voltage source means" as a means-plus-function limitation under 35 U.S.C. § 112, ¶ 6. ....Means-plus-function limitations are governed by 35 U.S.C. § 112, ¶ 6.................. The presumption triggered by use of the word "means" may be rebutted if the claim itself recites sufficient structure for performing the function. ....By contrast, when a term only indicates what the recited means "does, not what it is structurally," the claim is properly construed under § 112, ¶ 6............. For example, **Biomedino, LLC v. Waters Techs. Corp., 490 F.3d 946, 949 (Fed. Cir. 2007)**, we construed the phrase "control means for automatically operating said valving." 490 F.3d at 949. We held that the term "control" ..... Lighting Ballast points to case law in which this Court declined to apply means-plus-function claiming in view of expert testimony and other extrinsic evidence showing that certain claimed elements implied sufficient structure. In those cases, however, ..at means-plus-function claiming did not apply because the claim limitations at issue did not include the word "means." See **MIT v. Abacus Software, 462 F.3d 1344, 1353 (Fed. Cir. 2006) ....Greenberg v. Ethicon Endo-Surgery, Inc., 91 F.3d 1580, 1583 (Fed. Cir. 1996)** (construing the term "detent mechanism"; "means" did not appear in the claim.). In this case, we start with the presumption that means-plus function claiming does ....he claim limitation includes the word "means." ULT failed to .... evidence to overcome that presumption.

Fig. 8. CAFC decision 'Lighting Ballast v Philips Electron' [14] mapped to a workflow.

We propose to use inductive approaches by populating the workflow with related decisions ('Biomedino LLC v. Water Techs Corp' [15], 'MIT v. Abacus Software' [16], 'Greenberg v. Ethicon Endo Surgery, Inc' [17] etc) to obtain a generic workflow for 6th paragraph of § 112 as shown in Figure 9. Where, the norm in workflow format is represented using LegalruleML representation format described before and the nodes/rules are represented using ReactionRuleML. For this example we use Stanford parser, SentiwordNet, Prova and Pre defined legal lexicons, PUBPAT as semantic interface for reasoning the norms. A person of pertinent ordinary skill and creativity (posc) as defined by USSC affirms every reasoned result.

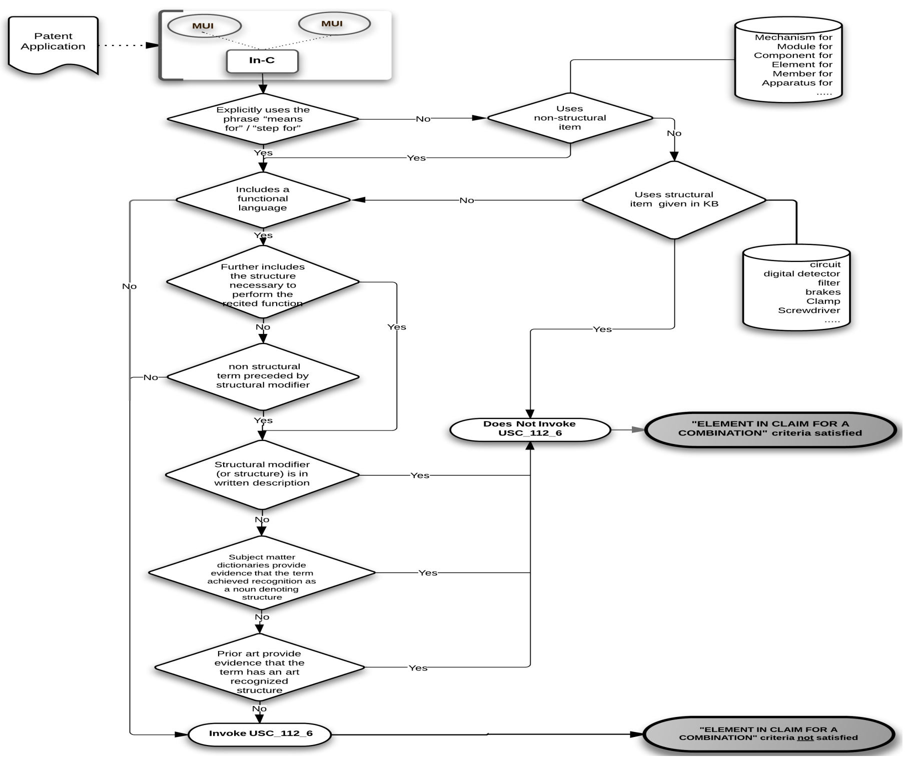


Fig. 9. 6th paragraph of § 112 (35. U.S.C Patent law)..

9 Conclusion and Future Steps

The solution to have a sub-system, based on configurable EP which connects the FSTP ES, thus making it full/-semi automatized in handling queries pertaining to EP and NLS thereby, providing a uniform platform for standardizing the generation and representation of complex rules (built using fewer NPS goal clauses/(patent) rules. Such a system would serve as a ready reckoner in drawing legal conclusions on top of scientific fact determined during FSTP analysis.

This would then help in applying the (elementary) cognitive norms required for interpretation and evaluation of such identified facts.

10 Acknowledgements

The author would like to thank Prof. Adrian Paschke and Prof. Sigram Schindler for their constructive comments and suggestions. This work has been partially supported by the Fact Screening and Transformation Project (FSTP) funded by the TelesPRI GmbH: www.fstp-expert-system.com.

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