SEMANTIC DETECTION OF RISKS AND CONFLICTS IN CONSTRUCTION CONTRACTS

Engy Serag, Director, Contracts & Claims Department, engy.serag@orascomci.com
Orascom Construction Industries, Egypt
Hesham Osman, Assistant Professor, hmosman@nileuniversity.edu.eg
Construction Engineering & Management program, Nile University, Egypt
Moustafa Ghanem, Research Fellow, mmg@doc.ic.ac.uk
Department of Computing, Imperial College, UK

ABSTRACT

Various problems facing construction contract administrators can be linked back to lack of understanding, misinterpretation and conflicts among contract clauses. Lack of adequate time to analyze contracts during the bidding stage results in contractors entering into contracts without sufficient analysis of contractual risks. Advances in the fields of semantic information extraction, text mining and natural language processing create opportunities for developing semi-automated systems for detection of risks and conflicts in construction contracts. This paper presents a framework for semi-automated detection of risks and conflicts in FIDIC contracts. The system is comprised of four main components: 1) A Contract Ontology acts as the core knowledge repository of the system. The ontology contains a formalized representation of FIDIC general conditions and relevant stipulations from legal code, 2) Text mining/NLP module provides semi-automatic parsing tools for supplementary conditions of construction contracts and provide concept / relationship matching in tandem with the ontology, 3) Problematic Clause Database contains examples of high-risk and ambiguous clauses from previous projects and, 4) Logic Reasoners undertake the detection of high risk and conflicting clauses will take place. The paper presents examples of potential ambiguity and conflicts in construction contracts and showcases how the system can be used to semi-automated the detection process.

Keywords: Contract Management, Semantic Systems, Ontologies, Text Mining

1. INTRODUCTION

The construction industry has been in rapid growth on both the local and global levels in the last few years. Rise in global infiltration and competition, in addition to the challenges stemming from technologies, labor and material cause significant challenges for construction companies and the construction industry as a whole. The construction industry is perceived to be adversarial in attitude which may be due to lack of common goals, competing needs, inequitable risk allocation, and contradictory and erroneous information(Cheung et al. 2006).

In each project, the contract is a legally binding agreement between two or more parties to exchange something of value. In construction, it is usually money in exchange for construction services to build a facility. Contracts can be oral or written, expressed or implied and be legally enforceable. Construction contracts in general determine the basis of the relationship between the contracting parties; a contract involves a promise by one party to provide services to the other party who has promised to pay for the work done in the project. A well drafted contract is

one with no vagueness and bias in its clauses, where clear defined clauses can eliminate any misunderstandings due to different interpretation by the owner; contractor, designer and all other parties involved in the contract. Different interpretation of construction contracts by the contracting parties may lead to disagreements, disputes, claims and litigation.

2. BACKGROUND:

The competing drive to build cheaper and faster projects may compromise the quality of construction and subsequently lead to disputes. While the interpretation of contracts is a common function of contractors, inspectors, designers and contract administrators based on their experience and common sense. One would assume that the contracting parties have the same interests in a contract. The conflicting interests and the manner in which contract documents are interpreted are the major causes of disagreements and disputes. While the interest of the owner at a minimum is a completed project at a cost and a schedule set forth in the contract, the contractor's interest is in securing a steady cash flow and profit (Wyse et al. 2005). Once disputes are encountered in a construction project, the contract documents generally provide the mechanism to handle and gradually solve these disputes because of the adverse environment they create in conjunction with the dissipated effort and the financial burden. If disputes are not solved during construction, contractors could sue the owner claiming an increased cost of construction resulting from: Loss of profits, loss of business, restriction of research, reduction of bonding capacity, and loss of an advantageous competitive position in the industry.

Due to the escalating number of claims and disputes along construction projects, many researchers have investigated ways to help the contracting parties minimize the chances of getting involved in a construction claim or disputes. Several studies attempted to understand the meanings of the contract and its clauses. According to Busconi et al. 2005, *"The contract is read as a whole and each of its parts are harmonious with one another; unless defied otherwise, terms shall be given their plain, ordinary, and proper meanings; Common sense and probable intention of the parties are resources when interpreting a contract; and ambiguities in the contract shall be construed against the drafter of the contract."* According to Hartman and Sneglove 1996, it is important to use the right wording in a contract to convey a common and specific understanding of the contract clauses by all parties to minimize the different interpretation of the perception of risk apportionment. The expectations and obligations of the parties boil down to the written language set forth in a contract, fair dealing and good faith. Thomas et al 1994 have developed well defined rules for the interpretation of contract clauses and observed that the interpretation process applied by the courts is largely consistent.

The probability of having a dispute in a construction project can be dependent on the type of project and the project characteristics. Some project types might be prone to contract disputes than others. Diekmann and Girard 1996 have been able to recognize which type of project characteristics; people, project or process characteristics have the most impact in causing disputes during the project. They have observed that the contractor's personnel have the greatest opportunity to impact the disputes while the project variables do not affect dispute performance to a great extent and the impact process falls between impacts of people and project. They concluded that accurate preconstruction planning and contractual relationship can make or break more than the project issues can.

The best way to resolve disputes is prevention by avoiding them through clear contracts, active partnering, cooperation and risk allocation. Otherwise if conflicts are encountered and persist to continue, they could be resolved in the following order of increase in complexity: Direct negotiations, Dispute Review Board, nonbinding mediation, binding arbitration and litigation by either a judge or a jury as an alternative to non resolved disputes which are costly and time consuming.

Previous research was carried out at San Diego State University that included reviewing twelve published research papers that investigated the common causes of construction disputes and claims where survey methods, measurement models and structural models were applied to understand the common causes of contract misinterpretation (Chester 2005, Jergeas 1994, Semple 1994, Thomas 2003, and Yates 2006). In this study, the authors identified six areas of conflict as a source of different interpretations that could potentially lead to disputes and claims. Also, they that need to be analyzed in every clause: (1) vagueness (2) ambiguity, (3) risk dispersion, (4) who does the clause mostly favors,(5) claim probability and (6) the predicted winner if there was a

construction claim. In this study six clauses were analyzed: (1) delays, (3) change conditions, (4) termination, (5) subsurface conditions, (6) payment and (7) acceptance of work. This study focused on investigating disputes that are resulting only from differing contract interpretation among the contracting parties. A survey form was generated and distributed addressing the areas of conflict; data was collected and analyzed using statistical analysis method. The authors prepared a survey that included 25 clauses that details those 7 clauses: (1) delays, (3) change conditions, (4) termination, (5) subsurface conditions, (6) payment and (7) acceptance of work. The authors analyzed two different standard forms of contract; the first one from the Standard Specifications for Public work Construction (Green book) to represent contracts drafted by an owner entity, and the second one from the general agreement of the Associate General Constructors of America (AGC) standard contract to represent a contract drafted by a contractor entity. The survey was distributed among owners and contractors to evaluate the level of interpretation for both parties. The tabulated data from the surveys was analyzed using: Microsoft Excel and Minitab. Microsoft Excel software was used to compile and tabulate the data and create plots. Minitab Program was used to evaluate the Pearson's correlation coefficient (r). SAS program was used to create multi-plots and eventually the decision tree; however, the results from Minitab program was used to evaluate the Pearson's correlation coefficient (r). This is in order to assess whether two continuous variables are linearly related or not. The coefficient ranges from -1 to +1; the closer the absolute correlation is to 1 the more tightly the data points fall on a line while a correlation close to 0 indicates no linear relationship. Based on the conducted study, it was found that almost all of the clauses used for this study were vague to some scale and because of this vagueness owners and contractors interpret the clauses in a different way. Most of the clauses used in the survey tend to favor the owner more than the contractor. Clauses that were found to be vaguer had higher probability of the claim than the clauses that were less vague. It was also concluded that Payment clause and Termination of contract clause from the City contract along with Delay clause, the Unit Price clause, and the Acceptance of work clause from AGC were the five of the vaguest clauses.

3. OBJECTIVE

Realizing the importance of a well drafted contract and clear contract language, the authors' goal in this study is to help the contracting parties avoid misinterpretations of the contract clauses and reduce or eliminate their impact on a project. The goal of this paper is to allow researchers to build a pilot study investigating the development and use of novel computer-based technologies to assist construction companies in minimizing the claims and disputes in AEC projects that occur over the misinterpretation of the contracts. The paper focuses on developing a framework to describe how these misinterpretations happen, analyze the vague and ambiguous words in the contract, detect any conflict between the contract clauses, and to evaluate the feasibility of automating the overall framework.

This research targets the development of a framework that defines the meaning of the vague or ambiguous words using Natural language processing in the contract and that identifies the missing and conflicting clauses through a tool like ontology, that will aid the owner and the contractor to discuss such misinterpretation problems beforehand and hence minimize the claims. Based on our understanding of the project objectives the technical vision of a proposed system is likely to be composed of three main components: (1) Text mining/NLP: To provide semi-automatic parsing tools for supplementary conditions of construction contracts and provide concept / relationship matching in tandem with the ontology. (2) Contract Ontology: This is the core knowledge repository of the system. The contract and legal ontology will contain a formalized representation of FIDIC general conditions and relevant stipulations from legal code. (3) Logic Reasoners: This is where the detection of high risk and conflicting clauses will take place.

4. METHODOLOGY

The development of a full-fledged system that will achieve the aforementioned objective is expected to take place in three stages. Stage 1 - Project Needs Assessment. Stage 2 - Pilot Project. Stage 3 - Full Project Implementation.

Stage 1 – Needs Assessment

During this stage the researchers should (1) collect data: this will be achieved by (i) Identifying the state-of-the art in legal contract management and in automated legal contract analysis for risk and conflict identification, (ii)Understand and evaluate different types of contracts which have been implemented internationally namely, standard contracts and customized ones, (iii) Evaluating the conflicts within the clauses and the conflict with other clauses in one contract, (iv) Determining the contract clauses that lead to conflicts, claims and disputes (C2D), and (v) Investigating the challenges and technologies for developing a framework and tool to provide a dictionary of vocabulary to represent the rationale behind the contract to describe: (a) Words in a clause that are vague, (b) The dependencies between clauses in the contract and clauses that conflict with one another, (c) When clauses need to be added to add to the integrity of the contract, (d) Which clauses need to be added /removed to lead to a higher productivity on the site and faster project delivery, and (2) develop the ontology: review existing legal / contract ontology, select suitable ontologies for reuse, and review work on logic representation of legal documents; (3) Automate legal reasoning: review the previous work on the applications of logic to legal reasoning and review and evaluate available logic reasoners that could be used in the project; (4) develop the text Mining/NLP: review previous text mining and natural language processing for legal documents and select text mining and NLP tools that will be used in the program.

Stage 2 – Pilot Project

In this stage the researchers should develop a prototype system as proof-of-concept for the adopted technologies. During the Ontology Development the researcher should develop core competency questions, select pilot clauses (10-15 contract clauses) that have been known to be problematic in clause conflicts, develop clause conflict scenarios, develop Ontological concepts and relationships in FIDIC General Conditions and relevant civil code stipulations (as needed to represent pilot clauses), develop Ontological axioms, develop list of high-risk clauses from previous contracts with domain expert input, and develop a prototype contract risk definition database. The researchers should also evaluate selected reasoner(s) with actual clause conflicts and risk identification and extend and customize reasoners to the problem domain. In the text mining/NLP the researcher ought to design and implement internal representation model for legal document storage and annotation and associated parsers, design and implement Named Entity (NE) Extractors for legal terms, design and implement NE relationship extractors for legal phrases, use visual tools to show dependencies between NEs, design and implement interfaces for interaction with ontology and reasoning tools, and prototype pattern matching tools for automated risk phrase identification and scoring based on expert knowledge. Finally the researcher should integrate software sub-systems into a prototype, conduct evaluation of integrated system based on example cases, and conduct evaluation of integrated system with the company's users.

Stage 3 – Full Project Implementation

Develop full system based on (1) Ontology Development: develop core competency questions, develop all Ontological concepts in FIDIC General Conditions and relevant civil code stipulations, develop all Ontological relationships in FIDIC General Conditions and relevant civil code stipulations, develop Ontological axioms, extend list of high-risk clauses from previous contracts with domain expert input, and develop a contract risk definition database. (2) Reasoning: refine reasoners to handle more complex conflicts, design, implement, evaluate Extensible Rule Base, and implement and evaluate visual tools to suggest amends. (3) Text Mining/NLP: refine existing document model, entity extractors and relationship extractors, refine, extend and evaluate pattern matching tools for risk phrase identification and scoring, design, implement and evaluate machine learning tools for automatic learning of risk and conflict patterns expressed in Natural Language, and refine interfaces to risk and conflict databases and logic rule base. (4) Integration and Evaluation: integrate software sub-systems into a prototype, design and implement user GUIs, conduct evaluation of integrated system based on example cases, and conduct an evaluation of the integrated system with the company's users.

5. PROPOSED SYSTEM ARCHITECTURE

The proposed semantic system is composed of three main components.

Text Mining/NLP: This module is responsible for parsing the free text in the documents being evaluated using named entity extractors and NLP text pre-processing. In the shown use case, the Supplementary Conditions of a construction contract are being parsed to check for potential semantic conflicts and high-risk clauses. In the shown use case semantic conflicts are checked between Supplementary Conditions and General Conditions.

Contract Ontology: The contracts ontology is the core knowledge repository of the system. A generic contracts ontology that represents key concepts in a taxonomical hierarchy along with relationships between contract concepts is developed. The upper-level ontological model is shown in Figure-1 and further discussed in the following section. In addition to the contracts ontology, two databases will be developed to house the actual contractual clauses of interest. The two databases are: 1) Contact Clause Database: This will contain the clauses of the general conditions and, 2) Risk Definition Database: This database will contain a listing of contract clauses that have been deemed to transfer considerable risks to the contractor or is written in such a way that it is ambiguous and open to multiple interpretations. The later database will be developed via input from subject-matter experts or through post-project reviews and documenting lessons learned during contract administration.

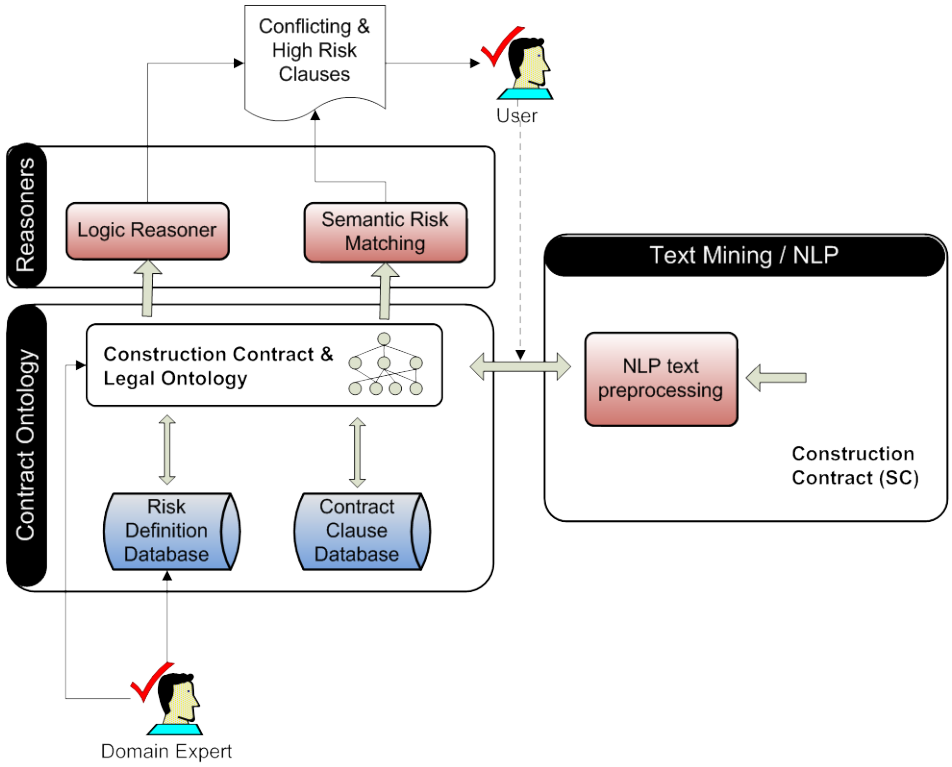

Figure 1 : Proposed System Architecture

Reasoners: This module will be responsible for detecting potential conflicts and/or semantic similarities that deem a clause to be either conflicting or similar to a well-known high risk clause. Reasoning can only occur once all contractual clauses are formally represented in a structured logical format according to the ontological constructs. An example of a potential conflict that can occur and its associated formal ontological representation is shown below:

Clause 1 (General Conditions): Design Review by the Engineer should not take more than 14 days

Clause 2 (Supplementary Conditions) Design Review by the Engineer should not take less than 14 days

Ontological Representation:
Process has *TimeConstraint* (*Constraint* = Maximum or Minimum, *Time* = Duration)
DisgnReview is-a *Process*
DesignReview has *TimeConstraint* (*Constraint* = Maximum, *Time* = Duration)

The logical reasoner can detect the aforementioned conflict whereby the time constraint for the design review process should always have a maximum value. The reader can appreciate the ramifications of a contractor missing the minor typo in Clause-2 above.

As shown in the system architecture, the proposed system is a far from a fully automated system. User input will still be required after the detection process to ensure that the detected conflicts truly warrant intervention from the contracts manager. As such, the system is intended to be an aid to contract managers during the contracts review process to flag potentially risky, ambiguous or conflicting contract clauses. The contract manager will still have to decide whether to negotiate a clause with the owner, clarify the ambiguity/conflict or simply accept the contract as-is and translate the risk into appropriate bid contingency.

6. CONCLUSION

The proposed semantic system will be developed in three stages, each stage bears certain benefits that would enable the construction company to utilize the outcome in case the project gets terminated at any of these stages. In stage 1 – Needs Assessment, the short-term benefits will be having obtained a set of best practices and these practices will be used in minimizing claims disputes. In stage 2 – Pilot Project, the medium-term benefits from developing a set of semi-automated tools for contract and legal document management will enable the contracts administrators to analyze the content of such documents. Finally the long-term benefits of stage 3 – full project implementation, when used during the tender stage to detect conflicts and ambiguous terms, it will enable the contractor to negotiate editing the clause with the owner, and in case the owner rejects, it will give the contractor an idea of the risks to quantify the contingency.

REFERENCES

Ashrafzadeh, Batta, and Serag (2008). " Study of Misinterpretations of Construction Contracts", San Diego State University.

Chester, M., and Hendrickson, C. (2005). "Cost Impacts, Scheduling Impacts, and the Claim Process during Construction", Journal of Construction Engineering and Management, ASCE, 131(1), 102-107.

Cheung, Sai On, Yiu, T.W., Kenneth, and Chim, Pui Shan. (2006). "How Rational are Construction Contracts", Journal of Professional Issues in Engineering Education and Practice, ASCE, 132(1), 48-56.

Wyse, D.D., and Malik, S. (2005). "Audit Contract Provisions and Real-Time Cost Reporting in Construction Contracting", Journal of Professional Issues in Engineering Education and Practice, ASCE, 131(4), 297-300.