Business process elicitation from regulatory compliance documents

An e-government case study

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Abstract— **There is an increase in the number of regulations, standards, legislations and other sources of compliance requirements, which enforce organizations to assess their business processes and make sure that they adhere to the constraints set forth. Following legislative and internal policy changes, every company has to refine its basic strategies in order to improve the quality and add value of products and services offered and reduce operational cost. To serve this effort, companies should focus on their business processes and agility, conforming to the regulatory context set. In this paper we discuss the process of extraction business process models from compliance document, using as a case study a real-world e-government Greek legislation. Our main goal was to utilize compliance requirements derived from a real e-government regulatory document and represent them in an executable form expressed in MTL patterns. Compliance rules are described based on same core components as business processes (activity, data, role and event) through graphical views to enable business analysts to elicit business process models from MTL rules.**

Keywords— *Regulatory Compliance Management, Business Process Identification, e-government*

I. INTRODUCTION

Any organization, institution and business, today more than ever, is forced to regularly review their structure and behavior in order to adapt to a constantly and dynamically changing environment, mainly due to the speed of development of new technologies, the globalization of business activities, legislative changes, and new expectations developed by customers.

Regarding legislative changes every company has to redefine its basic strategies in order to adhere to industry-specific legislation and to improve their quality of service to their customers.

To deal with the problem of regulatory compliance, there is a need for models of law that can be formally analyzed through various forms of reasoning to help requirements engineers find compliant solutions. A meta-modelling suggestion towards compliance management was presented in [1]. The compliance meta-model provides the necessary concepts and a recommended way of working upon the conceptual elicitation of rules from legal documents. This paper builds upon this earlier work and further extends it in a number of ways. The utility of these extensions is demonstrated on an e-government application. In this paper, the focus is on how these rules can be represented in a formal, LTL based, fashion and how they can be graphically represented in a rough view of a business process model.

The motivation of this paper is to demonstrate how the gap between narrative of legal rules and the execution of business processes is converging under a real world scenario [1]. To this end the paper demonstrates how compliance rules from narrative can be formally defined. Our work focuses on identifying how this formal definition can be used to generate graphical representation of the main business process or of the core business process components which needs to conform to the compliance rules.

The experience presented in this paper is based on a specific e-government legal document. The regulation selected is a provision regarding the setting of organizational and technical issues concerning the operation of the System Registry of Bank Accounts and Payment Accounts.

The purpose of this paper is two dimensional. The first objective is to document the methodological conceptual approach for transforming the narrative of compliance rules of an e-government legal document in a formal LTL-based representation with MTL expressions [2-4]. The second objective is to provide process designers and analysts with integrated graphical views of MTL compliance rules which may enable them to extract abstract business process representations.

The paper structures as follows: Section II is the related research work regarding existing compliance meta-model designing approaches primarily and secondly approaches of compliance management towards business processes. Section III presents the motivating real-world scenario. Section IV describes the theoretical framework helping us to evolve from the descriptive compliance requirements to a formal representation of them, and how they can be mapped to business processes concepts. Section V describes how compliance rules can be formally represented and how they can be transformed to an executable form. Conclusions and future work are presented in Section VI.

II. Related Work

Compliance management is a field of research that is growing in the last few years. The existing approaches are dealing with different aspects of compliance.

The first set of approaches is focusing on the extraction of legal requirements from the legal documents such as [5,6] where they develop conceptual frameworks for extracting rules from regulations and policies. Modeling legal requirements approaches are generally grounded on expressive, often modal, logics [7-11]. Other approaches, grounded in Natural Language Processing and Information Retrieval, support different forms of analysis such as determining case similarity and relevance [12]. Modelling regulations and extracting key concepts from legal documents are recognized as particularly challenging tasks [13]. Several reasons for it are underlined: 1) the very nature of language in which laws are written, containing many ambiguities, cross-references, domain-specific definitions, acronyms etc., 2) overlapping or complementing regulations at different level of authority, 3) frequent changes or amendment of regulations over time [13-16].

There are several approaches presenting conceptual meta-models or ontologies for compliance management towards business processes. With the increase in attention paid to the role of compliance within business processes, several works have been produced in the area of compliance management, attempting to address the current needs of organizations. Notably, the COSO framework [17] is an early work introduced as a key guidance to establish internal control mechanisms in organizations. The existing models do not provide explicit guidance addressing how compliance concepts and their interrelationships are defined and integrated. On the specification of compliance requirements there is [18] an approach for modelling control objectives within BP structures. Their work is one of the few works that actually introduce a basic model to capture compliance requirements.

Similarly, a number of approaches and technologies have been developed, proposing a separate BP modelling and compliance requirements modelling phases, which is followed by a model checking based approach for compliance verification [19-26].

The existing approaches are tangling with compliance from different aspects. Individually they are handling the notion of compliance with efficiency. Most of the existing IT solutions regarding compliance are emphasizing in a posteriori manner of dealing with compliance requirements and essentially about checking that the regulations are adhered to. We claim in this paper that when designing business processes one of the important considerations is that of legislative requirements i.e. the implementation based on such a design paradigm should result in processes that are at the outset compliant.

In this paper we are proposing an integrated compliance framework which will provide to the analysts a mean to a) express in a formal-mathematical fashion the extracted rules (MTL expressions), b) represent the MTL expressions in graphical views with the use of the core components of a business pro-cess and c) provide abstract business process models based on the rules and ensure compliance.

III. Motivating Case Study: Management and Operations of Payments Registry System

Since the goal of our approach is to examine how compliance rules/requirements can be applied in a business process or/and if it is possible to extract a primitive business process from their description, it was necessary to find a real legal source. The source that was used in this work was from an e-government application for the Greek State.

The regulation selected is an e-government provision regarding the setting of organizational and technical issues concerning the operation of the System Registry of Bank Accounts and Payment Accounts. The present Management and Operations Regulation specifies the procedures, functions and technical specifications governing the Registry of Bank Accounts and Payments Accounts (RBA and PA). This regulation is updated whenever changes occur in the operation of RBAs and PAs. Indicatively the regulation reports the new application integration cases, modification of the technical specifications, etc.

This specific provision was selected due to its strict and tight structure (two and a half pages of narrative text and 6 pages of appendices with technical details). Another advantage for using this regulation is that it is IT-oriented and its content is familiar to the authors since it describes how a real information system works and exchanges data under certain conditions.

IV. Theoretical Framework

A. Defining the essential compliance concepts

It is important to point out that majority of existing compliance solutions automate some part of compliance detection by generating audit reports based on specific, pre-defined checks against data pulled from enterprise applications [18]. One of the drawbacks of these approaches is that such checks take place after a violation has occurred. Clearly, there is a need for a comprehensive framework that harmonizes automated static verification, runtime monitoring and retrospective reporting.

As presented in [1] we have already designed a compliance meta-model which was tested with random legal sources as an attempt to verify its concepts. In this paper, we focus on the applicability section of the meta-model in order to identify business process core components and create abstract business process models based on compliance rules (Figure 1).
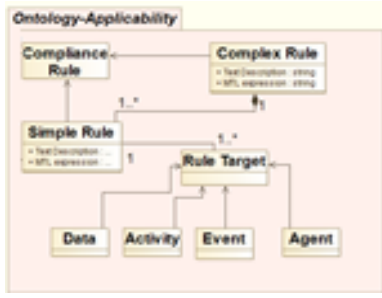
Figure 1 Applicability Semantics

The compliance rule is identified based on two attributes: a) a text description of the rule and b) a logical expression attribute, based on existing patterns from the approach of [2]. The rule target express the correspondence of compliance rules with the core BP components.

B. Extending the MTL expressions

Linear Temporal Logic (LTL) is lacking on expressing time requirements or resource specification towards compliance requirements that need to be expressed in a formal fashion. The use of MTL (metric temporal logic) expressions [2-4, 27] which is based on patterns supports different kinds of requirements and oversubscribe LTL semantics. MTL extends LTL and thus holds the same semantics and formation rules. Based on LTL, the MTL patterns achieve to represent the textual compliance rules in a formal view with all of their requirements described. MTL patterns are distinguished in four classes (Figure 2):

   a. *Order patterns* concern the behavioral aspect of process specifications, such as activity sequencing.
   b. *Occurrence patterns* address rules concerning the existence of certain structures or conditions in process specifications.
   c. *Resource patterns* address authorizations, assignments, and segregation-of-duties requirements.
   d. *Time patterns* are used with order and occurrence patterns to address temporal rules over processes.
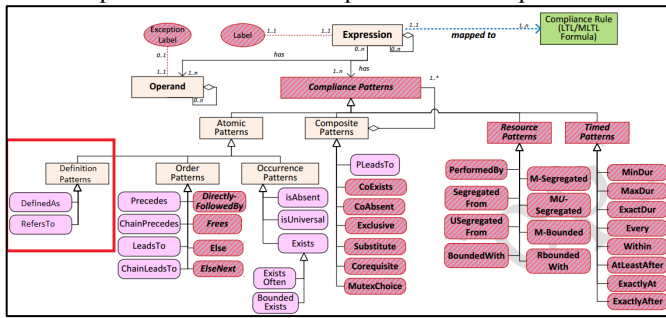

Figure 2 MTL meta-model extension [27]

P and Q objects, used in MTL expressions, are depicting all the different business process objects. Comparing to our compliance meta-model they are expressing the *Rule Target* entity as a whole since they are not declaring their nature. During the elicitation procedure in some specific MTL expressions such as *LeadsTo*, P and Q had constraints in terms of depicting the concept of the expression since the

aforementioned expression is only used to declare the sequential dependence of activity objects. Therefore the expressions as is are incomplete as to highlight the nature of objects. Moreover there was no possible way to express rules which are referring to other compliance sources or even the same one but in different sections.

Based on the requirements of our use case, we decided to extend the meta-model of the Compliance Request Language (CRL) [27] represented by a UML class diagram (Figure 2). The compliance pattern class is the core element of the meta-model, and each pattern is a sub-type of it. The extension decided was to add to the meta-model under the *Atomic Patterns* entity, a *Definition Patterns* entity with the *DefinedAs* aspect which facilitates the identification of objects and the *RefersTo* notion which express the reference to different compliance sources. These two extensions facilitate the transition from text to MTL rules and are in correspondence with the semantics of our compliance meta-model. The identification of objects with the *DefinedAs* "syntax" facilitates the transition of a textual compliance rule to a formal expression or even a mathematical one as it identifies the nature of a textual expression whether it is an action or a role or a time constraint or a data reference. The *RefersTo* pattern satisfies the self-reference concept of the compliance meta-model regarding the *Compliance Source* and *Compliance Essential* entities as well as the need to address where something within the legal document is mentioned or/and analyzed (see Section V.A).

C. Extracting business processes

The set of MTL expressions describing the Greek provision provided useful information and a preliminary list of actions by the textual rules and afterwards from the MTL patterns used. However, a graphical representation of MTL expressions will only facilitate the process of mapping the source to business process elements. There are related software attempts [27] which provide a compliance rule manager tool in order to test the correctness of MTL expressions and model the rules and their requirements.

By designing all the identified objects and their interrelationships in various views, we will be able to spot on weaknesses of the MTL expressions and organize the amount of information received from the compliance source. It will verify or/and revise the procedure of rule extraction that was followed above and give valuable observations regarding the modelling of a business process. Since our target is the mapping of compliance rules with business processes and the semi-automate design of a business process based on the extracted rules, we decided to depict the MTL expression with graphical triplets. We created a legend for the specific case study in order to have a continuous way of modelling which is presented in Figure 3. The legend is based on UML alike objects notion in order to be user friendly and easy to comprehend. Since our goal is to have a representation of compliance rules with all the core components of a business process model, a UML based legend felt appropriate.

The graphical representations were designed for supporting different aspects (Figure 4). They are offering the opportunity

to identify and thoroughly understand the interrelationships among activities with data usage and exchange, segregation of duties per role and how they flow under specific time constraints.

It was identified that under the specific case study, a composition of all the different graphical MTL views could lead to the design of an abstract business process model.
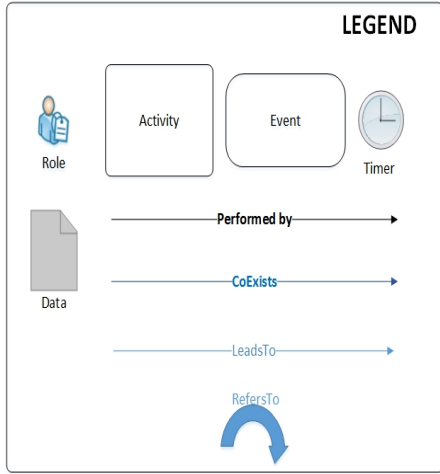

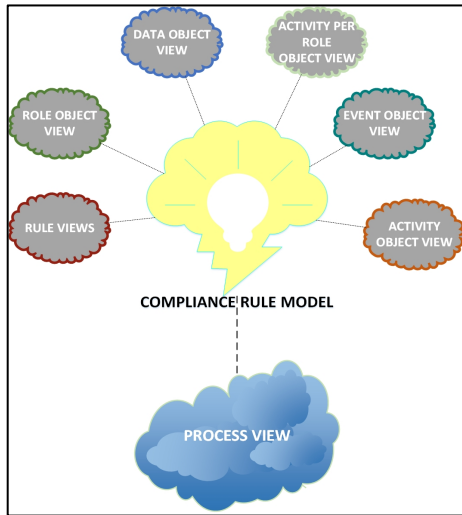Figure 3 Proposed legend for graphical views

Figure 4 Graphical views

V. DESCRIBING COMPLIANCE RULES IN AN EXECUTABLE FORM

The rules where described over text which was refined by the researchers comparing their initial description. An example is shown in Table 1. The *Compliance Essential* entity CE2 is not presented herein due to lack of space available.

Table 1 Example of an extracted simple rule

Compliance Essential	Complex Rule	Simple Rule
CE2 Description of System Operation	When submitting, the type of request for provision of information and data is specified, based on a predetermined list of	SR2.2a The request type is determined, in its submission, from a predetermined list of available requests offered by the system.

Compliance Essential	Complex Rule	Simple Rule
	available requests offered by the system and which are established herein and in future decisions.	SR2.2b The list of available requests is defined herein and in future decisions.

A. From narrative to MTL expressions

In our case study all the four categories of MTL patterns were useful to define the roles, the time events and the sequence of actions described within the text description of the rules extracted. While composing the MTL expressions it was noticed that we were lacking of vital expressions. The existing patterns were not defining the nature of the object expressed. Taking as an example the one presented in Table 1 with the MTL patterns already defined, the result is:

> *Specify_Type_of_request* **LeadsTo** *Submit_Request*
> /*Order Pattern P **LeadsTo**Q */
> *Specify_Type_of_request* **CoExists** *Request_list*
> /*Composition pattern, P **CoExists** Q*/

Given the weakness in formalizing the rules, we decided to extend the existing MTL meta-model with Definition Patterns as presented in Section IV.B. Therefore the complete set of MTL expressions for the previous example is the following:

> *Request_list* **DefinedAs** *Data Object*
> *Specify_Type_of_request* **DefinedAs** *Activity Object*
> *Submit_Request* **DefinedAs** *Activity Object*
> *Specify_Type_of_request* **LeadsTo** *Submit_Request*
> *Specify_Type_of_request* **CoExists** *Request_list*
> *Request_list* **RefersTo** *Provision_1258, Future_Provisions*

The transition from text to MTL expressions was a difficult process. The main reason was the fear of losing important information during the transition. The guidance was the definition of compliance rule (as a conceptual meta-object) by separating the proposals in verbs, subjects, objects and time constraints. By adding the *DefinedAs* pattern expression was easier to identify the core components described in the compliance meta-model (activity, data, event, and agent).

B. Graphical representation of MTL rules

The first designing approach is the representation of the set of each object category in order to determine how many objects we have extracted per category. An example of such a view is presented in Figure 5 where role objects view is presented.
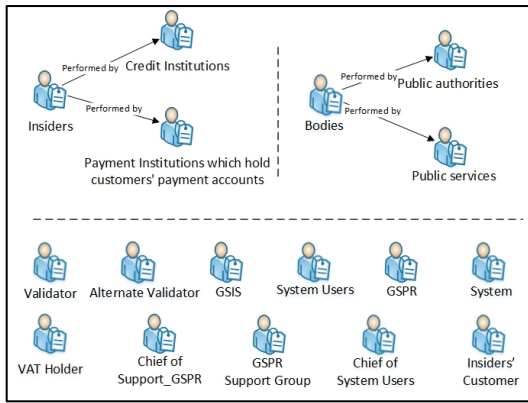
Figure 5 Role Objects View

The second approach was to have a view per rule. For example from *Compliance Essential* entity CE2- Description of System Operation, 22 simple compliance rules were extracted. All the objects and their described pattern-based interrelationships are composing a single view. In such way, it would be helpful for every designer who in the future will use these objects to trace back to the textual description or to the whole document and confirm or/and revise the existing graphical representation. For every set of rules (CE1 to CE7) we created a representation of their rules. An example of this aspect is shown in Figure 6 where SR2.2a and SR2.2b (aforementioned example) are graphically represented.

Another view represented within this graphical attempt was to have a single view of activities per role. This specific view has provided useful feedback in the revision of the roles setting. We also traced some duplicates in the activities objects which were a result of verbal expression differences.
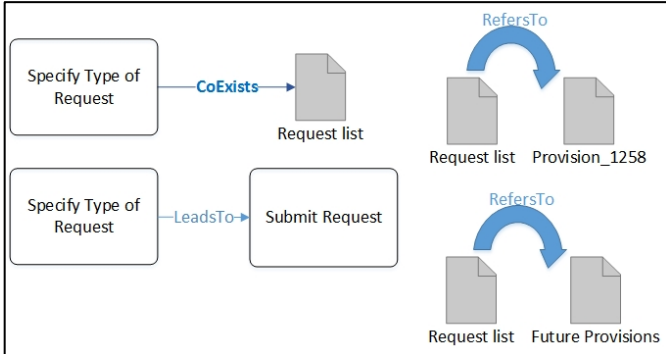

Figure 6 SR2.2a and SR2.2b Rule View

C. Description of the processes extracted by the rules

During the procedure of extracting rules we noticed that the specific document was describing several processes regarding the System Registry of Bank Accounts and Payments Accounts. When the setting of MTL expressions was finished along with their graphical representation, the processes identified were referring to four different aspects.

The first process is referring to the *Certification of Bodies and Users in the System*. The description of this process is matching to the graphical representation depicted in Figure 7. The second process was about the description of *how obliged-indebted legal persons (Insiders) will integrate into the System and what the constraints of this integration are* (Figure 8). A third flow was the description of *how the System operates, specifically for the ability of Users to enter and send requests to the Insiders*. Those two activities are supported electronically through a specific web application that has been developed for this purpose and is available through the GSIS (General Secretary of Information Systems) infrastructure. The last part of the provision is describing a different set of activities and it is the one referring to *how the data exchanged through the System are encrypted*.

Indicatively the first two processes are presented below as concluded from the graphical representation of compliance rules. The descriptions accompanying Figure 7 and Figure 8 are conducted from the graphical representations. The graphical process views are the result of the combination of the different views created.

Certification Process. In the system are integrated departmental structures of Bodies in Division level or higher. The Head of each service who is entitled to join the system is obliged to send to the Support Group a Special Request, in which must be mentioned the provisions under which this service is entitled to proceed to the obviation of banking secrecy, as well as the contact details of the qualified Validator (optionally a deputy's contact details) who will undertake the certification of Users of the Agency. The Support Group is required to examine the legality of the Body's membership request to the System, examining the related provisions to the obviation of banking secrecy concerning the Body, and correctness - completeness of the request. In case of positive result the Support Group introduces the system of Body information and data of the Validator. Then they convey electronic integration of the Body in all Insiders Legal Entities and notify the membership of the Body in various authorities. The Body is obliged to notify immediately the System for any change occurs in the data concerning him. Users of a Body are certified and imported from the Body Validator or his alternate. The deputy Validator is defined by the same Validator through the System. The Validator is responsible for updating the data of the Users, as well as the introduction of any change in their status, such as deleting a user or change the Head of Approval of a Us*er*.

Integration of the Insiders into the System. Each new institution or payment institution which is part of the Greek financial system, which provides services related to the requested System, considered by definition a bound Legal Entity and must join the system within three months from the date of first operation. If shutdown or merger of Insiders Legal Entities, the requirement of information is transferred to the Responsible Legal Entity which undertakes the repealed portfolio or merging insiders legal entity, without being allowed of a transitional period of inactivity (Figure 8).
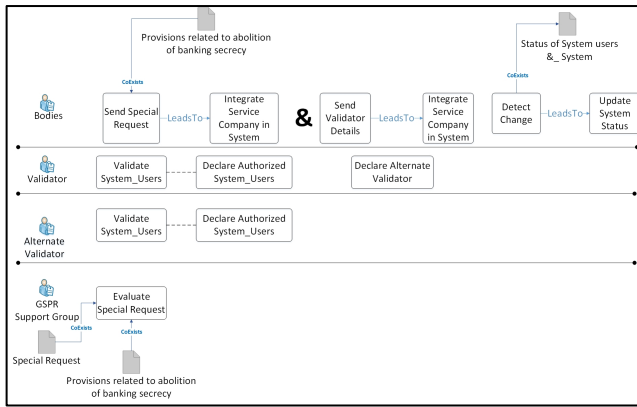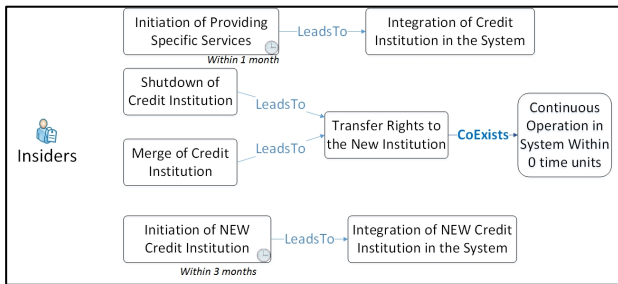
Figure 7 Certification Process

Figure 8 Insiders' Integration

VI. CONCLUSIONS AND FUTURE WORK

In this paper we have sought to show how the structuring of rules and finally their applicability towards a business process under a real-world case study could return valuable results. The approach is based on a set of detailed steps supported by conceptually well-founded principles. The use of the specific 'real-world' case has proved to be in support of our initial research objectives.

The target of fully automating the designing of a business process form MTL rule expressions seems rather challenging. We noticed that in the specific compliance source, various different processes were described. The one was referring to how an information system is designed and the second one was describing the processes executed into the system. Having this in mind, we thought to simply represent graphically the components described with MTL patterns. The added value of the views is two-fold

- The opportunity to correct several MTL expressions and review their syntax.
- The views can be related to the role of an intermediate between the narrative rules and the complete business process. Since we have already concluded that either the rule extraction, either the designing of a business process can be fully automated, the views are the state in between.

Compliance is an increasingly important area that has a major impact on enterprises of major industries. Whilst there are methods, and tools to assist these enterprises with compliance management, such support mechanisms are mostly concerned with document management to assist in the auditing (either internal or external). Our work aims to complement those research efforts that advocate a pro-active use of techniques for a continuous monitoring and improvement of business processes with respect to their degree of compliance with relevant legislation and standards.

REFERENCES

1. Stratigaki, C., P. Loucopoulos, and M. Nikolaidou. *Designing a Meta Model as the Foundation for Compliance Capability*. in *1st International Workshop on Capabilitry-oriented Business Informatics organized in conjunction with the 16th IEEE Conference on Business Informatics*. 2014. in Geneva, Switzerland.
2. Turetken, O., et al., *Capturing Compliance Requirements: A Pattern-Based Approach*. IEEE Software, 2012. **May/ June 2012**: p. 28-36.
3. Elgammal, A., et al. *Towards a Comprehensive Design-time Compliance Management: A Roadmap*. in *15th International Business Information Management Conference (IBIMA 2010)*. 2010. Egypt: IBIMA Publishing.
4. Turetken, O., et al., *Enforcing compliance on business processes through the use of patterns*, in *European Conference on Information Systems (ECIS 2011)*. 2011: Helsinki, Finland. p. Paper No. 5.
5. Siena, A., et al. *A Meta-Model for Modelling Law-Compliant Requirements*. in *Requirements Engineering and Law (RELAW), 2009 Second International Workshop on*. 2009.
6. Zeni, N., et al., *GaiusT: Supporting the Extraction of Rights and Obligations for Regulatory Compliance*. Requirements Engineering, 2013.
7. Gardner, A.v.d.L., *An Artificial Intelligence Approach to Legal Reasoning*. 1987: MIT Press. 240.
8. Hamfelt, A., *Formalizing multiple interpretation of legal knowledge*. Artificial Intelligence and Law. **3**(4): p. 221-265.
9. Hage, J., *Law and Defeasibility*. Artificial Intelligence and Law, 2003. **11**(2): p. 221-243.
10. Bulygin, E., *What Can One Expect from Logic in the Law? (Not Everything, but More than Something: A Reply to Susan Haack)*. Ratio Juris, 2008. **21**(1): p. 150-156.
11. Haack, S., *On Logic in the Law: "Something, but not All"*. Ratio Juris, 2007. **20**(1): p. 1-31.
12. Siena, A., et al. *Automated Reasoning for Regulatory Compliance*. in *32nd International Conference on Conceptual Modeling (ER 2013)*. 2013. Hing Kong.
13. Otto, P.N. and A.I. Anton. *Addressing Legal Requirements in Requirements Engineering*. in *Requirements Engineering Conference, 2007. RE '07. 15th IEEE International*. 2007.
14. Kiyavitskaya, N., et al., *Why Eliciting and Managing Legal Requirements Is Hard*, in *Proceedings of the 2008 Requirements Engineering and Law*. 2008, IEEE Computer Society. p. 26-30.
15. Kiyavitskaya, N., et al., *Extracting rights and obligations from regulations: toward a tool-supported process*, in *Proceedings of the twenty-second IEEE/ACM international conference on Automated software engineering*. 2007, ACM: Atlanta, Georgia, USA. p. 429-432.
16. Breaux, T.D., M.W. Vail, and A.I. Anton. *Towards Regulatory Compliance: Extracting Rights and Obligations to Align Requirements with Regulations*. in *Requirements Engineering, 14th IEEE International Conference*. 2006.
17. COSO. *COSO Framework*. 2013; Available from: http://www.coso.org/ic.htm.
18. Sadiq, S., G. Governatori, and K. Naimiri, *Modeling Control Objectives for Business Process Compliance*, in *5th International Conference on Business Process Management*. 2007.

19. Ghose, A.K. and G. Koliadis. *Auditing business process compliance*. in *International Conference on Service-Oriented Computing (ICSOC-2007)*. 2007.

20. Namiri, K. and N. Stojanovic, *A Formal Approach for Internal Controls Compliance in Business Processes*, in *8th Workshop on Business Process Modeling, Development and Support (BPMDS'07)*. 2007.

21. Yip, F., et al. *Rules and Ontology in Compliance Management*. in *Enterprise Distributed Object Computing Conference, 2007. EDOC 2007. 11th IEEE International*. 2007.

22. Armitage, S., R. Stevens, and A. Finkelstein, *Implementing a Compliance Manager*. Requirements Engineering Journal, 1998. **Vol. 3**(No. 2): p. pg 98-106.

23. Chung, P.W.H., L.Y.C. Cheung, and L. Fischer, *Managing the compliance of dynamic and complex processes*, in *Workflow handbook 2003*. 2003, Future strategies Inc., Book Division: Lighthouse Point, Florida. p. 201-220.

24. Ly, L.T., et al., *A Framework for the Systematic Comparison and Evaluation of Compliance Monitoring Approaches*, in *17th IEEE International EDOC Conference (EDOC 2013)*. 2013.

25. Rahmouni, H.B., et al. *Privacy compliance in european healthgrid domains: An ontology-based approach*. in *Computer-Based Medical Systems, 2009. CBMS 2009. 22nd IEEE International Symposium on*. 2009.

26. Weigand, H., W.J.A.M.v.d. Heuvel, and M. Hiel, *Business policy compliance in service-oriented systems*. Information Systems, 2011. **36**: p. 791-807.

27. Elgammal, A., et al., *Formalizing and appling compliance patterns for business process compliance*. Softw. Syst. Model., 2014. **15**(1): p. 119-146.